# LEED v4.1 BUILDING DESIGN AND CONSTRUCTION

Getting started guide for beta participants

February 2025

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# Welcome to LEED v4.1 Beta

Welcome to the next evolution of LEED for design and construction! Whether you are a seasoned LEED practitioner, or new to LEED, we encourage you to test out this bigger, stronger, bolder rating system for your buildings and to be a leader in shaping the future of building performance.

There are four key goals that have guided our technical development process for the LEED v4.1 BD+C rating system:

- ensure leadership
- increase achievability
- measure performance
- expand the market

This version of LEED is the result of countless hours of effort from our volunteers and staff and we are confident that the rating system meets those goals.

LEED is the world's rating system for the design, construction and operation of high-performance green buildings. For the last 18 years, various versions of LEED have pushed the global green building market forward progressively, with more than 93,000 registered and certified projects and more than 19 billion square feet of space worldwide.

Regions and markets move at different paces, and we want to be sure we can meet the needs of everyone in the green building community. LEED v4.1 represents a series of upgrades that will improve our standards, encourage leadership, and make our platform more user friendly, more accessible—and most importantly—more collaborative than ever before.

LEED v4.1 will be our most inclusive and transparent platform to date. That's because our most important requirement for adoption will come from our most valuable resource of all—YOU!

# LEED v4.1 BD+C Scorecard

| | | New Construction | Core and Shell | Schools | Retail | Data Centers | Warehouses and Distribution Centers | Hospitality | Healthcare |
|---|---|---|---|---|---|---|---|---|---|
| **INTEGRATIVE PROCESS** | | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** |
| Prerequisite | Integrative Project Planning and Design | | | | | | | | P |
| Credit | Integrative Process | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **LOCATION AND TRANSPORTATION** | | **16** | **20** | **15** | **16** | **16** | **16** | **16** | **9** |
| Credit | LEED for Neighborhood Development Location | 16 | 20 | 15 | 16 | 16 | 16 | 16 | 9 |
| Credit | Sensitive Land Protection | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Credit | High-Priority Site and Equitable Development | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| Credit | Surrounding Density and Diverse Uses | 5 | 6 | 5 | 5 | 5 | 5 | 5 | 1 |
| Credit | Access to Quality Transit | 5 | 6 | 4 | 5 | 5 | 5 | 5 | 2 |
| Credit | Bicycle Facilities | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Credit | Reduced Parking Footprint | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Credit | Electric Vehicles | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **SUSTAINABLE SITES** | | **10** | **11** | **12** | **10** | **10** | **10** | **10** | **9** |
| Prerequisite | Construction Activity Pollution Prevention | P | P | P | P | P | P | P | P |
| Prerequisite | Environmental Site Assessment | | | P | | | | | P |
| Credit | Site Assessment | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Credit | Protect or Restore Habitat | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| Credit | Open Space | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Credit | Rainwater Management | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| Credit | Heat Island Reduction | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| Credit | Light Pollution Reduction | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Credit | Site Master Plan | | | 1 | | | | | |
| Credit | Tenant Design and Construction Guidelines | | 1 | | | | | | |
| Credit | Places of Respite | | | | | | | | 1 |
| Credit | Direct Exterior Access | | | | | | | | 1 |
| Credit | Joint Use of Facilities | | | 1 | | | | | |
| **WATER EFFICIENCY** | | **11** | **11** | **12** | **12** | **11** | **11** | **11** | **11** |
| Prerequisite | Outdoor Water Use Reduction | P | P | P | P | P | P | P | P |
| Prerequisite | Indoor Water Use Reduction | P | P | P | P | P | P | P | P |
| Prerequisite | Building-Level Water Metering | P | P | P | P | P | P | P | P |
| Credit | Outdoor Water Use Reduction | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 1 |
| Credit | Indoor Water Use Reduction | 6 | 4 | 7 | 7 | 6 | 6 | 6 | 7 |
| Credit | Optimize Process Water Use | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| Credit | Water Metering | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **ENERGY AND ATMOSPHERE** | | **33** | **33** | **31** | **33** | **33** | **33** | **33** | **35** |
| Prerequisite | Fundamental Commissioning and Verification | P | P | P | P | P | P | P | P |
| Prerequisite | Minimum Energy Performance | P | P | P | P | P | P | P | P |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Prerequisite | Building-Level Energy Metering | P | P | P | P | P | P | P | P |
| Prerequisite | Fundamental Refrigerant Management | P | P | P | P | P | P | P | P |
| Credit | Enhanced Commissioning | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Credit | Optimize Energy Performance | 18 | 18 | 16 | 18 | 18 | 18 | 18 | 20 |
| Credit | Advanced Energy Metering | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Credit | Grid Harmonization | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Credit | Renewable Energy | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Credit | Enhanced Refrigerant Management | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| MATERIALS AND RESOURCES | | 13 | 14 | 13 | 13 | 13 | 13 | 13 | 19 |
| Prerequisite | Storage and Collection of Recyclables | P | P | P | P | P | P | P | P |
| Prerequisite | PBT Source Reduction – Mercury | | | | | | | | P |
| Credit | Building Life-Cycle Impact Reduction | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Credit | Environmental Product Declarations | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Credit | Sourcing of Raw Materials | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Credit | Material Ingredients | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Credit | PBT Source Reduction – Mercury | | | | | | | | 1 |
| Credit | PBT Source Reduction – Lead, Cadmium, and Copper | | | | | | | | 2 |
| Credit | Furniture and Medical Furnishings | | | | | | | | 2 |
| Credit | Design for Flexibility | | | | | | | | 1 |
| Credit | Construction and Demolition Waste Management | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| INDOOR ENVIRONMENTAL QUALITY | | 16 | 5 | 16 | 15 | 16 | 16 | 16 | 16 |
| Prerequisite | Minimum Indoor Air Quality Performance | P | P | P | P | P | P | P | P |
| Prerequisite | Environmental Tobacco Smoke Control | P | P | P | P | P | P | P | P |
| Prerequisite | Minimum Acoustic Performance | | | P | | | | | |
| Credit | Enhanced Indoor Air Quality Strategies | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Credit | Low-Emitting Materials | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Credit | Construction Indoor Air Quality Management Plan | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Credit | Indoor Air Quality Assessment | 2 | | 2 | 2 | 2 | 2 | 2 | 2 |
| Credit | Thermal Comfort | 1 | | 1 | 1 | 1 | 1 | 1 | 1 |
| Credit | Interior Lighting | 2 | | 2 | 2 | 2 | 2 | 2 | 1 |
| Credit | Daylight | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| Credit | Quality Views | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| Credit | Acoustic Performance | 1 | | 1 | | 1 | 1 | 1 | 2 |
| INNOVATION | | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Credit | Innovation | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Credit | LEED Accredited Professional | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| REGIONAL PRIORITY | | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Credit | Regional Priority | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| TOTAL | | 110 POSSIBLE POINTS | | | | | | | |

# WHAT YOU NEED TO KNOW

As a first step in launching LEED v4.1, USGBC released beta versions of each LEED rating system, allowing the market to work with the draft rating systems and provide feedback based on real-world application.

USGBC will present LEED v4.1 for public comment, followed by a member ballot. This beta rating system is not final; feedback from the beta will inform the public comment draft(s). We will update this document as needed and as more program features become available.

This document is a comprehensive guide to the LEED v4.1 BD+C beta program. The v4.1 BD+C Beta Guide contains guidance sections that are new or modified from LEED v4, as they are complimentary to the LEED v4 Reference Guide for Building Design and Construction. For the omitted sections, refer to the main reference guides.

**LEED v4.1 BD+C certification**

The certification process for LEED v4.1 BD+C remains unchanged – projects should first confirm that they meet the three current LEED Minimum Program Requirements and will use LEED Online for registration.

- Registration
  - Your first step is to confirm eligibility and select the appropriate rating system.
  - Next, register your project under the selected LEED v4.1 BD+C beta rating system in LEED Online at lo.usgbc.org.
  - For registration fees, view our detailed fees table at usgbc.org.
- Certification
  - To complete your application for certification you will need to upload required documentation and/or provide requested information *(for each prerequisite / credit being pursued).*
  - GBCI, the certification body for the LEED rating system, will perform the beta certification reviews, in accordance with the Guide to Certification for Commercial projects.

110 total points are available. A minimum of 40 points are required for certification. LEED has four levels of certification, depending on the point thresholds achieved:

- Certified: 40-49 points
- Silver: 50-59
- Gold: 60-79
- Platinum: 80+

**Credit Substitution**

Projects pursuing LEED v4 BD+C can replace v4 credits with LEED v4.1 credit language before their final review. Credits must be substituted in full; note special implementation guidance is available for select credits.

| v4 Credit | v4.1 Credit | Implementation Guidance |
|---|---|---|
| Outdoor Water Use Reduction | Outdoor Water Use Reduction | If pursuing three points in either Outdoor Water Use Reduction or Optimize Process Water Use, Core and Shell project teams must mark Indoor Water Use Reduction as |
| Indoor Water Use Reduction | Indoor Water Use Reduction | |
| Cooling Tower Water Use | Optimize Process Water Use | |

| | | |
|---|---|---|
| | | attempted in LEED Online to properly distribute points. |
| Optimize Energy Performance | Optimize Energy Performance | Project teams must also achieve the LEED v4.1 Minimum Energy Performance prerequisite. |
| Renewable Energy Production | Renewable Energy | Project teams must substitute Renewable Energy for both relevant v4 credits, Renewable Energy Production and Green Power and Carbon Offsets, up to a maximum of five points. |
| Green Power and Carbon Offsets | | |

Process for attempting credit substitutions:

1. In LEED Online, within each credit in your v4 project, you will see a gray arrow icon on the right side of each attempted credit on the credits tab.
2. Click this icon for each credit that you would like to substitute.
3. You will see a popup box that reads: "I am pursuing a LEED v4.1 credit substitution on this credit. Click confirm for each credit you plan to attempt.
4. Complete a copy of the LEED v4.1 form for each such credit substitution, as explained in our step-by-step guide. In the form, clearly indicate which version of the LEED v4.1 Addenda you are using. Once complete, upload it to the Special Circumstances section of the credit in your LEED v4 project in LEED Online.
5. Follow the credit specific instructions from the table above, uploading any additional documentation, narratives or calculations as outlined in the LEED v4.1 documentation requirements.
6. Submit credits for review following the standard process.

**Space Type Considerations for Tenant Spaces and Incomplete Spaces**

Core and Shell

As part of LEED v4 development, a change was made to the way Core and Shell projects are evaluated. Prior to LEED v4, the fit-out of tenant spaces was included in the Core and Shell scope by default and project teams were required to provide tenant fit-out guidelines to show that tenant spaces would meet the LEED credit requirements.

Based on project team feedback, in LEED v4 (and continuing in v4.1), LEED BD+C: Core and Shell only certifies the core and the shell of the building, not the tenant fit out, by default. It is assumed that the project team does not have control over the fit-out of tenant spaces, which allows project teams to address more credits without knowing how tenant spaces will be developed, and without needing to include future tenants in those decisions. LEED Core and Shell only certifies the portion of the building that is included within the scope of work or is governed by a signed Tenant Lease and Sales Agreement (TLSA).

In order to better acknowledge the limited scope of a Core and Shell project, certain credit thresholds have been modified in LEED v4.1, including an increase in the value of Outdoor Water Use Reduction and a decrease in the value of Indoor Water Use Reduction for Core and Shell projects.

If you wish to pursue credit beyond the construction scope of the LEED Core and Shell project, you may do so by providing a signed Tenant Lease and Sales Agreement (TLSA) for tenant spaces that are being included.

BD+C (Excluding Core and Shell)

*10% Incomplete Space Exemption*

You are allowed to exclude up to 10% of the project total gross floor area (or 20,000 gross floor area, whichever is less) from the binding owner commitment and tenant guidelines requirements within an individual prerequisite or credit as allowed in LEED v4, “if it is not possible to gather the necessary tenant data for these credits, or the applicant does not have control over the required element.” The specific spaces excluded as part of the 10% can vary by credit. In your prerequisite or credit documentation, clearly note which spaces have been excluded.

BD+C

*More Stringent Code Requirements for Unfinished Spaces*

Local code requirements that are more stringent than ASHRAE 90.1-2016 Appendix G may be modeled for credit in the Proposed Design, subject to the following requirements:

- Provide a copy of the local code requirements that are more stringent than ASHRAE 90.1-2016. Indicate in writing (highlight or provide section references) how the code will require a project like the one being proposed to follow the code.
- Provide a binding owner commitment letter paired with sample lease, ensuring that the specific local code requirements modeled will be installed in the building. The sample lease agreement must include language that is specific enough to address the credit claimed (e.g. The project must meet the Seattle Energy Code 2015 Lighting Power requirements using the Building Area Method; OR the project must have 15 SEER air conditioners for systems less than 6 tons, and 11.5 EER air conditioners for systems larger than 5 tons.)
- Note that credit may not be claimed for measures that would only be implemented in certain tenant configurations, where the binding tenant requirements do not ensure incorporation into the project. For example, credit may not be claimed for daylighting controls that are only required in open-space configurations, without specifying the area that must be fitted out with daylight controls. Similarly, credit may not be claimed for simply stating that the project must meet the local code lighting power requirements, when there are multiple methods for demonstrating lighting compliance.

## Recertification

Refer to the new guidance section, *Connection to Ongoing Performance*, to understand how each BD+C credit sets you up for success in performance tracking and recertification.

All certified projects are strongly encouraged to pursue recertification using the recertification guidance available on www.usgbc.org.

# IP Prerequisite: Integrative Project Planning and Design

This prerequisite applies to

- BD+C: Healthcare (1 point)

## INTENT

Maximize opportunities for integrated, cost-effective adoption of green design and construction strategies, emphasizing human health as a fundamental evaluative criterion for building design, construction and operational strategies. Utilize innovative approaches and techniques for green design and construction.

## REQUIREMENTS

HEALTHCARE

Use cross-discipline design and decision making, beginning in the programming and pre-design phase. At a minimum, ensure the following process:

**Owner's Project Requirements Document.** Prepare an Owner's Project Requirements (OPR) document. Develop a health mission statement and incorporate it in the OPR. The health mission statement must address "triple bottom line" values—economic, environmental and social. Include goals and strategies to safeguard the health of building occupants, the local community and the global environment, while creating a high-performance healing environment for the building's patients, caregivers and staff.

**Preliminary Rating Goals.** As early as practical and preferably before schematic design, conduct a preliminary LEED meeting with a minimum of four key project team members and the owner or owner's representative. As part of the meeting, create a LEED® action plan that, at a minimum:

- Determines the LEED certification level to pursue (Certified, Silver, Gold, or Platinum);
- Selects the LEED credits to meet the targeted certification level; and
- Identifies the responsible parties to ensure the LEED requirements for each prerequisite and selected credit are met.

**Integrated Project Team.** Assemble an integrated project team and include as many of the following professionals as feasible (minimum of four), in addition to the owner or owner's representative.

- Owner's capital budget manager
- Architect or building designer
- Mechanical engineer
- Structural engineer
- Energy modeler
- Equipment planner
- Acoustical consultant
- Telecommunications designer
- Controls designer
- Food Service Consultant
- Infection Control Staff
- Building science or performance testing agents
- Green building or sustainable design consultant
- Facility green teams
- Physician and nursing teams
- Facility managers
- Environmental services staff
- Functional and space programmers
- Commissioning agent
- Community representatives
- Civil engineer
- Landscape architect
- Ecologist
- Land planner
- Construction manager or general contractor
- Life cycle cost analyst; construction cost estimator
- Lighting Designer
- Other disciplines appropriate to the specific project type

**Design Charrette.** As early as practical and preferably before schematic design, conduct a minimum four-hour, integrated design charrette with the project team as defined above. The goal is to optimize the integration of green strategies across all aspects of building design, construction and operations, drawing on the expertise of all participants.

## GUIDANCE

There are no substantive changes to the prerequisite requirements; refer to the LEED v4 reference guide, with the following addition:

**Further Explanation**

Connection to Ongoing Performance

- LEED O+M IN credit Innovation: The final phase of the integrative process is the period of occupancy, operations, and performance feedback. Project teams can demonstrate their ongoing efforts in the LEED v4.1 O+M Integrative Process pilot credit.

# IP Credit: Integrative Process

This credit applies to

- BD+C: New Construction (1 point)
- BD+C: Core and Shell (1 point)
- BD+C: Schools (1 point)
- BD+C: Retail (1 point)
- BD+C: Data Centers (1 point)
- BD+C: Warehouses and Distribution Centers (1 point)
- BD+C: Hospitality (1 point)
- BD+C: Healthcare (1 point)

## INTENT

To support high-performance, cost-effective, equitable project outcomes through an early analysis of the interrelationships among systems.

## REQUIREMENTS

NC, CS, Schools, Retail, Data Centers, Warehouses & Distribution Centers, Hospitality, Healthcare

Beginning in pre-design and continuing throughout the design phases, identify and use opportunities to achieve synergies across disciplines and building systems. Use the analyses described below to inform the owner's project requirements (OPR), basis of design (BOD), design documents, and construction documents.

Discovery:
Choose two of the following to analyze:

Energy-Related Systems

Establish an energy performance target (EUI) no later than the schematic design phase. The target must be established using one of the following metrics:

- kBtu per square foot-year (kWh per square meter-year) of site energy use
- KBtu per square foot-year (kWh per square meter-year) of source energy use
- pounds per square foot-year (Kg per square meter-year) of greenhouse gas emissions
- energy cost per square foot-year (cost per square meter-year)

Perform a preliminary "simple box" energy modeling analysis before the completion of schematic design that explores how to reduce energy loads in the building and accomplish related sustainability goals by questioning default assumptions. Assess strategies associated with each of the following, as applicable:

- *Site conditions.* Assess shading, exterior lighting, hardscape, landscaping, and adjacent site conditions.
- *Massing and orientation.* Assess how massing and orientation affect HVAC sizing, energy consumption, lighting, and renewable energy opportunities.
- *Basic envelope attributes.* Assess insulation values, window-to-wall ratios, glazing characteristics, shading, and window operability.
- *Lighting levels.* Assess interior surface reflectance values and lighting levels in occupied spaces.
- *Thermal comfort ranges.* Assess thermal comfort range options.
- *Plug and process load needs.* Assess reducing plug and process loads through programmatic solutions (e.g., equipment and purchasing policies, layout options).

- *Programmatic and operational parameters.* Assess multifunctioning spaces, operating schedules, space allotment per person, teleworking, reduction of building area, and anticipated operations and maintenance.

Water-Related Systems

Perform a preliminary water budget analysis before the completion of schematic design that explores how to reduce potable water loads in the building, reduce the burden on municipal supply or wastewater treatment systems, and accomplish related sustainability goals. Assess and estimate the project's potential nonpotable water supply sources and water demand volumes, including the following, as applicable:

- *Indoor water demand.* Assess flow and flush fixture design case demand volumes, calculated in accordance with WE Prerequisite Indoor Water Use Reduction.
- *Outdoor water demand.* Assess landscape irrigation design case demand volume calculated in accordance with WE Credit Outdoor Water-Use Reduction.
- *Process water demand.* Assess kitchen, laundry, cooling tower, and other equipment demand volumes, as applicable.
- *Supply sources.* Assess all potential nonpotable water supply source volumes, such as on-site rainwater and graywater, municipally supplied nonpotable water, and HVAC equipment condensate. Analyze how nonpotable water supply sources can contribute to the water demand components listed above.

Assessment for Resilience

Conduct a risk assessment of any identified natural or environmental hazards affecting the project site(s) and building function out of the following:
- Sea Level Rise and Storm Surge
- Flooding
- Hurricane and High Winds
- Earthquake
- Wildfire
- Drought
- Landslides
- Extreme Heat
- Winter Storms

Demonstrate how the risk assessment influenced the project design and enhanced the project's resilience to natural disasters, disturbances, and changing climate conditions; provide reasoning for not addressing any identified hazards.

Social Equity

Beginning in pre-design and continuing throughout the design phases, review and then complete the LEED Project Team Checklist for Social Impact in order to assess and select strategies to address issues of inequity within the project and its community, team and supply chain. Through research and consultation with key stakeholders, ensure that all responses within the Checklist are ultimately documented as "Yes" or "No," and complete all sections for Stakeholders and Goals.

Health & Well-being

Beginning in pre-design and continuing throughout the design phases, use the following steps to inform the design and construction documents:

- Establish health goals. Set clear and specific goals to promote the health of core groups, including:

- Building occupants and users
- Surrounding community
- Supply chain

Develop a statement of health goals for each population, including a summary of how this health goal relates to the highest priority health need for each population.

- Prioritize design strategies. Select specific design and/or programming strategies to address the project's health goals. This could be accomplished by holding a stand-alone "health charrette" or by integrating health considerations into an existing green charrette.
- Anticipate outcomes. Identify expected impacts on population health behaviors and outcomes associated with the project's prioritized design strategies.

Implementation:

Develop a Project Team Letter. Provide a dated letter on the letterhead of the Integrative Process Facilitator that summarizes the team's integrative process approach and describes the difference that this integrative approach made in terms of improving project team interaction and project performance.

- Describe the approach developed by the project team for engaging a clearly defined and manageable integrative design process beginning in pre-design and continuing throughout the design phases.
- The letter must include a separate summary for each issue area analyzed by the project team, describing how the analysis informed the design and building form decisions in the project's OPR and BOD and the eventual design of the project. Describe the most important goals for each issue area and provide clear guidance on how to evaluate the project's impact on the selected goals.

The creation of this letter should be a team effort facilitated by the Integrative Process Facilitator. The letter must be signed by all principal project team members and made available to key stakeholders including, but not limited to the owner(s), facility manager(s), tenant(s), and community members. Describe how the letter was distributed to these stakeholders and/or made publicly available.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

Refer to the LEED v4 reference guide for an introduction to the integrative process.

More than ever, the Integrative Process credit documents the nature of the process, the understanding of system relationships, and the resultant decision making by all project team members through a project team letter. Project teams are better able to demonstrate the difference between the standard approach and the integrative approach for key issue areas like energy and water, as well as broader concepts at the frontier of the green building movement like site selection, social equity, and health and well-being.

**Step-by-Step Guidance**

Follow steps 1-7 in the LEED v4 reference guide, with the following modifications:

- All references to the Integrative Process Worksheet are replaced by the Project Team Letter.
- Assess strategies associated with each of the seven energy aspects, as applicable, and at least one on-site non-potable water source that could supply a portion of at least two water demand components.
- Step 1: Add the following paragraph at the end:

Consider reviewing ASHRAE Standard 209-2018, which provides a standardized methodology for applying energy modeling throughout the integrative design process to inform building design.

- Step 2: Add the following paragraph at the end:
  ASHRAE 209, Section 5.3 (Climate and Site Analysis) and Section 5.4 (Benchmarking) provide helpful guidance for conducting this preliminary research.
- Step 4: Add the following paragraph at the end:
  ASHRAE Standard 209-2018 Section 5.5 (Energy Charrette) provides a good framework for incorporating energy considerations into the design charrette.
- Step 5:
  - Replace last sentence beginning with "Conduct" with "Conduct such preliminary modeling to assess at least one strategy for each of the above seven aspects, as applicable."
  - Add the following paragraph at the end:
    ASHRAE Standard 209-2018 Sections 6.1 (Simple Box Modeling), 6.2 (Conceptual Design Modeling), and Modeling Cycle 3 (Load Reduction Modeling) may be used to demonstrate compliance with the Integrative Process credit requirements to develop a Simple Box Energy Model. The data reporting information described in Standard 209, Section 5.7 may also be used to generate a consistent reporting methodology during the energy analysis process.
- Step 7: Replace" "…identify at least two options for each of the seven aspects listed in Step 5" with "…identify one or more options for each of the seven aspects listed in Step 5, as applicable."

**Further Explanation**
Refer to the LEED v4 reference guide, with the following additions and modification:

Project teams may choose additional lenses through which to demonstrate the outcomes and benefits of an integrative process which include site selection, social equity, and/or health & well-being.

Required Documentation

- Project Team Letter

Referenced Standards

- ASHRAE Standard 209-2018, Energy Simulation Aided Design for Buildings except Low Rise Residential Buildings

Connection to Ongoing Performance

- LEED O+M IN credit Innovation: The final phase of the integrative process is the period of occupancy, operations, and performance feedback. Project teams can demonstrate their ongoing efforts in the LEED v4.1 O+M Integrative Process pilot credit.

# LT Credit: LEED for Neighborhood Development Location

This credit applies to

- BD+C: New Construction (8-16 points)
- BD+C: Core and Shell (8-20 points)
- BD+C: Schools (8-15 points)
- BD+C: Retail (8-16 points)
- BD+C: Data Centers (8-16 points)
- BD+C: Warehouses and Distribution Centers (8-16 points)
- BD+C: Hospitality (8-16 points)
- BD+C: Healthcare (5-9 points)

## INTENT

To avoid development on inappropriate sites. To reduce vehicle distance traveled. To enhance livability and improve human health by encouraging daily physical activity.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Locate the project within the boundary of a development certified under LEED for Neighborhood Development (Stage 2 or Stage 3 under the Pilot or v2009 rating systems, Certified Plan or Certified Built Project under the LEED v4 rating system).

Projects attempting this credit are not eligible to earn points under other Location and Transportation credits.

Table 1. Points for LEED ND location.

| Certification level | Points BD&C | Points BD&C (Core and Shell) | Points BD&C (Schools) | Points BD&C (Healthcare) |
|---|---|---|---|---|
| Certified | 8 | 8 | 8 | 5 |
| Silver | 10 | 12 | 10 | 6 |
| Gold | 12 | 16 | 12 | 7 |
| Platinum | 16 | 20 | 15 | 9 |

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following addition:

### Further Explanation

Connection to Ongoing Performance

- LEED O+M LT prerequisite Transportation Performance: Locating a building on a LEED ND site impacts vehicle miles travelled by encouraging and enhancing walkability. This credit would have a significant positive impact on the transportation patterns of building occupants. As a result, this credit makes the performance-based LT prerequisite Transportation Performance more achievable.

# LT Credit: Sensitive Land Protection

This credit applies to

- BD+C: New Construction (1 point)
- BD+C: Core and Shell (2 points)
- BD+C: Schools (1 point)
- BD+C: Retail (1 point)
- BD+C: Data Centers (1 point)
- BD+C: Warehouses and Distribution Centers (1 point)
- BD+C: Hospitality (1 point)
- BD+C: Healthcare (1 point)

## INTENT

To cultivate community resilience, avoid the development of environmentally sensitive lands that provide critical ecosystem services and reduce the environmental impact from the location of a building on a site.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Option 1. Previously Developed Land
Locate the development footprint on land that has been *previously developed*.

OR

Option 2. Avoidance of Sensitive Land
Locate the development footprint on land that does not meet the following criteria for sensitive land:

- *Prime farmland.* Prime farmland, unique farmland, or farmland of statewide or local importance as defined by the U.S. Code of Federal Regulations, Title 7, Volume 6, Parts 400 to 699, Section 657.5 (or local equivalent for projects outside the U.S.) and identified in a state Natural Resources Conservation Service soil survey (or local equivalent for projects outside the U.S.).
- *Floodplains*. A flood hazard area shown on a legally adopted flood hazard map or otherwise legally designated by the local jurisdiction or the state. For projects in places without legally adopted flood hazard maps or legal designations, locate on a site that is entirely outside any floodplain subject to a 1% or greater chance of flooding in any given year.
- *Habitat*. Land identified as habitat for the following:
    - species listed as threatened or endangered under the U.S. Endangered Species Act or the state's endangered species act, or
    - species or ecological communities classified by NatureServe as GH (possibly extinct), G1 (critically imperiled), or G2 (imperiled), or
    - species listed as threatened or endangered specifies under local equivalent standards (for projects outside the U.S.) that are not covered by NatureServe data.
- *Water bodies.* Areas on or within 100 feet (30 meters) of a *water body*, except for minor improvements.
- *Wetlands*. Areas on or within 50 feet (15 meters) of a *wetland*, except for minor improvements.

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**
Beta Update

The two credit options were given titles to clarify their intent and remain consistent with the format of other credit options. The list of minor improvements within wetland and water body buffers has been moved from the rating system language to the guide because it is guidance.

**Step-by-Step Guidance**

- Option 1 can now be referenced as “Option 1. Previously Developed Land.”
- Option 2 can now be referenced as “Option 2. Avoidance of Sensitive Land.”

**Further Explanation**

Identifying Sensitive Habitat

- Minor improvements within the wetland and water body buffers may be undertaken to enhance appreciation of them, provided such facilities are open all building users. Only the following improvements are considered minor:
- Bicycle and pedestrian pathways no more than 12 feet wide (3.5 meters), of which no more than 8 feet (2.5 meters) may be impervious;
- Activities to maintain or restore native natural communities and/or natural hydrology;
- One single-story structure per 300 linear feet (90 linear meters) on average, not exceeding 500 square feet (45 square meters);
- Grade changes necessary to ensure public access;
- Clearings, limited to one per 300 linear feet (90 linear meters) on average, not exceeding 500 square feet (45 square meters) each;
- Removal of the following tree types:
- Hazardous trees, up to 75% of dead trees
- Trees less than 6 inches (150 millimeters) diameter at breast height
- Up to 20% of trees more than 6 inches (150 millimeters) diameter at breast height with a condition rating of 40% or higher.
- Trees under 40% condition rating
- The condition rating must be based on an assessment by an arborist certified by the International Society of Arboriculture (ISA) using ISA standard measures, or local equivalent for projects outside the U.S.
- For Option 3, Brownfield Remediation: Reference the US EPA’s National Priorities list as a resource.

Connection to Ongoing Performance

- LEED O+M SS credit Site Management: During an assessment, a project team may find features such as vegetation, land use, or hydrology that require protection to achieve this credit. The same assessment may be used to identify protection measures in the related credit.
- LEED O+M SS credit Rainwater Management: Sensitive land or previously undeveloped land on the project site that is left undisturbed may be used to manage runoff and help achieve the related credit.

# LT Credit: High-Priority Site and Equitable Development

This credit applies to

- BD+C: New Construction (1-2 points)
- BD+C: Core and Shell (2-3 points)
- BD+C: Schools (1-2 points)
- BD+C: Retail (1-2 points)
- BD+C: Data Centers (1-2 points)
- BD+C: Warehouses and Distribution Centers (1-2 points)
- BD+C: Hospitality (1-2 points)
- BD+C: Healthcare (1-2 points)

## INTENT

To build the economic and social vitality of communities, encourage project location in areas with development constraints and promote the ecological, cultural, and community health of the surrounding area while understanding the needs and goals of existing residents and businesses.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

**Option 1. High Priority Site (1 point BD&C except Core and Shell, 2 points Core and Shell)**

**Path 1. Economically Disadvantaged Community Location (1 point BD&C except Core and Shell, 2 points Core and Shell)**

Locate within one of the following areas

- Census tract* in which average household income is at or below 80% AMI
- Census tract in which at least 20% of population is at or below poverty rate of state, provincial, or other regional jurisdiction
- Census tract in which unemployment is at least 150% of the state, provincial, or other regional jurisdiction.

*or local equivalent government-defined municipal tract for projects outside the U.S.

OR

**Path 2. Brownfield Remediation (1 point BD&C except Core and Shell, 2 points Core and Shell)**

Locate on a *brownfield* where soil or groundwater contamination has been identified, and where the local, state, or national authority (whichever has jurisdiction) requires its remediation. In cases of voluntary remediation by the project team, provide confirmation by the local, state, or national authority (whichever has jurisdiction) to verify that the site is a brownfield. Perform remediation to the satisfaction of the relevant authority.

AND/OR

**Option 2. Equitable Development (1 point BD&C except Core and Shell, 2 points Core and Shell)**

**Path 1. Equity & Community Benefits (1 point BD&C except Core and Shell, 2 points Core and Shell)**

Develop and implement an equity plan.

OR

Path 2. Affordable Housing in Residential or Mixed-Use Projects (1 point)

Include a proportion of new rental and/or for-sale dwelling units priced for households earning less than the area median income (AMI). Rental units must be maintained at affordable levels for a minimum of 15 years. Existing dwelling units are exempt from requirement calculations. Meet or exceed the minimum thresholds in Table 1. Projects must meet or exceed the minimum percentage of units mandated through inclusionary zoning by their local jurisdictions.

Table 1. Minimum affordable units

| | |
|---|---|
| Rental Dwelling Units | 10 percent of total rental units (or at least one unit) priced up to 60% AMI |
| For-Sale Dwelling Units | 5 percent of total for-sale units (or at least one unit) priced up to 80% AMI |

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

*Option 1 – Path 1* promotes the social and economic revitalization of economically depressed or disadvantaged communities by rewarding the location of certain appropriate projects on such sites. Many low-income communities have sites that are vacant or underutilized because of perceived stigmas or economic barriers. Such projects also achieve savings because they are served by existing infrastructure.

*Option 1 – Path 2* promotes the redevelopment of contaminated sites, where hazardous materials are removed from a site's soil or groundwater, thereby reducing the exposure of humans and wildlife to environmental pollution and improving environmental health. Contaminated site redevelopment often reduces the footprint of the project's elements, with a redevelopment site using an average of 78% less land than the same project would if it were built on a greenfield.[1]

*Option 2 - Path 1* encourages any and all members of the project team to promote and further social equity by integrating strategies that address identified social and community needs and disparities within a project's own community. In order to go beyond charity to support meaningful transformation, building teams must begin to understand the various parts of their communities and understand how they are connected, and community members (particularly those who are vulnerable, disadvantaged and under-represented) must have a greater voice in decisions that impact them.

*Option 2 – Path 2* recognizes careful pricing of units to accommodate underserved populations and reflect the area's income context. Project teams begin by setting goals for the income level or levels they would like to serve. These target incomes are tailored to the project's location, using the area's median income as a baseline.

[1] Deason, J.P., G.W. Sherk, and G.A. Carroll, Public Policies and Private Decisions Affecting the Redevelopment of Brownfields (Environmental and Energy Management Program, George Washington University, 2001).

**Step-by-Step Guidance**

Option 1 – Path 1. Economically Disadvantaged Community Location

**Step 1. Determine baseline metrics for income, unemployment, and/or poverty:**

For projects located in the U.S., refer to the U.S. Census American FactFinder. For projects located in Canada, refer to Statistics Canada. Projects located in other countries should refer to the relevant national or regional agency responsible for demographic data reporting.

Obtain the baseline metric(s) for the state, provincial, or regional jurisdiction in which the project is located.

**Step 2. Determine income, unemployment, and poverty rates for project site(s).**

Using the same data source(s), obtain the (metrics) for the census tract or equivalent, government-defined municipal tract in which the project is located.

**Step 3. Calculate the threshold rate**

Compare the census tract rate to the regional rate to determine if income, unemployment, or poverty rates for the project's census tract meet the required thresholds in Option 1, Path 1. Projects must meet the required threshold for **at least one** metric.

Option 1 – Path 2. Brownfield Remediation

**Step 1. Identify contamination**

As early as possible in the development process, determine the presence of any on-site soil or groundwater contamination.

- To identify contamination, consult local records, conduct a Phase 1 or Phase 2 environmental site assessment (or a local equivalent), or work with a biologist or environmental scientist.
- The credit explicitly applies to soil or groundwater contamination. Asbestos and other contaminants inside buildings (whether demolished or remaining) or in debris do not count as contamination under this credit requirement. However, it is recommended that project teams consider these factors in an overall site assessment.
- If the project is located on a site that has already been completely assessed and remediated, the results of that assessment and remediation may be used toward achievement of this option if complete documentation is provided.

**Step 2. Determine applicable remediation requirements**

- Obtain a declaration from the authority having jurisdiction indicating the presence of contamination, and work with that authority to determine the remediation requirements for the contaminated site.
- If part of the site is found to have contamination, then the entire area within the LEED project boundary is considered a contaminated site.
- In the U.S., the authority having jurisdiction may be the U.S. Environmental Protection Agency or a state or local government regulatory agency responsible for identification of contaminants and remediation protocols.

**Step 3. Complete remediation**

- Remediate the project site to the satisfaction of the authority having jurisdiction. Completing remediation typically involves working with a remediation specialist.

- Remediation can be a long process. Identifying any contamination and beginning remediation is often just the first step; a site undergoing remediation may therefore receive credit at the time of certification.
- Many local governments or other authorities will not grant entitlement or other planning approvals until remediation has made the site safe for human occupancy and intended use.

## Option 2 - Path 1. Equity & Community Benefits

### Step 1. Designate Community Benefits Expert

This credit awards one point to projects that undertake a process to understand who their community includes, identify community needs related to equity for vulnerable populations, and develop and implement strategies for the project to assist the community in meeting those needs. The relationship between building project teams and social equity are complex. This pilot credit is intended as a starting place to help green building projects understand their relationships to the impacted community and implement targeted strategies that address social equity.

Effective community engagement and needs assessments are critical components of social equity. Building relationships and establishing trust can take years of work on the part of skilled practitioners. For some projects, working with community members is an integral part of the design process and improving equitable access is a core part of the project mission. For others, the ability to develop, implement and respond to an effective community engagement and needs assessment process may be beyond their scope or capabilities.

The project team should assess their internal capacity to facilitate an effective and meaningful community assessment and engagement process and identify an expert to lead implementation of this option's requirements. This expert and facilitator may be an existing team member, an additional consultant, or a representative from the community who is brought on as a team member. Consider the specific skills that are needed for your project based on the team's initial understanding of their community, relevant equity topics, and community benefits concepts. For example, if the project necessitates the relocation of community members, the project team should incorporate a relocation expert.

### Step 2. Define and Understand Your Community

The foundational step in promoting social equity within the community is to define that community.

From the perspective of building scale projects, communities have both geographic and functional definitions. Geographic communities start with your neighborhood—the people who live and work in and near your project and interact with it by proximity. The exact distance can depend on your setting. In urban environments, it may be everyone living or working within a few city blocks or within a ¼ mile. In rural areas, where the distance between neighbors might be much greater, the radius may be larger. Geographic communities can also extend further out beyond your neighborhood to include your town, city or county. All of these may be relevant.

Functional communities include all of the people who come to your building to work or visit. These people may or may not live nearby. This category includes your employees, contractors, operations staff, and visitors. It may vary significantly depending on the type of project. For example, housing, offices, hotels, schools or retail projects will all have unique combinations of occupants, contractors and visitors.

In new projects, these definitions can be challenging as they may be in flux. For example, if your project may potentially contribute to displacement of people who currently live or work on the site but may not be able to afford to stay, these people should be included in your community assessment. Similarly, if there are employees who have yet to be hired or contracts yet to be assigned (e.g. for maintenance), these future community members should be included. Both of these groups provide opportunities for meaningful social equity interventions.

In addition, community can be defined by other types of affinities or commonalities, such as age religion, ethnicity, sexual orientation or gender identity, as well as by income level, homelessness, mental health, or education levels. Your project may choose to focus on one or more of these groups, regardless of their proximity or direct relationship to the project. For instance, projects located in low income or disadvantaged communities might focus on their immediate neighbors, while projects in more affluent communities might focus on workers or visitors who travel to the site from further away.

The purpose of this credit is not just to help improve connections with the various aspects of your community (although that is important). The goal is to focus on the members of your community who are chronically vulnerable, disadvantaged, underserved, or have limited access, and to find ways within your project to begin to address these inequities.

Step 3. Partner with a Local Organization

Identify one or more organizations that work directly with the people of the vulnerable community that you have identified. Engage these organizations as partners to help identify ways that your project can improve social equity for the population they represent.

Qualifying organizations must have a mission and core function focused on increasing access or addressing the needs of vulnerable populations and facilitate direct community engagement activities on a regular basis with their targeted populations. Organizations should ideally have non-profit status, have a local presence and an active relationship with the local target population, and have been active for at least three years.

Examples of acceptable organizations include:

- Community advocacy groups
- Social or environmental justice organizations
- Community development corporations
- Labor organizations or worker cooperatives
- Schools and community education institutions
- Social or human service organizations
- Health care organizations
- Housing organizations and organizations serving people experiencing homelessness
- Food production and access programs
- Weatherization organizations targeting low income or minority populations
- Professional and vocational training programs
- Arts access programs

As a best practice, the project team should engage with this partner organization as early as possible in the design phase and incorporate community representation into their integrative process.

Step 4. Conduct Community Engagement Process

Encourage responsiveness to community needs by involving the people who live or work in the community in project design and planning and in decisions about how it should be improved or how it should change over time.

Develop a community engagement plan and timeline that incorporates a variety of outreach methods, beginning in the design phase, continuing into construction and operations phases, and includes at least one public activity. The process should engage a representative sample of the community, with priority on populations experiencing inequities, served by the partner organization, and affected by the project.

Each community engagement activity must be led by the development team, an expert consultant, or the local partner organization and be directly related to the project.

Record and incorporate the viewpoints and priorities of different stakeholders raised in the community engagement process in project team decision-making, and document community participation in the planning and design process.

For best practices and strategies, see Further Explanation, Community Engagement.

Step 5. Demonstrate Community Benefits

In partnership with stakeholders and the local partner organization, develop a community benefits plan to implement equity-building strategies that reflect the needs and assets of the community identified in Step 2 and 4. Identify implementation steps, milestone dates, measurement methods, and benchmarks to track progress of these strategies into the operations phase. Document implementation of the strategies, as well as the agreement of the partner organization on the community benefits approach.

For best practices and examples of qualifying strategies, see Further Explanation, Demonstrating Community Benefits.

Option 2 – Path 2. Affordable Housing in Residential or Mixed-Use Projects

Step 1. Determine Area Median Income for Project Location

Contact local or regional officials to determine the area median income associated with the project's location or, for U.S. projects, refer to the U.S. Department of Housing and Urban Development website for the most recent Income Limits.

Step 2. Determine Target Income for Residents

Use the AMI and Equation 1 to calculate the target household income percentages that the project seeks to serve. For projects to earn a point under Option 2, Path 2 of this credit, rental units must target household incomes that do not exceed 60% AMI. For-sale units must target household incomes that do not exceed 80% AMI.

***Equation 1. Target Income***

*Target Income = AMI x household income percentage goal*

Step 3. Adjust Target Income for Each Dwelling Size

Use Equation 2 and the appropriate bedroom (BR) factor(s) from the table below to calculate the adjusted target household income for each dwelling.

***Bedroom (BR) factors for adjusting target income***

| Unit | BR Factor |
|---|---|
| Studio | 0.70 |
| 1 BR | 0.75 |
| 2 BR | 0.90 |
| 3 BR | 1.04 |
| 4 BR | 1.16 |

*Equation 2. Adjusted Target Income*

*Adjusted target income = Target income x BR factor*

Step 4. Calculate Maximum Pricing

Calculate the maximum price that would qualify a rental or for-sale unit of a given size as affordable, for each adjusted target income level.

- For rental units, determine the maximum monthly rent according to Equation 3. A factor of 30% is applied to adjusted target income as the recommended maximum percentage of income that households should spend on rent payments.
- For for-sale units, determine the maximum amount of income available to pay principal, taxes, and insurance (PITI) according to Equation 4. A factor of 28% is applied to adjusted target income as the recommended maximum percentage of income that households should spend on homeownership.

*Equation 3. Maximum monthly rent*

*Maximum monthly rent = (Adjusted target income x 0.30) / 12*

*Equation 4. Maximum monthly principal, interest, taxes, and insurance (PITI)*

*Maximum monthly PITI = (Adjusted target income x 0.28) / 12*

Step 5. Reserve Required Number of Affordable Units

Apply prices that do not exceed the calculated monthly rent or monthly PTI to the appropriate number of units. A point is achieved for meeting either threshold for minimum number of affordable units: at least 10% of total rental units (or at least one unit) priced up to 60% AMI, or at least 5% of total for-sale units (or at least one unit) priced up to 80% AMI.

Step 6. Obtain Binding Agreement to Maintain Affordable Rental Rates for At Least 15 Years.

Obtain a binding agreement from the responsible developer that the affordable rental rates will be maintained for at least 15 years, starting from the date of unit occupancy. This agreement may be in the form of a deed restriction, operating agreement, or other recorded document.

**Further Explanation**

Defining and Understanding Your Community

The U.S. EPA's EJSCREEN: Environmental Justice Mapping and Screening Tool is an invaluable resource for understanding the environmental justice context of a proposed land-use or building project.

Community Engagement

Consider community engagement approaches from other existing LEED credits, including:

- LEED Community Outreach and Involvement Credit
- LEED Integrative Process Credit
- LEED Inclusive Design Pilot Credit
- LEED Social Equity within the Community Pilot Credit

- LEED Integrative Process for Health Promotion

Demonstrating Community Benefits:

Community benefits are a project's contributions and opportunities for surrounding communities, local workers, and/or other populations affected by the project. Benefits may address a range of community issues, such as living wages, local hiring, and affordable housing requirements.

### Exemplary Performance

Projects achieving more than two paths are eligible to receive an additional point for exemplary performance.

### Related Credit Tips

IP Credit Integrative Process. The implementation of an integrative process must include all principal project team members and its results must be made available to key stakeholders including community members. Moreover, project teams may choose an additional lens through which to demonstrate the outcomes and benefits of an integrative process for an Exemplary Performance point. One of the optional issue areas to carry out analysis relevant to the project addresses social equity.

### Connection to Ongoing Performance

LEED O+M LT prerequisite Transportation Performance: Locating a building on any of the high-priority site types addressed in this credit significantly increases the likelihood that the project will be in a dense area served by transit and diverse uses, which would in turn have a significant positive impact on the transportation patterns of building occupants. As a result, this credit makes a performance-based LT prerequisite Transportation Performance more achievable. LT prerequisite Transportation Performance evaluates a building's transportation characteristics through the collection and measurement of occupant survey data, rewarding projects based on how building occupants actually travel to and from the project.

# LT Credit: Surrounding Density and Diverse Uses

This credit applies to

- BD+C: New Construction (1-5 points)
- BD+C: Core and Shell (1-6 points)
- BD+C: Schools (1-5 points)
- BD+C: Data Centers (1-5 points)
- BD+C: Warehouses and Distribution Centers (1-5 points)
- BD+C: Hospitality (1-5 points)
- BD+C: Retail (1-5 points)
- BD+C: Healthcare (1 point)

## INTENT

To conserve land and protect farmland and wildlife habitat by encouraging development in areas with existing infrastructure. To support neighborhood and local economies, promote walkability and low or no carbon transportation, and reduce vehicle distance traveled for all. To improve public health by encouraging daily physical activity.

## REQUIREMENTS

NC, CS, RETAIL, HOSPITALITY

Option 1. Surrounding Density (2–3 points BD&C except Core and Shell, 2-4 points Core and Shell)

Locate on a site whose surrounding existing density within a ¼-mile (400-meter) offset of the project boundary meets the values in Table 1. Use either the "separate residential and nonresidential densities" or the "combined density" values.

Table 1a. Points for average density within 1/4 mile of project (IP units)

| Combined density | Separate residential and nonresidential densities | | Points BD&C (except Core and Shell) | Points BD&C (Core and Shell) |
|---|---|---|---|---|
| Square feet per acre of buildable land | Residential density (DU/acre) | Nonresidential density (FAR) | | |
| 22,000 | 7 | 0.5 | 2 | 2 |
| 35,000 | 12 | 0.8 | 3 | 4 |

Table 1b. Points for average density within 400 meters of project (SI units)

| Combined density | Separate residential and nonresidential densities | | Points BD&C (except Core and Shell) | Points BD&C (Core and Shell) |
|---|---|---|---|---|
| Square meters per hectare of buildable land | Residential density (DU/hectare) | Nonresidential density (FAR) | | |
| 5,050 | 17.5 | 0.5 | 2 | 2 |

| | | | | |
|---|---|---|---|---|
| 8,035 | 30 | 0.8 | 3 | 4 |

DU = dwelling unit; FAR = floor-area ratio.

SCHOOLS

Option 1. Surrounding Density and Connectivity (2–3 points)

Path 1. Surrounding Density

Locate on a site whose surrounding existing density within a ¼-mile (400-meter) offset of the project boundary meets the values in Table 1. Use either the “separate residential and nonresidential densities” or the “combined density” values.

Table 1a. Points for average density within 1/4 mile of project (IP units)

| Combined density | Separate residential and nonresidential densities | | Points |
|---|---|---|---|
| Square feet per acre of buildable land | Residential density (DU/acre) | Nonresidential density (FAR) | |
| 22,000 | 7 | 0.5 | 2 |
| 35,000 | 12 | 0.8 | 3 |

Table 1b. Points for average density within 400 meters of project (SI units)

| Combined density | Separate residential and nonresidential densities | | Points |
|---|---|---|---|
| Square meters per hectare of buildable land | Residential density (DU/hectare) | Nonresidential density (FAR) | |
| 5,050 | 17.5 | 0.5 | 2 |
| 8,035 | 30 | 0.8 | 3 |

DU = dwelling unit; FAR = floor-area ratio.

Physical education spaces that are part of the project site, such as playing fields and associated buildings used during sporting events only (e.g., concession stands) and playgrounds with play equipment, are excluded from the development density calculations.

Path 2. Connected Site (1-2 points)

Locate the project on a previously developed site that also meets one of the connected site conditions listed below.

Table 2. Points for connected site

| Type of site | Points |
|---|---|
| Adjacent | 1 |
| Infill | 2 |

- To qualify as an adjacent site, at least 25% of the project boundary must border parcels that are previously developed sites.
- To qualify as an infill site, at least 75% of the project boundary must border parcels that are previously developed sites.
- Bordering rights-of-way do not constitute previously developed land; it is the status of the property on the other side of the right-of-way that contributes to the calculation. Any part of the boundary that borders a water body is excluded from the calculation.

AND/OR

### Option 2. Diverse Uses (1–2 points)

Construct or renovate a building or a space within a building such that the building's main entrance is within a ½-mile (800-meter) walking distance from the following number of uses (see Appendix 1), as listed below.

Table 1. Points for proximity to uses

| Uses | Points |
|---|---|
| 4–7 | 1 |
| ≥ 8 | 2 |

The following restrictions apply.
- A use counts as only one type (e.g., a retail store may be counted only once even if it sells products in several categories).
- No more than two uses in each use type may be counted (e.g. if five restaurants are within walking distance, only two may be counted).
- The counted uses must represent at least three of the five categories, exclusive of the building's primary use.

## Data Centers, Warehouses & Distribution Centers

### Option 1. Development and Adjacency (2–3 points)

Construct or renovate the project on a previously developed site that was used for industrial or commercial purposes. (2 points).

OR

Construct or renovate the project on a site that is both a previously developed and an adjacent site. The adjacent sites must be currently used for industrial or commercial purposes (3 points).

AND/OR

### Option 2. Transportation Resources (1–2 points)

Construct or renovate the project on a site that has two or three (1 point) or four (2 points) of the following transportation resources:
- The site is within a 10-mile (16 kilometer) driving distance of a main logistics hub, defined as an airport, seaport, *intermodal facility*, or *freight village* with intermodal transportation.
- The site is within a 1-mile (1600-meter) driving distance of an on-off ramp to a *highway.*
- The site is within a 1-mile (1600-meter) driving distance of an access point to an active freight rail line.
- The site is served by an active freight rail spur.

In all cases, a planned transportation resource must be sited, funded, and under construction by the date of the certificate of occupancy and complete within 24 months of that date.

HEALTHCARE

### Option 1. Surrounding Density (1 point)

Locate on a site whose surrounding existing density within a ¼-mile (400-meter) offset of the project boundary is:

1. At least 7 dwelling units per acre (17.5 DU per hectare) with a 0.5 floor-area ratio. The counted density must be *existing* density, not zoned density, or
2. At least 22,000 square feet per acre (5 050 square meters per hectare) of buildable land.

For previously developed existing rural healthcare campus sites, achieve a minimum development density of 30,000 square feet per acre (6890 square meters per hectare).

OR

### Option 2. Diverse Uses (1 point)

Construct or renovate a building on a site such that the building's main entrance is within a ½-mile (800-meter) walking distance of the main entrance of at least seven operational and publicly accessible uses (listed in Appendix 1).

The following restrictions apply.

- A use may be counted as only one type (e.g., a retail store may be counted only once even if it sells products in several categories).
- No more than two uses in each use type may be counted (e.g., if five restaurants are within walking distance, only two may be counted).
- The counted uses must represent at least three of the five categories, exclusive of the building's primary use.

ALL PROJECTS

### Option 3. Walkable Location

Locate on a site with a Walk Score® or equivalent third-party walkability assessment for the following thresholds, as listed below.

**Table 1. Points for walkable location (1-5 points BD+C except Core & Shell and Healthcare, 6 points Core & Shell, 1 point Healthcare)**

| Walk Score® | Points | Points (Core & Shell) | Points (Healthcare) |
|---|---|---|---|
| 90 to 100 | 5 | 6 | - |
| 80 to 89 | 4 | 4 | - |
| 70 to 79 | 3 | 3 | - |
| 60 to 69 | 2 | 2 | - |
| 50 to 59 | 1 | 1 | - |
| ≥ 50 | - | - | 1 |

Projects attempting Option 3 are not eligible to earn points under Option 1 or Option 2.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

In this credit, data centers have been combined with warehouses and distribution centers to have different requirements, reflecting the needs of buildings devoted to housing goods (and not people). Updates also clarify that surrounding existing density is measured within a ¼-mile (400-meter) offset, not radius, of the project boundary.

A new path for school projects has been added to Option 1 to recognize the unique circumstances some schools project face during site selection, especially for communities outside of dense urban areas. Path 2, Connected Site recognizes the benefit of locating new schools near existing development.

A new option has been added for all projects to recognize the benefit of walkable locations as assessed by Walk Score® and equivalent walkability assessment tools. Walk Score® measures surrounding density, road network metrics, and destinations within walking distance and is a reasonable proxy for the metrics in Option 1 and Option 2.

**Step-by-Step Guidance**

Follow steps in the LEED v4 reference guide, with the following modifications:

- Data Centers have been added to the Warehouses and Distribution Centers pathway. Any reference to this pathway should be considered requirements for data centers as well.
- For Schools projects attempting Option 1, Path 2, follow guidance below for determining adjacent and infill site status.

  Step 1. Identify qualifying previously developed parcels around the project site

  On a vicinity map, identify parcels adjacent to the project's perimeter. For each parcel, calculate the percentage of previous development area.

  - Qualifying parcels have at least 75% previous development coverage. If a portion of a lot smaller than 1 acre is previously developed, the entire lot's area may be considered previously developed.
  - Start with parcels that look most developed and skip those that appear marginal.

  Step 2. Confirm that the project is an adjacent site or infill site

  Measure the project's entire perimeter, the length of perimeter segments adjacent to waterfront (if any), and the longest continuous perimeter segments adjacent to qualifying parcels. Use Equation 1 to determine the percentage of the project boundary adjacent to previously developed parcels.

  *Equation 1. Percentage of boundary adjacent to previous development*

  *% adjacent boundary = continuous perimeter adjacent to previously developed parcels / (total perimeter – any waterfront perimeter) x 100*

- To qualify as an infill site, at least 75% of the site boundary must be adjacent to qualifying previously developed parcels.
- To qualify as an adjacent site, at least one continuous segment of the site boundary adjacent to qualifying previously developed parcels must be 25% or more of the net perimeter length.
- If no continuous segments are at least 25% of the net perimeter length, the site does not qualify as an adjacent site.

- For projects attempting Option 3, access the project's Walk Score by entering the project address at https://www.walkscore.com/.

**Further Explanation**

Walk Score measures the walkability of an address on the following scale:

| Walk Score® | Description |
|---|---|
| 90-100 | Walker's Paradise<br>Daily errands do not require a car. |
| 70-89 | Very Walkable<br>Most errands can be accomplished on foot. |
| 50-69 | Somewhat Walkable<br>Some errands can be accomplished on foot. |
| 25-49 | Car-Dependent<br>Most errands require a car. |
| 0-24 | Car-Dependent<br>Almost all errands require a car. |

Source: Walk Score

While quantitative walkability assessment tools, including Walk Score, provide valuable insight into the relative potential for walking in a measured location, these tools have acknowledged limitations for reflecting the actual conditions on the ground and the safety and efficacy of walking. Project teams are encouraged to utilize other resources, including but not limited to multimodal transportation data collection and analysis, travel surveys, and pedestrian safety audits. For more information, refer to https://www.walkscore.com/methodology.shtml

In addition, a project's design has the potential to influence walking and other active modes as alternatives to driving through the orientation of the building on the site and connectivity between the site and the surrounding street network, and by including high-quality sidewalks and crossing facilities that enhance multimodal travel on and around the project.

Required Documentation

- Data centers have been added to the Warehouses and Distribution Centers pathway. Any reference in the tables to the pathway should be considered requirements for Data Centers as well.
- For Schools projects attempting Option 1, Path 2, a map of surrounding land and its status (previously developed, per the definition in Step-by-Step Guidance) is required documentation.
- For projects attempting Option 3, attach a screenshot of the resulting Walk Score, making sure to include the project's address and score.

Connection to Ongoing Performance

- LEED O+M LT prerequisite Transportation Performance: Locating a building in a dense area served by transit and diverse uses would have a significant positive impact on the transportation patterns of building occupants. As a result, this credit makes the performance-based LT prerequisite Transportation Performance more achievable.

# LT Credit: Access to Quality Transit

This credit applies to

- BD+C: New Construction (1-5 points)
- BD+C: Core and Shell (1-6 points)
- BD+C: Schools (1-4 points)
- BD+C: Data Centers (1-5 points)
- BD+C: Warehouses and Distribution Centers (1-5 points)
- BD+C: Hospitality (1-5 points)
- BD+C: Retail (1-5 points)
- BD+C: Healthcare (1-2 points)

## INTENT

To encourage development in locations shown to have multimodal transportation choices or otherwise reduced motor vehicle use, thereby reducing greenhouse gas emissions, air pollution, and other environmental and public health harms associated with motor vehicle use.

## REQUIREMENTS

NC, CS, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, RETAIL

### Path 1. Access to Public Transit Service (1 to 5 points BD+C, except Core and Shell; 1 to 6 points Core and Shell)

Locate any *functional entry* of the project within a ¼-mile (400-meter) *walking distance* of existing or planned bus, *streetcar*, or *informal transit stops,* or within a ½-mile (800-meter) walking distance of existing or planned *bus rapid transit* stops, passenger rail stations (i.e. light, heavy, or commuter rail) or commuter ferry terminals. The transit service at those stops and stations in aggregate must meet the minimums listed in Table 1. Planned stops and stations may count if they are sited, funded, and under construction by the date of the certificate of occupancy and are complete within 24 months of that date.

Both weekday and weekend trip minimums must be met.

- For each qualifying transit route, only trips in one direction are counted towards the threshold.
- For weekend trips, only trips on the day with the higher number of trips are counted towards the threshold.
- If a qualifying transit route has multiple stops within the required walking distance, only trips from one stop are counted towards the threshold.
- Privately-run shuttles are only acceptable for Path 1 if the service is also made available to the public.

**Table 1. Minimum daily public transit service**

| Weekday trips | Weekend trips | Points BD&C (except Core and Shell) | Points BD&C (Core and shell |
|---|---|---|---|
| 72 | 30 | 1 | 1 |
| 100 | 70 | 2 | 2 |
| 144 | 108 | 3 | 3 |
| 250 | 160 | 4 | 4 |
| 360 | 216 | 5 | 6 |

If *existing* transit service is temporarily rerouted outside the required distances for less than two years, the project may meet the requirements, provided the local transit agency has committed to restoring the routes with service at or above the prior level.

OR

### Path 2. Access to Project-sponsored Transit Service

Commit to providing year-round transit service (vans, shuttles, buses) for regular occupants and visitors that meets the minimums listed in Table 2, Service must be guaranteed for at least 3 years from the project's certificate of occupancy.

Within the project boundary, provide at least one transit stop shelter at each transit stop within a ¼-mile (400-meter) walking distance from a functional entry of the project. A building lobby is allowed instead of shelter if the transit stop is visible from inside and located no greater than 200 feet (60 meters) walking distance from the transit stop.

- For each qualifying transit route, total trips (inbound and outbound) are counted towards the threshold.
- If a qualifying transit route has multiple stops within the required walking distance, only trips from one stop are counted towards the threshold.
- Only directly accessible trips within the specified distances are allowed. Trips available from connected transit facilities do not contribute to the minimum trips under Path 2.

Table 2. Minimum daily project-sponsored transit service

| Total daily trips | Points |
|---|---|
| 30 | 1 |
| 45 | 2 |

Provide a guaranteed ride home program for employees who have carpooled, taken transit, walked, or cycled to work but require alternative transportation home for emergencies or unscheduled overtime.

## Schools

### Option 1. Transit-Served Location (1–4 points)

Locate any *functional entry* of the project within a ¼-mile (400-meter) *walking distance* of existing or planned bus, *streetcar*, or *informal transit* stops, or within a ½-mile (800-meter) walking distance of existing or planned *bus rapid transit* stops, passenger rail stations, or commuter ferry terminals. The transit service at those stops and stations must meet the minimums listed in Tables 1 and 2. Planned stops and stations may count if they are sited, funded, and under construction by the date of the certificate of occupancy and are complete within 24 months of that date.

- For each qualifying transit route, only trips in one direction are counted towards the threshold.
- If a qualifying transit route has multiple stops within the required walking distance, only trips from one stop are counted towards the threshold.

Table 1. Minimum daily transit service

| Weekday trips | Points |
|---|---|
| 72 | 1 |

| | |
|---|---|
| 144 | 2 |
| 250 | 3 |
| 360 | 4 |

Projects served by two or more transit routes such that no one route provides more than 60% of the prescribed levels may earn one additional point, up to the maximum number of points.

If existing transit service is temporarily rerouted outside the required distances for less than two years, the project may meet the requirements, provided the local transit agency has committed to restoring the routes with service at or above the prior level.

OR

### Option 2. Pedestrian Access (1–4 points)

Show that the project has an *attendance boundary* such that the specified percentages of dwelling units are within no more than a 3/4-mile (1200-meter) walking distance (for grades 8 and below, or ages 14 and below), and 1 1/2-mile (2400-meter) walking distance (for grades 9 and above or ages 15 and above) of a functional entry of a school building. Points are awarded according to Table 3.

### Table 2. Points for dwelling units within walking distance

| Percentage of dwelling units in attendance boundary | Points |
|---|---|
| 50% | 1 |
| 60% | 2 |
| 70% or more | 4 |

In addition, locate the project on a site that allows pedestrian access to the site from all residential areas in the attendance boundary.

## Healthcare

Locate any *functional entry* of the project within a ¼-mile (400-meter) *walking distance* of existing or planned bus, *streetcar*, or *informal transit* stops, or within a ½-mile (800-meter) walking distance of existing or planned *bus rapid transit* stops, passenger rail stations or commuter ferry terminals. The transit service at those stops and stations in aggregate must meet the minimums listed in Tables 1 and 2. Planned stops and stations may count if they are sited, funded, and under construction by the date of the certificate of occupancy and are complete within 24 months of that date.

Both weekday and weekend trip minimums must be met.

- For each qualifying transit route, only trips in one direction are counted towards the threshold.
- If a qualifying transit route has multiple stops within the required walking distance, only trips from one stop are counted towards the threshold.

### Table 1. Minimum daily transit service

| Weekday trips | Weekend trips | Points |
|---|---|---|
| 72 | 30 | 1 |
| 144 | 108 | 2 |

Projects served by two or more transit routes such that no one route provides more than 60% of the prescribed levels may earn one additional point, up to the maximum number of points.

If *existing* transit service is temporarily rerouted outside the required distances for less than two years, the project may meet the requirements, provided the local transit agency has committed to restoring the routes with service at or above the prior level.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

Updates to this credit recognize the challenges project teams face in meeting the pervasive limitations to weekend transit requirements. The weekend minimum thresholds are reduced and project teams are now allowed to count the weekend day with the higher number of trips rather than the weekend average. With newly added intermediate thresholds, projects (excluding Core and Shell) can now earn 2 and 4 points, as well as a 3-point threshold for Schools.

Path 2, Project-sponsored Transit Service has been added to recognize the benefits of developer- or employer-sponsored transit service toward reducing SOV trips and VMT impacts from the project, especially in areas where public transportation does not exist or does not provide high frequency service.

**Step-by-Step Guidance**

Follow steps in the LEED v4 reference guide, with the following modifications:

- Step 4. The number of transit vehicle trips on a weekend. If weekend counts are different, only count the weekend day with the highest number of trips.
- Disregard any mention of the "commuter rail or ferry only" pathway. This section has been removed from the rating system.
- For Path 2, follow the steps outlined below:

  Step 1. Select private transit service provider

  Identify and hire a private transit service capable of providing transportation between the project site and external destinations (e.g., residential areas, public transportation stations). Year-round service for regular occupants and visitors at the minimum service frequency stipulated in credit requirements must be guaranteed for at least 3 years from the project's certificate of occupancy.

  Step 2. Plan private transit service

  Using a site map, show the service route and regular stops. The route must include at least one transit stop with shelter within a ¼-mile walk distance from a functional entry of the project or a building lobby within 200 feet walking distance of the transit stop, as indicated in the credit requirements. Route should be designed to reduce driving trips to the project site; destinations may include residential areas and/or public transportation stations. Plan for operation with minimum service frequency indicated in the credit requirements.

  Step 3. Plan rider facilities

  If transit stop(s) are located more than 200 feet from building lobby, provide adequate transit shelter(s) for riders. For a building lobby within 200 feet of transit stops that will be used as a qualifying waiting area, ensure adequate space is available for waiting riders.

  Step 4. Establish guaranteed ride home program

Design a qualifying program that provides a guaranteed ride home for employees who have taken transit, carpooled, waked, or bicycled to work but require alternative transportation home for emergencies or unscheduled overtime. The program may utilize taxi, ridehailing service, or company vehicles. A guaranteed ride home policy must be maintained that specifies the following, at a minimum:

- Employee eligibility
- Trip eligibility
- Maximum number of uses
- Responsibility for program administration
- Procedures for using the program, including any necessary forms for registration and/or reimbursement

Source: Adapted from "Guaranteed Ride Home: A Backup for Commuters Who Use Alternative Modes." Victoria Transportation Policy Institute (VTPI). https://vtpi.org/tdm/tdm18.htm

**Further Explanation**

Example

- The example provided references commuter rail, light rail, and averaged weekend trips. These references are no longer applicable and should be disregarded.

Required Documentation

For Path 2. Project-sponsored transit service, the following documentation is required:

- Map showing planned route, including transit stop(s) on project site with distances from functional entries, and off-site destinations. Include a description of off-site destinations.
- Schedule of year-round service, including service frequency (total trips per day)
- Guaranteed ride home policy

Definitions

Refer to the LEED v4 reference guide for additional definitions.

- Replace all references to rail transit with the umbrella term, "passenger rail". Replace all references to "rideshare" with the term "informal transit".
- passenger rail a diversity of rail transit service including light, heavy, and commuter rail transit. Passenger rail systems are characterized by wheeled vehicles running on rails or tracks. They may provide long-distance intercity transit services as well as local daily commuter or intra-city trips. Rail transit systems may vary with respect to vehicle type, car count, operating speeds, right-of-way characteristics, and service schedule.
- informal transit a publicly available transit service that includes a fixed route service, fare structure, and regular operation. It does not consist of taxi, private shuttles or seasonal, on-call or on-demand transit.

Connection to Ongoing Performance

- LEED O+M LT prerequisite Transportation Performance: Locating a project in a dense area served by transit and diverse uses would have a significant positive impact on the transportation patterns of building occupants, which is a data set that project teams are required to collect in order to measure building performance under the performance-based LT prerequisite Transportation Performance.

# LT Credit: Bicycle Facilities

This credit applies to

- BD+C: New Construction (1 point)
- BD+C: Core and Shell (1 point)
- BD+C: Schools (1 point)
- BD+C: Data Centers (1 point)
- BD+C: Warehouses and Distribution Centers (1 point)
- BD+C: Hospitality (1 point)
- BD+C: Retail (1 point)
- BD+C: Healthcare (1 point)

## INTENT

To promote bicycling and transportation efficiency and reduce vehicle distance traveled. To improve public health by encouraging utilitarian and recreational physical activity.

## REQUIREMENTS

NEW CONSTRUCTION, CORE AND SHELL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, RETAIL, HEALTHCARE

Bicycle Network

Design or locate the *project* such that a *functional entry* or bicycle storage is within a 200-yard (180-meter) *walking distance* or *bicycling distance* from a *bicycle network* that connects to at least one of the following:

- at least 10 diverse uses (see Appendix 1);
- a school or *employment center,* if the project total floor area is 50% or more residential; or
- *a bus rapid transit* stop, passenger rail station, or ferry terminal.

All destinations must be within a 3-mile (4800-meter) bicycling distance of the project boundary.

Planned bicycle trails or lanes may be counted if they are fully funded by the date of the certificate of occupancy and are scheduled for completion within three years of that date.

Bicycle Storage and Shower Rooms

Case 1. Commercial or Institutional Projects
Provide *short-term bicycle storage* for at least 2.5% of all peak visitors, but no fewer than four storage spaces per building.

Provide *long-term bicycle storage* for at least 5% of all regular building occupants, but no fewer than four storage spaces per building in addition to the short-term bicycle storage spaces.

Provide at least one on-site shower with changing facility for the first 100 regular building occupants and one additional shower for every 150 regular building occupants thereafter.

Case 2. Residential Projects
Provide *short-term bicycle storage* for at least 2.5% of all peak visitors but no fewer than four storage spaces per building.

Provide *long-term bicycle storage* for at least 15% of all regular building occupants, but no less than one storage space per three residential units.

Case 3. Mixed-Use Projects

Meet the Case 1 and Case 2 storage requirements for the nonresidential and residential portions of the project, respectively.

### Large-Occupancy Projects Only:

The following guidance should be applied when determining the number of showers needed for projects with a large number of occupants:

NEW CONSTRUCTION, SCHOOLS, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, RETAIL, HEALTHCARE

Provide at least one on-site shower with changing facility for the first 100 regular building occupants and one additional shower for every 150 regular building occupants thereafter, up to 999 regular building occupants.

- one additional shower for every 500 regular building occupants, for the additional 1,000 – 4,999 regular building occupants
- one additional shower for every 1,000 regular building occupants, for the additional 5,000 + regular building occupants

CORE AND SHELL

Provide at least one on-site shower with changing facility for the first 100 regular building occupants and one additional shower for every 150 regular building occupants thereafter, up to 999 regular building occupants.

- one additional shower for every 750 regular building occupants, for the additional 1,000 – 4,999 regular building occupants
- one additional shower for every 1,500 regular building occupants, for the additional 5,000 + regular building occupants

### For All Projects

*Short-term bicycle storage* must be within 200 feet (60meters) walking distance of any main entrance. *Long-term bicycle storage* must be within 300 feet (90 meters) walking distance of any *functional entry*. Vertical distances travelled by elevator are exempt from counting towards the walking distance requirements.

Bicycle storage capacity may not be double-counted: storage that is fully allocated to the occupants of non-project facilities cannot also serve project occupants. Indoor storage is acceptable as long as it meets the walking distance requirements. On-site bicycle sharing stations within the project boundary may count for 50% of the long-term and short-term bicycle storage space. Zero lot line projects may count publicly available bicycle parking towards their short-term storage requirements if it meets the maximum allowable walking distance.

Provide at least one on-site shower with changing facility for the first 100 regular building occupants and one additional shower for every 150 regular building occupants thereafter. Exclude patients and K-12 students from the regular building occupant count. Residential projects do not need to provide additional showers.

SCHOOLS

### Bicycle Network

Design or locate the *project* such that a *functional entry* and/or bicycle storage is within a 200-yard (180-meter) *walking distance* or *bicycling distance* of a *bicycle network* that connects to either of the following:

- a *bus rapid transit* stop or passenger rail station or ferry terminal; or
- 50% of dwelling units within the school's attendance boundary.

The stops/stations or dwelling units must be within no more than a 1 1/2-mile (2400-meter) biking distance (for grades 8 and below, or ages 14 and below), and 3-mile (4800-meter) biking distance (for grades 9 and above or ages 15 and above).
Provide dedicated bicycle lanes that extend at least to the end of the school property with no barriers (e.g., fences) on school property.

Bicycle Storage and Shower Rooms

Meet storage and shower requirements for all projects and provide *long-term bicycle storage* for at least 5% of all regular building occupants (excluding students grade 3 and younger), but no fewer than four storage spaces per building.

<u>RETAIL</u>

Bicycle Network
Meet Bicycle Network requirements for all projects.

Bicycle Storage and Shower Rooms
Meet storage distance and shower requirements for all projects and provide at least two *short-term bicycle storage* spaces for every 5,000 square feet (465 square meters), but no fewer than two storage spaces per building.

Provide *long-term bicycle storage* for at least 5% of regular building occupants, but no fewer than two storage spaces per building in addition to the short-term bicycle storage spaces.

Provide a bicycle maintenance program for employees or bicycle route assistance for employees and customers. Route assistance must be provided in a manner easily accessible to both employees and customers.

<u>HEALTHCARE</u>

Bicycle Network
Meet Bicycle Network requirements for all projects.

Bicycle Storage and Shower Rooms
Meet storage and shower requirements for all projects and provide *short-term bicycle storage* for at least 2.5% of all peak visitors, but no fewer than four storage spaces per building.

Provide *long-term bicycle storage* for at least 5% of regular building occupants (excluding patients), but no fewer than four storage spaces per building in addition to the short-term bicycle storage spaces.

## GUIDANCE
Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**
Beta Update
This updated credit is more achievable for diverse project-types as storage and facility requirements are more representative of common site conditions. In recognition of their growing prevalence and impact, on-site bicycle sharing stations are now allowed to count for 50% of long-term and short-term bicycle storage space for all projects. Required walking distances to storage have been extended based on feedback regarding common layout conditions. To better accommodate projects with a high occupancy count, a LEED Interpretation about showers has been adopted that adjusts the number of showers that are realistic for large buildings.

**Step-by-Step Guidance**
Refer to the LEED v4 reference guide, with the following addition:

- Take note of the exemption of vertical distance from the walking distance requirements.
- Refer to new requirements and thresholds before proceeding with storage equations, such as the new percentage storage required per three dwelling units for residential projects.
- Step 5. For high-occupancy projects, meet the applicable shower and changing facility requirements for the building's space type.
- For multifamily and residential projects, the ability to store bicycles within units does not count as long-term storage.

**Further Explanation**
Refer to the LEED v4 reference guide, with the following additions:

Selecting Bicycle Storage
Recommended bicycle rack designs, derived from The Association of Pedestrian and Bicycle Professionals (APBP) Essentials of Bike Parking Guide, include:

- For all applications: Inverted U (or Stable, Loop), Post and Ring, and Wheelwell-secure.
- For high- density, space-constrained situations: Staggered Wheelwell-secure, Vertical, and Two-Tier.
- Bicycle rack designs that are not recommended include: Wave, Schoolyard, Coathanger, Wheelwell, Bollard, Spiral, and Swing Arm Secured.

Rating System Variations
Refer to the LEED v4 reference guide, with the following addition and modifications:

<u>Core and Shell</u>
Refer to Appendix 2, Default Occupancy Counts, for occupancy count requirements and guidance.

<u>Retail</u>
For projects that are part of a multitenant complex only: If bicycle storage spaces have been provided in the complex in which the project is located, determine the number of spaces that may be attributed to the project by dividing the project's floor area by the total floor area of the development (buildings only) and multiplying the percentage result by the total number of spaces. If this number does not meet the credit requirement, the project must provide additional bicycle storage.

<u>Historic Urban Locations</u>
If the requirements on the width of bike paths cannot be met due to the *historic urban context* of the bicycle network, compensating measures to reduce street speeds and/or to enhance biking security on routes connecting to a qualifying bike network are acceptable:

- A security lane for biking (marked dedicated bike lane, which can be shared by cars in narrow sections of the street when no bikes are present) or a physically dedicated bike lane less than 5 feet (1.5 meters) wide
- Intersections spaced no more than 400 feet (122 meters) apart
- Travel lane widths no greater than 10 feet (3 meters) and parallel parking lane widths no greater than 8 feet (2.4 meters)

Historicity of the area and/or whether the site receives legal protection are determining factors for whether a building has a historic urban context.

Referenced Standards
The Association of Pedestrian and Bicycle Professionals (APBP), Essentials of Bike Parking: Selecting and Installing Bike Parking that Works (2015), pages 6-8:
https://www.apbp.org/resource/resmgr/Bicycle_Parking/EssentialsofBikeParking_FINA.pdf

### Required Documentation

Refer to the LEED v4 reference guide, with the following addition:

Historic urban locations and routes must be clearly identified by type in a narrative.

### Definitions

- **long-term bicycle storage** bicycle parking that is easily accessible to residents and occupants and covered to protect bicycles from rain and snow.
- **historic urban context** refers to limiting conditions linked to historic urban planning that may consequentially impact buildings and infrastructure within the associated jurisdiction. Such site conditions may make buildings act as traffic calming structures or may affect street access and the width of right-of-way. Historicity of the area and whether the site receives legal protection are determining factors for whether a bicycle network has a historic urban context.

### Connection to Ongoing Performance:

- LEED O+M LT prerequisite Transportation Performance: Improving bicycle facilities and access to a bicycle network as well as implementing any corresponding bicycle programs may help improve a project's transportation performance score.

# LT Credit: Reduced Parking Footprint

This credit applies to

- BD+C: New Construction (1 point)
- BD+C: Core and Shell (1 point)
- BD+C: Schools (1 point)
- BD+C: Retail (1 point)
- BD+C: Data Centers (1 point)
- BD+C: Warehouses and Distribution Centers (1 point)
- BD+C: Hospitality (1 point)
- BD+C: Healthcare (1 point)

## INTENT

To minimize the environmental harms associated with parking facilities, including automobile dependence, land consumption, and rainwater runoff.

## REQUIREMENTS

NC, CS, Retail, Schools, Data Centers, Warehouses & Distribution Centers, Hospitality, Healthcare

Option 1. No Parking or Reduce Parking (1 point)

Do not exceed the minimum local code requirements for parking capacity.

Provide parking capacity that is a 30% reduction below the base ratios for parking spaces, by building type, found in Appendix 4. Table 1. Base Ratios for Parking.
Alternatively, projects may demonstrate baseline and reduced parking capacity using calculations for the most appropriate land use found in the Institute of Transportation Engineers (ITE) *Parking Generation Manual, 5th Edition* or a comparable and current resource applied by a qualified transportation engineer or planner.

Projects with no off-street parking meet the requirements.

OR

Option 2. Carshare (1 point)

Provide dedicated parking for carshare vehicles. Provide carshare vehicle parking space(s) for at least 1% of total parking spaces, rounded up. If the project has fewer than 100 parking spaces, provide one carshare vehicle parking space.

Establish an agreement between the project and carshare company guaranteeing that new or existing carshare vehicle space(s) will be dedicated for a minimum of two years from the certificate of building occupancy.

Existing carshare vehicles located in nearby on- or off-street parking areas do not contribute to credit achievement.

OR

Option 3. Unbundling Parking (1 point)

Sell parking separately from all property sales or leases. For owner-occupied projects, do not provide free or subsidized parking for employees.

Implement a daily parking fee at a cost equal to or greater than the daily roundtrip cost of municipal public transit.

For All Projects
The credit calculations must include all existing and new off-street parking spaces that are leased or owned by the project, including parking that is outside the project boundary but is used by the project. On-street parking in public rights-of-way is excluded from these calculations.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

This credit has been updated to give project teams more flexibility. The credit includes four new options, allowing additional strategies for diverse project types. By removing the carpool preferred parking requirement, updates also recognize that carpooling is not an easily enforced nor a universally adopted strategy.

**Step-by-Step Guidance**

- Steps in LEED v4 reference guide should be regarded within the context of Option 1. No Parking or Reduce Parking.
- Disregard any references related to carpool preferred parking.
- Disregard any references to Cases 1 and 2.
- Refer to Appendix 4 where any instance of the outdated standard is mentioned.
- For projects that use pooled parking, calculate compliance using the project's share of the pooled parking.
- Mixed-use projects should determine the percentage reduction by first aggregating the parking amount of each use (as specified by the base ratios) and then determining the percentage reduction from the aggregated parking amount.
- Do not count parking spaces for fleet and inventory vehicles unless these vehicles are regularly used by employees for commuting as well as business purposes.
- Projects cannot achieve points under Option 1. No Parking or Reduce Parking if they have subsidized off-site parking for occupants, even if no new parking has been constructed. There must be no new or existing off-street parking owned or leased by the project, including parking that is outside the project boundary but is used by the project.
- For Option 2. Carshare, locate carshare parking within a ¼-mile (400-meter) walking distance from the project boundary.

**Further Explanation**

Required Documentation

Refer to the LEED v4 reference guide, with the following addition:

- For Option 2. Carshare, projects are required to show legal agreement between the carshare company and the project. Engage in at least a 2-year agreement.
- For Option 3. Unbundling Parking, provide documentation that shows the project will implement a daily parking fee at a cost equal to or greater than the daily roundtrip cost of municipal public transit for one person.

Referenced Standards

- Institute of Transportation Engineers, Parking Generation Manual, 5th edition

Exemplary Performance

- Achieve a 60% parking capacity reduction from the base ratio.

### Definitions

- **off-street parking** any indoor or outdoor facility or area for vehicle parking that is not located on the streets, such as garages, lots, and driveways.
- **carshare** refers to short-term car rental services intended to reduce the necessity for private vehicle ownership, are generally priced by the hour (or fraction of an hour), and have automated pick-up/drop-off processes for program subscribers.

### Connection to Ongoing Performance

- LEED O+M LT prerequisite Transportation Performance: Earning this credit will help improve a project's transportation performance score.

# LT Credit: Electric Vehicles

This credit applies to

- BD+C: New Construction (1 point)
- BD+C: Core and Shell (1 point)
- BD+C: Schools (1 point)
- BD+C: Retail (1 point)
- BD+C: Data Centers (1 point)
- BD+C: Warehouses and Distribution Centers (1 point)
- BD+C: Hospitality (1 point)
- BD+C: Healthcare (1 point)

## INTENT

To reduce pollution by promoting alternatives to conventionally fueled automobiles.

## REQUIREMENTS

NC, CS, Data Centers, Hospitality, Retail, Healthcare, Schools

Provide charging infrastructure for electric vehicles for on-site parking.

**Option 1. Electric Vehicle Supply Equipment (1 point)**
Install *electrical vehicle supply equipment (EVSE)* in 5% of all parking spaces used by the project or at least two spaces, whichever is greater. Clearly identify and reserve these spaces for the sole use by plug-in electric vehicles.

The EVSE must:

- Provide a Level 2 charging capacity (208 – 240 volts) or greater for each required space
- Comply with the relevant regional or local standard for electrical connectors, such as SAE Surface Vehicle Recommended Practice J1772, SAE Electric Vehicle Conductive Charge Coupler or IEC 62196 of the International Electrotechnical Commission for projects outside the U.S.
- Meet the *connected functionality* criteria for ENERGY STAR certified EVSE and be capable of responding to time-of-use market signals (e.g. price). Projects pursuing EA credit Grid Harmonization should incorporate EVSE into any demand response program or load flexibility and management strategies.

OR

**Option 2. Electric Vehicle Ready Infrastructure (1 point)**
Make 10% of parking spaces or at least 6 spaces, whichever is greater, *EV Ready*.

To be *EV Ready*, include a dedicated electrical circuit with sufficient capacity for each required space. Each circuit shall have conduit and wire sufficient to provide Level 2 charging or greater, and shall end at an electrical box or enclosure located near each required space.

Schools

Meet Option 1 or Option 2 above.

OR

**Option 3: Electric buses or school-owned vehicles (1 point)**
Develop and implement a plan for acquiring at least 1 electric bus and/or for every other bus serving the school to meet the following emissions standards within seven years of the building certificate of occupancy:

- nitrogen oxide (NOx) emissions of 0.50 grams or less per brake horsepower-hour; and
- particulate matter emissions of 0.01 grams or less per brake horsepower-hour.

Emission standards must be met for each bus and not by an average of the entire fleet serving the school.

Develop and implement a plan for 50% of all other (non-bus) vehicles owned or leased to serve the school to be electric vehicles.

<u>Warehouses & Distribution Centers</u>

**Option 1. Electric Vehicle Charging (1 point)**
Provide an on-site fleet with at least one *yard tractor* that is powered by electricity and provide on-site charging for the vehicles.

OR

**Option 2. Reduced Truck Idling (1 point)**
Provide an electrical connection for at least 50% of all dock door locations and/or truck parking locations to limit truck idling on the site.

Provide signage to communicate a reduced idling policy.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

**Beta Update**

This updated credit now refers to electric vehicles (EV) only, and the credit title has been changed to Electric Vehicles to reflect this. As the EV market grows around the world and outpaces other alternative fuels, updates are reflecting the huge potential of electric vehicles to contribute to a clean energy transition. Preferred parking requirements and other achievement barriers have also been removed and replaced with simplified language addressing newly added options that reward the installation of electric vehicle infrastructure.

**Step-by-Step Guidance**

- Disregard any references related to carpool preferred parking, alternative fueling, or permanently installed signage or pavement markings for preferred parking.
- Refer to all vehicles as electric vehicles.
- Projects are no longer required to meet the American Council for an Energy Efficient Economy (ACEEE) green score threshold of 45. However, project teams are encouraged to use the ACEE GreenerCars Ratings as a reference for information on vehicles ranked “Above Average.”
- Schools pursuing Option 3 are encouraged to collaborate with utility organizations and consider electric grid management options or electric bus storage opportunities. Working in conjunction with a utility company can help reduce stress on the electric grid during peak demand periods as well as help subsidize the cost of electric buses.

**Further Explanation**

Refer to the LEED v4 reference guide, with the following addition:

- Discounted parking rates are no longer applicable or viable as a substitute for preferred parking since it is no longer a requirement.
- Signage for preferred parking are no longer required. Signage for charging stations are still strongly encouraged, however.
- ACEEE scores no longer apply.

Required Documentation

Refer to the LEED v4 reference guide, with the following modification:

- Documentation related to preferred parking spaces, fueling stations, and discounted parking rates are no longer required.

Referenced Standards

- EPA ENERGY STAR Electric Vehicle Supply Equipment (EVSE) Key Product Criteria – Connected Functionality https://www.energystar.gov/products/evse_key_product_criteria

Definitions

- **EV Ready** A dedicated electrical circuit with appropriate capacity for an electric vehicle charging station.
- **electric vehicles (EV)** vehicles driven by electric motors which draw energy from either storage batteries or overhead cables.
- **electric vehicle supply equipment (EVSE)** the conductors, including the ungrounded, grounded, and equipment grounding conductors, the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets or apparatuses installed specifically for the purpose of delivering energy from the premises wiring to the electric vehicle. (National Electric Codes and California Article 625).
- **connected functionality** refers to EVSE that are capable of supporting building and/or utility demand response programs (ENERGY STAR EVSE Key Product Criteria)

Connection to Ongoing Performance:

- LEED O+M LT prerequisite Transportation Performance: Providing and improving electric vehicle charging facilities and infrastructure implementing any corresponding electric vehicle incentivizing programs may help improve a project’s transportation performance score.
- LEED O+M EA credit Grid Harmonization: Electric charging stations aligning with the existing demand response program or infrastructure comply with the related performance-based credit.

# SS Prerequisite: Construction Activity Pollution Prevention

This prerequisite applies to

- BD+C: New Construction
- BD+C: Core and Shell
- BD+C: Schools
- BD+C: Retail
- BD+C: Data Centers
- BD+C: Warehouses and Distribution Centers
- BD+C: Hospitality
- BD+C: Healthcare

## INTENT

To reduce pollution from construction activities by controlling soil erosion, waterway sedimentation, and airborne dust that disproportionately impact frontline communities.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Create and implement an erosion and sedimentation control plan for all construction activities associated with the project. The plan must conform to the erosion and sedimentation requirements of the 2017 U.S. Environmental Protection Agency (EPA) Construction General Permit (CGP) or local equivalent, whichever is more stringent. Projects must apply the CGP regardless of size. The plan must describe the measures implemented.

## GUIDANCE

There are no substantive changes to the prerequisite requirements; refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

Updated the referenced standard which was out of date.

**Step-by-Step Guidance**

- Refer to the 2017 edition of the U.S. Environmental Protection Agency (EPA) Construction General Permit (CGP) where any instance of the outdated standard is mentioned.

**Further Explanation**

Referenced Standards

- **U.S. EPA, National Pollutant Discharge Elimination System (NPDES), Stormwater Discharges from Construction Activities, 2017:** https://www.epa.gov/npdes/stormwater-discharges-construction-activities

Connection to Ongoing Performance:

- LEED O+M SS credit Rainwater Management: Implementing an ESC plan that minimizes soil compaction where vegetation will be planted or where infiltration measures will be installed will support reducing runoff volumes, in accordance with the related credit's requirements.

# SS Prerequisite: Environmental Site Assessment

This prerequisite applies to

- BD+C: Schools
- BD+C: Healthcare

## INTENT

To protect the health of vulnerable populations by ensuring that the site is assessed for environmental contamination and that any environmental contamination has been remediated.

## REQUIREMENTS

<u>SCHOOLS, HEALTHCARE</u>

Conduct a Phase I Environmental Site Assessment as described in ASTM E1527-13 (or a local equivalent) to determine whether environmental contamination exists at the site. If contamination is suspected, conduct a Phase II Environmental Site Assessment as described in ASTM E1903–11 (or a local equivalent).

If a site is contaminated, remediate the site to meet local, state, or national environmental protection agency region residential (unrestricted) standards, whichever are most stringent.

## GUIDANCE

There are no substantive changes to the prerequisite requirements; refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

Updated the referenced standard which was out of date.

**Step-by-Step Guidance**

- Refer to the E1527-13 edition of the ASTM standard where any instance of the outdated standard is mentioned.

**Further Explanation**

Referenced Standards

- ASTM E1527-13 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process

# SS Credit: Site Assessment

This credit applies to

- BD+C: New Construction (1 point)
- BD+C: Core and Shell (1 point)
- BD+C: Schools (1 point)
- BD+C: Retail (1 point)
- BD+C: Data Centers (1 point)
- BD+C: Warehouses and Distribution Centers (1 point)
- BD+C: Hospitality (1 point)
- BD+C: Healthcare (1 point)

## INTENT

To assess site conditions, environmental justice concerns, and cultural and social factors, before design to evaluate sustainable options and inform related decisions about site design.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Complete and document a site survey or assessment[2] that includes the following information:

*Topography.*

- Contour mapping
- Unique topographic features
- Slope stability risks

*Hydrology.*

- Special Flood Hazard Areas (SPFHA) as determined by FEMA's Flood Insurance Rate Map (FIRM) (or local equivalent for projects outside the U.S.)
- Delineated natural water bodies wetlands, lakes, streams, and shorelines (refer to U.S. EPA's Clean Water Act or local equivalent for projects outside the U.S.)
- Rainwater collection and reuse opportunities
- Impervious and pervious surfaces within the site boundary

*Climate.*

- Solar exposure and shading opportunities
- Heat island effect potential
- Seasonal sun angles
- Prevailing winds
- Average monthly precipitation and temperature ranges

*Vegetation.*

- Primary vegetation types
- Greenfield area
- Significant tree mapping
- Federal or state threatened or endangered species lists; for projects outside the U.S., International Union for Conservation of Nature (IUCN) Red List of Threatened Species
- Invasive plant species listed by regional, state, or federal entities
- EPA Level III ecoregion description (or local equivalent)

[2] Components adapted from the Sustainable Sites Initiative: Guidelines and Performance Benchmarks 2009, Prerequisite 2.1: Site Assessment.

*Soils.*

- Natural Resources Conservation Service soils delineation (or local equivalent for projects outside the U.S.)
- U.S. Natural Resources Conservation Service (or local equivalent for projects outside the United States) prime farmland, unique farmland, farmland of statewide importance, or farmland of local importance
- Healthy soils
- Previous development
- Disturbed soils

*Human use.*

- Views
- Adjacent transportation infrastructure, bicycle network, and bicycle storage
- Adjacent diverse uses
- Construction materials with existing recycle or reuse potential

*Human health effects.*

- Proximity of vulnerable populations
- Adjacent physical activity opportunities
- Proximity to major sources of air and water pollution

The survey or assessment should demonstrate the relationships between the site features and topics listed above and how these features influenced the project design; give the reasons for not addressing any of those topics.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

The removal of a U.S.-specific standard, TR-55, from the required considerations and broadening of this concept to account for all impervious and pervious surfaces on site has made this updated credit more approachable to most project teams. The credit now requires projects to describe their EPA Level III Ecoregion (or local equivalent) in order to understand what native and adapted vegetation is appropriate for their site, integrative information that better contextualizes the credit intent.

**Further Explanation**

Refer to the LEED v4 reference guide, with the following modifications:

- Hydrology: Disregard any mention of the Natural Resources Conservation Service TR-55 program as it is no longer required.
- Hydrology: Estimate the water storage capacity of the site by calculating the area of impervious and pervious surfaces. Table 2 lists of other possible sources of information.
- Vegetation:
    - Source – EPA Level III Ecoregion Descriptions (ftp://newftp.epa.gov/EPADataCommons/ORD/Ecoregions/pubs/NA_TerrestrialEcoregionsLevel3_Final-2june11_CEC.pdf)
    - Description – Descriptions identifying North American ecoregions and detailing their associated ecosystems and vegetation types.

Required Documentation

- Provide a map illustrating the topography of the site.
- Provide a map illustrating the site's Special Flood Hazard Areas (SPFHA) as determined by FEMA's Flood Insurance Rate Map (FIRM) (or local equivalent showing the 100-year floodplain for projects outside the U.S.).
- Provide the description of the site's EPA Level III ecoregion (or local equivalent).

Referenced Standards

- EPA Level III Ecoregion Descriptions: ftp://newftp.epa.gov/EPADataCommons/ORD/Ecoregions/pubs/NA_TerrestrialEcoregionsLevel3_Final-2june11_CEC.pdf

Connection to Ongoing Performance:

- LEED O+M SS credit Site Management: Conducting a site assessment and identifying natural areas providing habitat will fulfill the related credit's site assessment requirements.
- LEED O+M LT credit Transportation Performance: Analyzing the surrounding sites and diverse uses, transportation infrastructure, bicycle network, as well as assessing existing bicycle facilities and potential future facility needs, may help inform and influence the improvement of a project's transportation performance score.
- LEED O+M SS credit Rainwater Management: Studying the climate, rainfall, and hydrology of the site and watershed will help determine applicable strategies to earn the related performance-based credit.
- LEED O+M SS credit Heat Island Reduction: Site assessment can lead to identification of paving, shading, or roofing materials that can contribute to requirements of the related performance-based credit.
- LEED O+M EA credit Energy Performance: An analysis of the climate, including solar access, temperatures, diurnal swings, wind patterns, humidity, and rainfall will support more effective passive and active energy efficiency strategies.

# SS Credit: Protect or Restore Habitat

This credit applies to

- BD+C: New Construction (1-2 points)
- BD+C: Core and Shell (1-2 points)
- BD+C: Schools (1-2 points)
- BD+C: Retail (1-2 points)
- BD+C: Data Centers (1-2 points)
- BD+C: Warehouses and Distribution Centers (1-2 points)
- BD+C: Hospitality (1-2 points)
- BD+C: Healthcare (1 point)

## INTENT

To conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.

## REQUIREMENTS

NC, CS, Schools, Retail, Data Centers, Warehouses & Distribution Centers, Hospitality, Healthcare

Preserve and protect from all development and construction activity 40% of the *greenfield* area on the site (if such areas exist).

AND

Restore a portion of the site, including the building footprint, identified as *previously disturbed (if such areas exist)* and follow vegetation and soil requirements below. Vegetated roof surfaces may be included in the habitat area calculations if the plants are native or adapted and provide habitat. Points are awarded according to Table 1.

**Table 1. Points for percentage of area restored**

| Restored Area | Points BD+C (except Healthcare) | Points BD+C (Healthcare) |
|---|---|---|
| 15% of previously disturbed area | 1 | 1 |
| 25% of previously disturbed area | 2 | - |

### Soil Restoration

Restore disturbed soils in areas that will later serve as the final habitat area.

- Imported soils may not include the following:
  - o soils defined regionally by the Natural Resources Conservation Service web soil survey (or local equivalent for projects outside the U.S.) as *prime farmland*, unique farmland, or farmland of statewide or local importance;
  - o soils from other *greenfield* sites; or
  - o sphagnum peat moss

### Vegetation

Plant a minimum of 6 species of vegetation that are native or adapted to the project's EPA Level III ecoregion (or local equivalent for projects outside of the U.S.). Include a minimum of 2 out of the following plant categories: tree, shrub, and ground cover. Designate a portion of the habitat area for a pollinator garden consisting of native flowering plants and totaling at least 30 square feet (3 square meters).

Schools only:

Dedicated athletic fields that are solely for athletic uses are exempted from counting toward the total site area. These areas may not count toward the protected greenfield or restored habitat areas.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

### Behind the Intent

Beta Update

This updated credit is now more achievable for various project types and more directly addresses the intent of the credit as it relates to habitat protection and revitalization. The restoration requirement was reduced from a minimum of 30% to 15%, and a second threshold was added at 25% for two points to reward projects for increased restoration. Soil requirements have been streamlined and testing requirements have been removed, except for imported soils. A vegetation section was added to encourage planting of diverse vegetation and pollinator habitat. Option 2. Financial Support was removed to encourage focus on local habitat restoration.

### Step-by-Step Guidance

Refer to the LEED v4 reference guide, with the following modifications:

Verify that at least 15%, rather than 30%, of previously disturbed areas will be restored.

- Soil tests are only required for imported soils.
- Option 2 Financial Support is no longer offered in this credit.
- Vegetation:
  - A contiguous series of habitat areas, including pollinator gardens, connected by landscaped paths are encouraged in order to facilitate connectivity for wildlife, especially pollinating insects that cannot travel far without access to food sources. Pollinator gardens are recommended for areas such as parking lots, which include several small contiguous parcels of vegetation.
  - *Ground cover* includes native and adapted grasses as well as perennials and other plant species. See WE Credit Outdoor Water Use Reduction for more guidance on ground cover.
  - Refer to the Xerces Society's Pollinator-Friendly Plant Lists as a resource to select appropriate plants for local pollinators.

### Further Explanation

Refer to the LEED v4 reference guide, with the following modifications:

- Best Practices for Habitat Protection:
  - For more information on invasive vegetation, refer to the USDA's NRCS PLANTS Database, the Invasive Plant Atlas of the United States website, and/or state and federal Noxious Weed laws (or local equivalent for projects outside of the U.S.).
- Vegetated Roofs:
  - Projects no longer need to meet a floor-area ratio (FAR) density minimum for vegetated roofs to be considered part of the restored area.

### Required Documentation

Refer to the LEED v4 reference guide, with the following modifications:

- Site plan depicting the project boundary, building footprint(s), preserved greenfield area(s) (if applicable), previously disturbed area, restored habitat area, native and adapted vegetation, and designated pollinator garden.

- Plants list, including pollinator plants, appropriate for project's EPA Level III ecoregion (or local equivalent for projects outside the U.S.); must include a minimum of 2 out of the following plant categories: tree, shrub, and ground cover.
- Description of disturbed or compacted soils to be revegetated
- EPA Level III Ecoregion description (or local equivalent)
- No longer required: Soil test results for non-imported soils.
- No longer required: Projects with vegetated roofs to provide the floor area ratio (FAR)
- Option 2: Financial Support has been removed and relevant documentation requirements are no longer applicable.

### Referenced Standards

Refer to the LEED v4 reference guide, with the following additions:

- EPA Level III Ecoregion Descriptions: ftp://newftp.epa.gov/EPADataCommons/ORD/Ecoregions/pubs/NA_TerrestrialEcoregionsLevel3_Final-2june11_CEC.pdf
- USDA Natural Resources Conservation Service, PLANTS Database: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/plantsanimals/plants/
- Invasive Plant Atlas of the United States: https://www.invasiveplantatlas.org/
- U.S. State and Federal Noxious Weed laws: https://plants.usda.gov/java/noxComposite
- Xerces Society for Invertebrate Conservation, Pollinator-Friendly Plant Lists: xerces.org/pollinator-conservation/plant-lists/

### Exemplary Performance

- Restore a minimum of 35% (including the building footprint) of all previously disturbed area on site using soil and vegetation that meet the credit requirements.

### Definitions

- **adapted vegetation** vegetation that is not native to the particular region it was introduced to, but has evolved or maintained characteristics conducive for healthy growth and requires no additional resources or maintenance, such as water for irrigation, in comparison to similar species native to the area. An adapted species is non-aggressive or disruptive to native plant communities.
- **contiguous** adjoined or adjacent parcels that facilitate connectivity
- **greenfield site** area that has not been graded, compacted, cleared, or disturbed and that supports (or could support) open space, habitat, or natural hydrology. See also: previously disturbed.
- **habitat area** area that supports native wildlife populations by providing locations for nesting, cover, respite, and/or food sources.
- **invasive vegetation** nonnative or exotic vegetation that quickly grows and aggressively reproduces, often disrupting or displacing native plant communities. The plant's vigor combined with a lack of natural enemies leads to outbreak populations.
- **pollinator** an insect or animal that moves pollen from the male anther of a flower to the female stigma of a flower in order to pollinate the vegetation.
- **pollinator garden** area that is planted with native flowering vegetation that provide nectar, pollen, habitat, or nesting area for native pollinating fauna.
- **previously disturbed** areas that have been graded, compacted, cleared, previously developed, or disturbed in any way. These are areas that do not qualify as 'greenfield.'

### Connection to Ongoing Performance:

- LEED O+M credit Site Management: Naturally vegetated areas that meet the requirements of this credit are less likely to require the routine use of maintenance equipment. They could also reduce irrigation, nutrient application, and erosion, thereby helping the project meet the requirements of the related performance-based credit.
- LEED O+M SS credit Rainwater Management: Restoring and protecting greenfield areas with native or adapted vegetation will help provide applicable strategies to earn the related performance-based credit.
- LEED O+M SS credit Heat Island Reduction: Vegetated roofs can be counted for both credits.

# SS Credit: Open Space

This credit applies to

- BD+C: New Construction (1 point)
- BD+C: Core and Shell (1 point)
- BD+C: Schools (1 point)
- BD+C: Retail (1 point)
- BD+C: Data Centers (1 point)
- BD+C: Warehouses and Distribution Centers (1 point)
- BD+C: Hospitality (1 point)
- BD+C: Healthcare (1 point)

## INTENT

To create exterior open space that encourages interaction with the environment, social interaction, passive recreation, and physical activities.

## REQUIREMENTS

NC, CS, Schools, Retail, Data Centers, Warehouses & Distribution Centers, Hospitality, Healthcare

Provide outdoor space greater than or equal to 30% of the total site area (including building footprint).

At least 25% of the required outdoor open space must be vegetated space planted with two or more types of vegetation or have *overhead vegetated canopy*.

The outdoor space must be physically accessible and be one or more of the following:

- social area: a pedestrian-oriented paving or landscape area that accommodate outdoor social activities;
- recreational area: a recreation-oriented paving or landscape area that encourage physical activity;
- diverse green space: a landscape area with two or more types of vegetation that provide opportunities for year-round visual interest;
- garden: a garden space dedicated to community gardens or urban food production; or
- habitat area: preserved or created habitat that meets the criteria of SS Credit Protect or Restore Habitat and includes elements of human interaction. These areas automatically meet the vegetation criteria of this credit.

Extensive or intensive vegetated roofs that are physically accessible can be used toward the minimum vegetation requirement, and qualifying roof-based physically accessible paving areas can be used toward credit compliance.

Wetlands or naturally designed ponds may count as open space if the side slope gradients average 1:4 (vertical:horizontal) or less and are vegetated.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions:

**Behind the Intent**

Beta Update

Updates clarify requirements about the percentage of outdoor space and vegetated space to qualify as open space. Projects must provide outdoor space greater than or equal to 30% of the total site area. Of the total outdoor open space required, a minimum of 25% must be vegetated or have overhead vegetated canopy. Minimal changes to verbiage regarding vegetation have also been made to clarify types of vegetation that meet the requirements.

**Further Explanation**

Connection to Ongoing Performance:

- LEED O+M SS credit Rainwater Management: Vegetated landscape areas with native or adapted vegetation will help provide applicable strategies to earn the related credit.
- LEED O+M SS credit Heat Island Reduction: Vegetated roofs can be counted for both credits.

# SS Credit: Rainwater Management

This credit applies to

- BD+C: New Construction (1-3 points)
- BD+C: Core and Shell (1-3 points)
- BD+C: Schools (1-3 points)
- BD+C: Retail (1-3 points)
- BD+C: Data Centers (1-3 points)
- BD+C: Warehouses and Distribution Centers (1-3 points)
- BD+C: Hospitality (1-3 points)
- BD+C: Healthcare (1-2 points)

## INTENT

To reduce runoff volume and improve water quality by replicating the natural hydrology and water balance of the site, based on historical conditions and undeveloped ecosystems in the region to avoid contributing to flooding downstream in frontline communities.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

**Option 1. Percentile of Rainfall Events (1-3 points except Healthcare, 1-2 points Healthcare)**

In a manner best replicating *natural site hydrology* processes, retain *on site* the runoff from the associated percentile of regional or local rainfall events. The percentile event volume must be retained (i.e. infiltrated, evapotranspirated, or collected and reused) using *low-impact development (LID*) and *green infrastructure (GI) practices*. GI and LID strategies can be either structural or non-structural. Points are awarded according to Table 1.

**Table 1. Points for percentile of rainfall retained**

| All Projects | Zero lot line Projects | Points | Points Healthcare |
|---|---|---|---|
| 80th Percentile | 70th Percentile | 1 | 1 |
| 85th Percentile | 75th Percentile | 2 | 2 |
| 90th Percentile | 80th Percentile | 3 | - |

OR

**Option 2. Natural land cover conditions (3 points except Healthcare, 2 points Healthcare)**

Calculate the difference between the projected runoff volume under the proposed design conditions and the runoff volume under natural land cover conditions that existed prior to any disturbance. Retain (i.e. infiltrate, evapotranspirate, or collect and reuse) on site the increase in runoff volume using LID and GI *practices*.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

**Beta Update**

Projects are now able to earn points for retaining runoff for the 80th, 85th, or 90th percentile of regional or local rainfall events, whereas the credit previously required the 95th or 98th percentile.

Thresholds for zero lot line projects have also been reduced. To ensure clarity, a more refined definition for zero lot line has been included and the term “manage” has been replaced with the more specific and technical “retain (i.e. infiltrate, evapotranspirate, or collect and reuse)”. More guidance and resources have also been added to clarify acceptable LID strategies. New exemplary performance thresholds for all projects have been added, including exemplary performance under Option 2. Natural landcover conditions which rewards projects for fostering resilience by designing for future precipitation conditions.

**Step-by-Step Guidance**

Refer to the LEED v4 reference guide, with the following modifications:

- The percentile rainfall event thresholds have been changed to 80th, 85th, and 90th percentile for all projects and 70th, 75th, and 80th percentile for zero lot line projects.
- Option 1, Step 2. Obtain Rainfall Data for Project Location: Use daily rainfall data and the methodology in the U.S. Environmental Protection Agency (EPA) Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act to determine the percentile amount to be retained.
- Option 1, Step 2. Obtain Rainfall Data for Project Location: Once you've gathered the rainfall events data, any rainfall events less than or equal to 0.1 inches should be omitted.
- Option 1, Step 7. Conventional grey infrastructure devices and hard runoff conveyance systems, such as detention or retention ponds, pipes, culverts and vaults, can be compliant if used as a component of LID/GI systems to meet the requirements of this credit.

**Further Explanation**

Refer to the LEED v4 reference guide, with the following modifications:

- Examples of acceptable LID techniques include the following:
    - planting rain gardens with native or adapted plant material (e.g. trees or shrubs);
    - installing a vegetated roof;
    - using permeable paving, consisting of porous above-ground materials (e.g., open pavers, engineered products), a base layer designed to drain water away from the building, and (often) a 6-inch-deep (150 millimeters) subbase; and
    - installing permanent infiltration or collection features (e.g., vegetated swale, rain garden, rainwater cistern) that can retain the runoff from the associated percentile of regional or local rainfall events.
- Treatment of Runoff:

  Projects teams should consider prioritizing infiltration of runoff from impervious surfaces considered to be a significant source of pollutants in rainwater runoff. Such surfaces include those which are subject to: vehicular use; industrial activities; or storage of erodible or leachable materials, wastes, or chemicals and which receive direct rainfall or the run-on of rainfall.
- Green Infrastructure and Low-Impact Development Strategies:

  Employ LID and GI strategies that mimic the natural infiltration-based, groundwater-driven hydrology of the site. If project teams are facing environmental or technical barriers to proceeding with LID techniques, consult the EPA’s Low-Impact Development website for detailed “Barrier Buster Fact Sheets” that address specific issues, such as how to combat clay soil constraints and designing LID practices on sloped sites.
- Project Type Variations, zero lot line projects:

  Any setback area resulting from a planned below-grade space, such as an underground parking garage, does not void a project’s zero lot line status so long as the setback area is designed as pedestrian-oriented amenity space, such as outdoor seating.

Referenced Standards

- **EPA’s LID website:** https://www.epa.gov/nps/lid

- **Georgetown Climate Center's Green Infrastructure Toolkit:** http://www.georgetownclimate.org/adaptation/toolkits/green-infrastructure-toolkit/green-infrastructure-strategies-and-techniques.html"

### Exemplary Performance

Option 1. Percentile of rainfall events

| All Projects | Zero lot line Projects |
|---|---|
| 98th Percentile | 95th Percentile |

Option 2. Natural land cover conditions

Retain on site an additional 20% in runoff volume to address future precipitation rates (1.2 * [difference in annual runoff volume from the natural landcover to the post-developed condition]) using LID and GI practices.

### Definitions

Refer to the LEED v4 reference guide, with the following modifications:

- **retain (rainwater) on site** to capture and reserve a specified volume of rainfall to mimic natural hydrologic function. Retention is a function of rainwater management that includes strategies involving evapotranspiration, infiltration, and capture and reuse.

### Connection to Ongoing Performance:

- LEED O+M WE credit Water Performance: LID and GI measures that harvest and reuse rainwater may help reduce potable water demand. Thus, these measures help ensure that projects will use less water throughout the building life cycle, which may help improve a project's water performance score. Tracking water consumption on a regular basis through metering supports effective water management and provides performance data to help verify that building systems are operating as designed.
- LEED O+M SS credit Heat Island Reduction: Vegetated roofs installed for achievement of this credit will also qualify for the related performance-based credit.

# SS Credit: Heat Island Reduction

This credit applies to

- BD+C: New Construction (1-4 points)
- BD+C: Core and Shell (1-4 points)
- BD+C: Schools (1-4 points)
- BD+C: Retail (1-4 points)
- BD+C: Data Centers (1-4 points)
- BD+C: Warehouses and Distribution Centers (1-4 points)
- BD+C: Hospitality (1-4 points)
- BD+C: Healthcare (1-4 points)

## INTENT

To minimize inequitable effects on microclimates and human, especially frontline communities, and wildlife habitats by reducing heat islands.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Choose one of the following options:

**Option 1. Nonroof and Roof (2 points except Healthcare, 1 point Healthcare)**

Meet the following criterion:

$$\frac{\text{Area of Nonroof Measures}}{0.5} + \frac{\text{Area of High-Reflectance Roof}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.75} \geq \text{Total Site Paving Area} + \text{Total Roof Area}$$

Alternatively, an SRI and SR weighted average approach may be used to calculate compliance.

Use any combination of the following strategies.

*Nonroof Measures*

- Use the existing plant material or install plants that provide shade over paving areas (including playgrounds) on the site within 10 years of planting. Install vegetated planters. Plants must be in place at the time of occupancy permit and cannot include artificial turf.
- Provide shade with structures covered by energy generation systems, such as solar thermal collectors, photovoltaics, and wind turbines.
- Provide shade with architectural devices or structures. If the device or structure is a roof, it shall have an aged *solar reflectance (SR)* value of at least 0.28 as measured in accordance with ANSI/CRRC S100. If the device or structure is not a roof, or if aged solar reflectance information is not available, it shall have at installation an initial SR of at least 0.33 as measured in accordance with ANSI/CRRC S100.
- Provide shade with vegetated structures.
- Use paving materials with an initial *solar reflectance (SR)* value of at least 0.33.
- Use an *open-grid pavement system* (at least 50% unbound).

*High-Reflectance Roof*

Use roofing materials that have an aged SRI equal to or greater than the values in Table 1. If aged SRI is not available, the roofing material shall have an initial SRI equal to or greater than the values in Table 1.

**Table 1. Minimum solar reflectance index value, by roof slope**

| | Slope | Initial SRI | Aged SRI |
|---|---|---|---|
| Low-sloped roof | ≤ 2:12 | 82 | 64 |
| Steep-sloped roof | > 2:12 | 39 | 32 |

Roof area that consists of functional, usable spaces (such as helipads, recreation courts, and similar amenity areas) may meet the requirements of nonroof measures. Applicable roof area excludes roof area covered by mechanical equipment, solar energy panels, skylights, and any other appurtenances.

*Vegetated Roof*
Install a vegetated roof using native or adapted plant species.

OR

Option 2. Parking under Cover (1 point)
Place a minimum of 75% of *parking spaces under cover*. Any roof used to shade or cover parking must (1) have an aged SRI of at least 32 (if aged value information is not available, use materials with an initial SRI of at least 39 at installation), (2) be a vegetated roof, or (3) be covered by energy generation systems, such as solar thermal collectors, photovoltaics, and wind turbines.

The credit calculations must include all existing and new off-street parking spaces that are leased or owned by the project, including parking that is outside the project boundary but is used by the project. On-street parking in public rights-of-way is excluded from these calculations.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

This updated credit references the new ANSI/Cool Roof Rating Council S100 standard for "Rapid Ratings." Updates also clarify that functional space for occupant use located on a roof can be included under nonroof calculations. To ensure that this credit is maximizing its intended impact, projects pursuing Option 2. Parking Under Cover are required to include all off-street parking used by the project in their calculations.

**Step-by-Step Guidance**

Refer to the LEED v4 reference guide, with the following modification:

- Identify hardscape and roof area
  - Common roads that serve multiple buildings should not be included in this calculation. If the roads include the primary parking areas (i.e. parking spots along the road), those parking areas should be included in the calculation.
- Selecting roofing materials:
  - Initial SRI shall be computed in accordance with ASTM E1980, under medium wind-speed conditions from initial values of solar reflectance and thermal emittance measured in accordance with ANSI/CRRC S100.
  - Aged SRI shall be computed in accordance with ASTM E1980, under medium wind-speed conditions from aged values of solar reflectance and thermal emittance measured in accordance with ANSI/CRRC S100.
  - Values of roof solar reflectance, thermal emittance, and solar reflectance index may be available at the Cool Roof Ratings Council's Rated Products Directory.
- Evaluate compliance against credit requirements:

- o Equation 2, within the “summed for all high-reflectance roof areas” portion, replace 'Required SR' in the denominator with 'Required SRI'.
- o Credit calculations must include all existing and new off-street parking spaces owned or leased by the project.

**Further Explanation**

Referenced Standards

- ANSI/CRRC S100, Standard Test Methods for Determining Radiative Properties of Material
- ASTM E1980 Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces
- Cool Roof Ratings Council, Rated Products Directory: https://coolroofs.org/directory

Definitions

- common road for the purposes of this credit, a common road is defined as a narrow or small road or alleyway between buildings, which may or may not be drivable.
- solar reflectance (SR) The ratio of the reflected solar flux to the incident solar flux.
- solar reflectance, initial (initial SR) a solar reflectance that is measured prior to aging.
- solar reflectance, aged (aged SR) a solar reflectance that is measured after laboratory or natural aging.
- solar reflectance index (SRI) a measure of the constructed surface’s ability to stay cool in the sun by reflecting solar radiation and emitting thermal radiation. A standard black surface has an initial SRI of 0, and a standard white surface has an initial SRI of 100.
- thermal emittance (TE) the ratio of the radiant heat flux emitted by a specimen to that emitted by a blackbody radiator at the same temperature.
- thermal emittance, initial (initial TE) a thermal emittance that is measured prior to aging.
- thermal emittance, aged (aged TE) a thermal emittance that is measured after laboratory or natural aging.

Connection to Ongoing Performance:

- LEED O+M SS Credit Rainwater Management: Reducing a site’s hardscape area and/or using open-grid paving will improve infiltration rates and may help projects earn the related performance-based credit. Vegetated roofs can also contribute to rainwater management.

# SS Credit: Light Pollution Reduction

This credit applies to

- BD+C: New Construction (1point)
- BD+C: Core and Shell (1 point)
- BD+C: Schools (1 point)
- BD+C: Retail (1 point)
- BD+C: Data Centers (1 point)
- BD+C: Warehouses and Distribution Centers (1 point)
- BD+C: Hospitality (1 point)
- BD+C: Healthcare (1 point)

## INTENT

To increase night sky access, improve nighttime visibility, and reduce the consequences of development for wildlife and people.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Meet uplight and light trespass requirements, using either the backlight-uplight-glare (BUG) method (Option 1) or the calculation method (Option 2). Projects may use different options for uplight and light trespass.

Meet these requirements for all exterior luminaires located inside the project boundary (except those listed under "Exemptions"), based on the following:

- the photometric characteristics of each luminaire when mounted in the same orientation and tilt as specified in the project design; and
- the lighting zone of the project property (at the time construction begins). Classify the project under one lighting zone using the lighting zones definitions provided in the Illuminating Engineering Society and International Dark Sky Association (IES/IDA) Model Lighting Ordinance (MLO) User Guide.

Additionally, meet the internally illuminated signage requirement.

Uplight

Option 1. BUG Rating Method

Do not exceed the following luminaire uplight ratings, based on the specific light source installed in the luminaire, as defined in IES TM-15-11, Addendum A.

**Table 1. Maximum uplight ratings for luminaires**

| MLO lighting zone | Luminaire uplight rating |
|---|---|
| LZ0 | U0 |
| LZ1 | U1 |
| LZ2 | U2 |
| LZ3 | U3 |
| LZ4 | U4 |

OR

Option 2. Calculation Method

Do not exceed the following percentages of total lumens emitted above horizontal.

Table 2. Maximum percentage of total lumens emitted above horizontal, by lighting zone

| MLO lighting zone | Maximum allowed percentage of total luminaire lumens emitted above horizontal |
|---|---|
| LZ0 | 0% |
| LZ1 | 0% |
| LZ2 | 1.5% |
| LZ3 | 3% |
| LZ4 | 6% |

AND

Light Trespass

Option 1. BUG Rating Method

Do not exceed the following luminaire backlight and glare ratings (based on the specific light source installed in the luminaire), as defined in IES TM-15-11, Addendum A, based on the mounting location and distance from the lighting boundary.

Table 3. Maximum backlight and glare ratings

| | MLO lighting zone | | | | |
|---|---|---|---|---|---|
| Luminaire mounting | LZ0 | LZ1 | LZ2 | LZ3 | LZ4 |
| | Allowed backlight ratings | | | | |
| > 2 mounting heights from lighting boundary | B1 | B3 | B4 | B5 | B5 |
| 1 to 2 mounting heights from lighting boundary and properly oriented | B1 | B2 | B3 | B4 | B4 |
| 0.5 to 1 mounting height to lighting boundary and properly oriented | B0 | B1 | B2 | B3 | B3 |
| < 0.5 mounting height to lighting boundary and properly oriented | B0 | B0 | B0 | B1 | B2 |
| | Allowed glare ratings | | | | |
| Building-mounted > 2 mounting heights from any lighting boundary | G0 | G1 | G2 | G3 | G4 |
| Building-mounted 1–2 mounting heights from any lighting boundary | G0 | G0 | G1 | G1 | G2 |
| Building-mounted 0.5 to 1 mounting heights from any lighting boundary | G0 | G0 | G0 | G1 | G1 |

| | | | | | |
|---|---|---|---|---|---|
| Building-mounted < 0.5 mounting heights from any lighting boundary | G0 | G0 | G0 | G0 | G1 |
| All other luminaires | G0 | G1 | G2 | G3 | G4 |

The lighting boundary is located at the property lines of the property, or properties, that the LEED project occupies. The lighting boundary can be modified under the following conditions:

- When the property line abuts a public area that includes, but is not limited to, a walkway, bikeway, plaza, or parking lot, the lighting boundary may be moved to 5 feet (1.5 meters) beyond the property line.
- When the property line abuts a public street, alley, or transit corridor, the lighting boundary may be moved to the center line of that street, alley, or corridor.
- When there are additional properties owned by the same entity that are contiguous to the property, or properties, that the LEED project is within and have the same or higher MLO lighting zone designation as the LEED project, the lighting boundary may be expanded to include those properties.

Orient all luminaires less than two mounting heights from the lighting boundary such that the backlight points toward the nearest lighting boundary line. Building-mounted luminaires with the backlight oriented toward the building are exempt from the backlight rating requirement.

OR

### Option 2. Calculation Method

Do not exceed the following vertical illuminances at the lighting boundary (use the definition of lighting boundary in Option 1). Calculation points may be no more than 5 feet (1.5 meters) apart. Vertical illuminances must be calculated on vertical planes running parallel to the lighting boundary, with the normal to each plane oriented toward the property and perpendicular to the lighting boundary, extending from grade level to 33 feet (10 meters) above the height of the highest luminaire.

Table 4. Maximum vertical illuminance at lighting boundary, by lighting zone

| MLO lighting zone | Vertical illuminance |
|---|---|
| LZ0 | 0.05 fc (0.5 lux) |
| LZ1 | 0.05 fc (0.5 lux) |
| LZ2 | 0.10 fc (1 lux) |
| LZ3 | 0.20 fc (2 lux) |
| LZ4 | 0.60 fc (6 lux) |

FC = footcandle.

AND

### Internally Illuminated Exterior Signage

Do not exceed a luminance of 200 cd/m² (nits) during nighttime hours and 2000 cd/m² (nits) during daytime hours.

### Exemptions from Uplight and Light Trespass Requirements

The following exterior lighting is exempt from the requirements, provided it is controlled separately from the nonexempt lighting:

- specialized signal, directional, and marker lighting for transportation;
- lighting that is used solely for façade and landscape lighting in MLO lighting zones 3 and 4, and is automatically turned off from midnight until 6 a.m.;
- lighting for theatrical purposes for stage, film, and video performances;
- government-mandated roadway lighting;

- hospital emergency departments, including associated helipads;
- lighting for the national flag in MLO lighting zones 2, 3, or 4; and
- internally illuminated signage.

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following addition:

### Step-by-Step Guidance

Refer to the LEED v4 reference guide, with the following modification:

- Existing Fixtures
    - Calculations must include existing fixtures. If fixture type or manufacturer cannot be identified, the project team should analyze a new, similar fixture with the same bulb type, wattage, lumen output, and physical design that can be expected to have similar photometric properties.

### Further Explanation

Connection to Ongoing Performance:

- LEED O+M EA credit Energy Performance: A proper lighting design both minimizes light pollution and maximizes energy efficiency, which could improve a project's overall energy performance.

# SS Credit: Site Master Plan

This credit applies to

- BD+C: Schools (1-4 points)

## INTENT

To ensure that the sustainable site benefits achieved by the project continue, regardless of future changes in programs or demographics.

## REQUIREMENTS

SCHOOLS

The project must achieve at least four of the following six credits, using the associated calculation methods. The achieved credits must then be recalculated using the data from the master plan.

- LT Credit: High Priority Site
- SS Credit: Site Development—Protect or Restore Habitat
- SS Credit: Open Space
- SS Credit: Rainwater Management
- SS Credit: Heat Island Reduction
- SS Credit: Light Pollution Reduction

A *site master plan* for the school must be developed in collaboration with school authorities. Previous sustainable site design measures should be considered in all master-planning efforts so that existing infrastructure is retained whenever possible. The master plan must therefore include current construction activity plus future construction (within the building's lifespan) that affects the site. The master plan development footprint must also include parking, paving, and utilities.

Projects where no future development is planned are not eligible for this credit.

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following addition:

**Further Explanation**

Connection to Ongoing Performance:

- LEED O+M SS credit Site Management: Considering how infrastructure included in the scope of the project can be maintained or enhanced will help with establishing best practice maintenance procedures. Upholding sustainable site design measures informed by the site master plan can potentially reduce the need for power maintenance equipment, facilitating achievement of the related performance-based credit.

# SS Credit: Tenant Design and Construction Guidelines

This credit applies to

- BD+C: Core and Shell (1-4 points)

## INTENT

To educate tenants in implementing sustainable design and construction features in their tenant improvement build-outs.

## REQUIREMENTS

CS

Publish for tenants an illustrated document with the following content, as applicable:

- a description of the sustainable design and construction features incorporated in the core and shell project and the project's sustainability goals and objectives, including those for tenant spaces;
- recommendations, including examples, for sustainable strategies, products, materials, and services; and
- information that enables a tenant to coordinate space design and construction with the building systems when pursuing the following LEED v4.1 for Interior Design and Construction prerequisites and credits:
  - WE Prerequisite: Indoor Water Use Reduction
  - WE Credit: Indoor Water Use Reduction
  - EA Prerequisite: Minimum Energy Performance
  - EA Prerequisite: Fundamental Refrigerant Management
  - EA Credit: Optimize Energy Performance
  - EA Credits: Advanced Energy Metering
  - EA Credit: Renewable Energy
  - EA Credit: Enhanced Refrigerant Management
  - MR Prerequisite: Storage and Collection of Recyclables
  - EQ Prerequisite: Minimum Indoor Air Quality Performance
  - EQ Prerequisite: Environmental Tobacco Smoke Control
  - EQ Credit: Enhanced Indoor Air Quality Strategies
  - EQ Credit: Low-Emitting Materials
  - EQ Credit: Construction Indoor Air Quality Management Plan
  - EQ Credit: Indoor Air Quality Assessment
  - EQ Credit: Thermal Comfort
  - EQ Credit: Interior Lighting
  - EQ Credit: Daylight
  - EQ Credit: Quality Views
  - EQ Credit: Acoustic Performance

Provide the guidelines to all tenants before signing the lease.

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following addition:

**Further Explanation**

Connection to Ongoing Performance

- LEED O+M EA credit Energy Performance and WE credit Water Performance: Core and shell projects that require tenants to demonstrate a specified percentage reduction in energy and water use can include the assumed tenant reduction in the core and shell energy and water models. Such requirements must be incorporated into the tenant lease and can be accurately measured by installing whole building energy and water meters. It is a simple yet critical strategy for understanding total energy and water use of tenants throughout the building life cycle. Tracking energy use and water consumption on a regular basis supports effective building management and provides data to help verify that building systems are operating as designed.

# SS Credit: Places of Respite

This credit applies to

- BD+C: Healthcare (1-4 points)

## INTENT

To provide patients, all staff, and visitors with the health benefits of the natural environment by creating outdoor places of respite on the healthcare campus.

## REQUIREMENTS

HEALTHCARE

Provide places of respite that are accessible to patients and visitors, equal to 5% of the *net usable program area* of the building.

Provide additional dedicated places of respite for staff, equal to 2% of the net usable program area of the building.

Places of respite must be outdoors, or be located in interior atria, greenhouses, solaria, or conditioned spaces; such interior spaces may be used to meet up to 30% of the required area if 90% of each qualifying space's gross floor area achieves a direct line of sight to unobstructed views of nature.

All areas must meet the following requirements.

- The area is accessible from within the building or located within 200 feet (60 meters) of a building entrance or access point.
- The area is located where no medical intervention or direct medical care is delivered.
- Options for shade or indirect sun are provided, with at least one seating space per 200 square feet (18.5 square meters) of each respite area, with one wheelchair space per five seating spaces.
- Horticulture therapy and other specific clinical or special-use gardens unavailable to all building occupants may account for no more than 50% of the required area.
- Universal-access natural trails that are available to visitors, staff, or patients may account for no more than 30% of the required area, provided the trailhead is within 200 feet (60 meters) of a building entrance.

Additionally, outdoor areas must meet the following requirements.

- A minimum of 25% of the total outdoor area must be planted with two or more adapted or native vegetation types, or have *overhead vegetated canopy*. Monocultures, such as conventional grass lawns or turfgrass, do not count towards this requirement.
- The area is open to fresh air, the sky, and the natural elements.
- Signage must meet the 2010 FGI Guidelines for Design and Construction of Health Care Facilities (Section 1.2-6.3 and Appendix A1.2-6.3:Wayfinding).
- Places of respite may not be within 25 feet (7.6 meters) of a smoking area (see EQ Prerequisite Environmental Tobacco Smoke Control).

Existing places of respite on the hospital campus may qualify if they otherwise meet the credit requirements.

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following addition:

**Further Explanation**

Definitions

- **monoculture** the cultivation of a single plant species in a given area.

### Connection to Ongoing Performance

- LEED O+M SS Credit Rainwater Management: Rain gardens and other rainwater management features may also serve as outdoor places of respite.

# SS Credit: Direct Exterior Access

This credit applies to

- BD+C: Healthcare (1-4 points)

## INTENT

To provide patients, all staff, and visitors with the health benefits of  the natural environment by creating outdoor places of respite on the healthcare campus.

## REQUIREMENTS

HEALTHCARE

Provide direct access to an exterior courtyard, terrace, garden, or balcony. The space must be at least 5 square feet (0.5 square meters) per patient for 75% of all inpatients and 75% of qualifying outpatients whose clinical length of stay (LOS) exceeds four hours.

Patients whose length of stay exceeds four hours, and whose treatment makes them unable to move, such as emergency, stage 1 surgical recovery, and critical care patients, may be excluded.

Places of respite outside the building envelope that meet the requirements of SS Credit Places of Respite that are immediately adjacent to clinical areas or with direct access from inpatient units may be included.

Qualifying spaces must be designated as nonsmoking . The spaces must also  be located more than 100 feet (30 meters) from building exhaust air locations, loading docks, and roadways with idling vehicles.

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following addition:

**Further Explanation**

Connection to Ongoing Performance

- LEED O+M SS Credit Rainwater Management: Rain gardens and other rainwater management features may also serve as outdoor spaces that meet the requirements of this credit.

# SS Credit: Joint Use of Facilities

This credit applies to

- BD+C: Schools (1-4 points)

## INTENT

To integrate the school with the community by sharing the building and its playing fields for nonschool events and functions.

## REQUIREMENTS

SCHOOLS

**Option 1. Make Building Space Open to the General Public (1 point)**
In collaboration with the school authorities, ensure that at least three of the following types of spaces in the school are accessible to and available for shared use by the general public:

- auditorium;
- gymnasium;
- cafeteria;
- one or more classrooms;
- playing fields and stadiums; and
- joint parking.

Provide access to toilets in joint-use areas after normal school hours.

OR

**Option 2. Contract with Specific Organizations to Share Building Space (1 point)**
In collaboration with the school authorities, contract with community or other organizations to provide at least two types of dedicated-use spaces in the building, such as the following:

- commercial office;
- health clinic;
- community service centers (provided by state or local offices);
- police office;
- library or media center;
- parking lot; and
- one or more commercial businesses.

Provide access to toilets in joint-use areas after normal school hours.

OR

**Option 3. Use Shared Space Owned by Other Organizations (1 point)**
In collaboration with the school authorities, ensure that at least two of the following six types of spaces that are owned by other organizations or agencies are accessible to students:

- auditorium;
- gymnasium;
- cafeteria;
- one or more classrooms;
- swimming pool; and
- playing fields and stadiums.

Provide direct pedestrian access to these spaces from the school. In addition, provide signed joint-use agreements with the other organizations or agencies that stipulate how these spaces will be shared.

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following addition:

**Further Explanation**

Connection to Ongoing Performance:

- LEED O+M LT credit Alternative Transportation: Shared school parking lots or parking lots on neighboring sites used for school functions may reduce the number of new parking spaces, which may help improve a project's transportation performance score

# WE Prerequisite: Outdoor Water Use Reduction

This prerequisite applies to

- BD+C: New Construction
- BD+C: Core & Shell
- BD+C: Schools
- BD+C: Retail
- BD+C: Data Centers
- BD+C: Warehouses & Distribution Centers
- BD+C: Hospitality
- BD+C: Healthcare

## INTENT

To reduce outdoor potable water consumption and preserve no and low-cost potable water resources.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Reduce outdoor water use through one of the following options. Nonvegetated surfaces, such as permeable or impermeable pavement, should be excluded from the landscape area calculations. Athletic fields and playgrounds (if vegetated) and food gardens may be included or excluded at the project team's discretion.

Option 1. No Irrigation Required

Show that the landscape does not require a permanent irrigation system beyond a maximum two-year establishment period.

OR

Option 2. Reduced Irrigation

Reduce the project's landscape water requirement by at least 30% from the calculated baseline for the site's peak watering month. Reductions must be achieved through plant species selection and irrigation system efficiency, as calculated by the Environmental Protection Agency (EPA) WaterSense Water Budget Tool.

## GUIDANCE

There are no substantive changes to the prerequisite requirements; refer to the LEED v4 reference guide, with the following addition:

**Further Explanation**

Connection to Ongoing Performance

- LEED O+M WE credit Water Performance: Designing out the need for a permanent irrigation system, selecting native or adapted plants for project landscaping and/or installing efficient irrigation systems reduces irrigation water use throughout the building life cycle, which may help improve a project's water performance score.

# WE Prerequisite: Indoor Water Use Reduction

This prerequisite applies to

- BD+C: New Construction
- BD+C: Core & Shell
- BD+C: Schools
- BD+C: Retail
- BD+C: Data Centers
- BD+C: Warehouses & Distribution Centers
- BD+C: Hospitality
- BD+C: Healthcare

## INTENT

To reduce indoor potable water consumption and preserve no and low cost potable water resources.

## REQUIREMENTS

NC, CS, SCHOOLS, NC-RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, NC-HOSPITALITY, HEALTHCARE

### Building Water Use

For the fixtures and fittings listed in Table 1, as applicable to the project scope, reduce aggregate water consumption by 20% from the baseline. Base calculations on the volumes and flow rates shown in Table 1.

All newly installed toilets, urinals, private lavatory faucets, and showerheads that are eligible for labeling must be WaterSense labeled (or a local equivalent for projects outside the U.S.).

**Table 1. Baseline water consumption of fixtures and fittings**

| *Fixture or fitting* | *Baseline (IP units)* | *Baseline (SI units)* |
|---|---|---|
| Toilet (water closet)* | 1.6 gpf | 6 lpf |
| Urinal* | 1.0 gpf | 3.8 lpf |
| Public lavatory (restroom) faucet | 0.5 gpm at 60 psi** all others except private applications | 1.9 lpm at 415 kPa, all others except private applications |
| Private lavatory faucets | 2.2 gpm at 60 psi | 8.3 lpm at 415 kPa |
| Kitchen faucet (excluding faucets used exclusively for filling operations) | 2.2 gpm at 60 psi | 8.3 lpm at 415 kPa |
| Showerhead* | 2.5 gpm at 80 psi per shower stall | 9.5 lpm at 550 kPa per shower stall |

* WaterSense label available for this product type
gpf = gallons per flush
gpm = gallons per minute
psi = pounds per square inch

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

Projects located where standard supply pressure is different than the LEED baseline supply pressure may calculate the water consumption of flow fixtures and fittings at the local standard supply pressure.

## Appliance and Process Water Use

Install appliances, equipment, and processes within the project scope that meet the requirements listed in the tables below.

Existing appliances intended for reuse in the project are not required to meet the requirements in Table 2.

Table 2. Standards for appliances

| *Appliance* | *Requirement* |
|---|---|
| Residential clothes washers | ENERGY STAR or performance equivalent* |
| Commercial clothes washers | ENERGY STAR or performance equivalent |
| Residential dishwashers (standard and compact) | ENERGY STAR or performance equivalent* |
| Prerinse spray valves | ≤ 1.3 gpm (4.9 lpm) |
| Ice machine | ENERGY STAR or performance equivalent and use either air-cooled or closed-loop cooling, such as chilled or condenser water system |

gpm = gallons per minute

lpm = liters per minute

*Projects in Europe may install residential appliances meeting the EU A label.

Table 3. Standards for processes

| *Process* | *Requirement* |
|---|---|
| Heat rejection and cooling | No once-through cooling with potable water for any equipment or appliances that reject heat |
| Cooling towers and evaporative condensers | Equip with<br>• makeup water meters<br>• conductivity controllers and overflow alarms<br>• efficient drift eliminators that reduce drift to maximum of 0.002% of recirculated water volume for counterflow towers and 0.005% of recirculated water flow for cross-flow towers |

<u>Healthcare, Retail, Schools, and Hospitality Only</u>

In addition, water-consuming appliances, equipment, and processes must meet the requirements listed in Tables 4 and 5.

Table 4. Standards for appliances

| *Kitchen equipment* | *Requirement (IP units)* | *Requirement (SI units)* |
|---|---|---|

| | | | |
|---|---|---|---|
| Dishwasher | Undercounter | ≤ 1.6 gal/rack | ≤ 6.0 liters/rack |
| | Stationary, single tank, door | ≤ 1.4 gal/rack | ≤ 5.3 liters/rack |
| | Single tank, conveyor | ≤ 1.0 gal/rack | ≤ 3.8 liters/rack |
| | Multiple tank, conveyor | ≤ 0.9 gal/rack | ≤ 3.4 liters/rack |
| | Flight machine | ≤ 180 gal/hour | ≤ 680 liters/hour |
| Food steamer | Batch | ≤ 6 gal/hour/pan | ≤ 23 liters/hour/pan |
| | Cook-to-order | ≤ 10 gal/hour/pan | ≤ 38 liters/hour/pan |
| Combination oven, | Countertop or stand | ≤ 3.5 gal/hour/pan | ≤ 13 liters/hour/pan |
| | Roll-in | ≤ 3.5 gal/hour/pan | ≤ 13 liters/hour/pan |

Table 5. Process requirements

| | |
|---|---|
| Discharge water temperature tempering | Where local requirements limit discharge temperature of fluids into drainage system, use tempering device that runs water only when equipment discharges hot water<br>OR<br>Provide thermal recovery heat exchanger that cools drained discharge water below code-required maximum discharge temperatures while simultaneously preheating inlet makeup water<br>OR<br>If fluid is steam condensate, return it to boiler |
| Venturi-type flow-through vacuum generators or aspirators | Use no device that generates vacuum by means of water flow through device into drain |

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

WE prerequisite Indoor Water Use Reduction incorporates feedback from and market barriers identified by LEED project teams. The intent of these changes is to make prerequisite compliance more achievable and relevant to international project teams by recognizing regional variations while maintaining the stringency of requirements for water performance.

**Further Explanation**

Refer to the LEED v4 reference guide, with the following additions:

### Occupant Types

If the project includes separate gender neutral and/or ADA restrooms without urinals, assume that 5% of male occupants and 5% of female occupants use these restrooms. Enter 95% into the percent of males expected to use restrooms with urinals in the Indoor Water Use Reduction Calculator. Alternately, estimate this percentage based on the project's restroom layout and anticipated usage patterns or weighted fixture counts.

### International Tips

Refer to the LEED v4 reference guide, with the following modifications:

- International projects located where standard water supply pressure is different than the LEED baseline supply pressure values may calculate the water consumption of flow fixtures and fittings at the local standard water supply pressure. Product cutsheets must demonstrate that the fixture or fitting complies with the LEED baseline flow rate.
    - Projects that are unable to provide manufacturer documentation of the fixture flow rate at the LEED baseline water supply pressure may use the local standard supply water pressure in the design case and the standard LEED baseline flow rates in the baseline case.
    - Projects served by water supply pressures different than specified in LEED may install pressure compensating aerators in flow fixtures to achieve the desired flow rate without compromising user satisfaction.
- Where local building code conflicts with LEED prescriptive requirements, project teams may select fixtures that comply with local code and compensate by selecting more water-efficient fixtures for other fixture types, provided that the flow rate for the fixture is the lowest allowable by code, and the project meets in aggregate the required 20% reduction from LEED baseline. Provide an excerpt of the local code highlighting the flow rate requirements when submitting for review.
- The EU A label for residential appliances is an acceptable alternative to ENERGY STAR. The EU Ecodesign and Labelling framework establishes minimum performance standards for the energy and environmental performance of appliances and products.
- The CEE Commercial Clothes Washer Specification is no longer active. Commercial clothes washers require the ENERGY STAR label or performance equivalent.
    - Performance equivalent refers to both the energy and water criteria in the ENERGY STAR product specifications, available on the ENERGY STAR website.
    - Products must meet the standards of the current version of ENERGY STAR as of the date of their purchase.

### Referenced Standards

Refer to the LEED v4 reference guide, with the following modification:

Delete “Consortium for Energy Efficiency” from the list of referenced standards.

### Connection to Ongoing Performance

- LEED O+M WE credit Water Performance: Selecting efficient fixtures, fittings and appliances in the design phase helps ensure that projects will use less water throughout the building life cycle, which may help improve a project’s water performance score.

# WE Prerequisite: Building-Level Water Metering

This prerequisite applies to

- BD+C: New Construction
- BD+C: Core & Shell
- BD+C: Schools
- BD+C: Retail
- BD+C: Data Centers
- BD+C: Warehouses & Distribution Centers
- BD+C: Hospitality
- BD+C: Healthcare

## INTENT

To conserve low cost potable water resources and support water management and identify opportunities for additional water savings by tracking water consumption.

## REQUIREMENTS

NC, CS, Schools, Retail, Data Centers, Warehouses & Distribution Centers, Hospitality, Healthcare

Install permanent water meters that measure the total potable water use for the building and associated grounds. Meter data must be compiled into monthly and annual summaries; meter readings can be manual or automated.

Commit to sharing with USGBC the resulting whole-project water usage data for a five-year period beginning on the date the project accepts LEED certification or typical occupancy, whichever comes first.

This commitment must carry forward for five years or until the building changes ownership or lessee.

## GUIDANCE

There are no substantive changes to the prerequisite requirements; refer to the LEED v4 reference guide, with the following additions and modifications:

**Further Explanation**

Connection to Ongoing Performance

- LEED O+M WE credit Water Performance: Installing whole building water meters is a simple yet critical strategy for understanding total water use throughout the building life cycle. Tracking water consumption on a regular basis supports effective water management and provides performance data to help verify that building systems are operating as designed. Projects can submit data via the Arc platform to comply with the prerequisite requirement to share whole-project water usage data with USGBC and get started on the path to recertification.

# WE Credit: Outdoor Water Use Reduction

This credit applies to

- BD+C: New Construction (1-2 points)
- BD+C: Core & Shell (1-3 points)
- BD+C: Schools (1-2 points)
- BD+C: Retail (1-2 points)
- BD+C: Data Centers (1-2 points)
- BD+C: Warehouses & Distribution Centers (1-2 points)
- BD+C: Hospitality (1-2 points)
- BD+C: Healthcare (1 point)

## INTENT

To reduce outdoor potable water consumption and preserve no and low-cost potable water resources.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Reduce outdoor water use through one of the following options. Nonvegetated surfaces, such as permeable or impermeable pavement, should be excluded from landscape area calculations. Athletic fields and playgrounds (if vegetated) and food gardens may be included or excluded at the project team's discretion.

**Option 1. No Irrigation Required (2 points except Healthcare and CS, 1 point Healthcare, 3 points CS)**

Show that the landscape does not require a permanent irrigation system beyond a maximum two-year establishment period.

OR

**Option 2. Reduced Irrigation (1-2 points except Healthcare and CS, 1 point Healthcare, 3 points CS)**

Reduce the project's landscape water requirement (LWR) by at least 50% from the calculated baseline for the site's peak watering month. Reductions must first be achieved through plant species selection and irrigation system efficiency as calculated in the Environmental Protection Agency (EPA) WaterSense Water Budget Tool.

Additional reductions beyond 30% may be achieved using any combination of efficiency, alternative water sources, and smart scheduling technologies.

**Table 1. Points for reducing irrigation water**

| *Percentage reduction from baseline* | *Points (except Healthcare)* | *Points (Healthcare)* | *Points (CS)* |
|---|---|---|---|
| 50% | 1 | 1 | 1 |
| 75% | -- | -- | 2 |
| 100% | 2 | — | 3 |

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

Core and Shell projects can now earn up to 3 points under WE credit Outdoor Water Use Reduction. One point was re-allocated from WE credit Indoor Water Use Reduction to this credit, to better align WE points available with the typical scope of work of Core and Shell projects and to reward incremental outdoor water use savings.

**Further Explanation**

Connection to Ongoing Performance

- LEED O+M WE credit Water Performance: Designing out the need for a permanent irrigation system, selecting native or adapted plants for project landscaping and/or installing efficient irrigation systems reduces irrigation water use throughout the building life cycle, which may improve a project's water performance score. The use of alternative water systems for irrigation further reduces building potable water use.

# WE Credit: Indoor Water Use Reduction

This credit applies to

- BD+C: New Construction (1-6 points)
- BD+C: Core & Shell (1-4 points)
- BD+C: Schools (1-7 points)
- BD+C: Retail (1-7 points)
- BD+C: Data Centers (1-6 points)
- BD+C: Warehouses & Distribution Centers (1-6 points)
- BD+C: Hospitality (1-6 points)
- BD+C: Healthcare (1-7 points)

## INTENT

To reduce indoor potable water consumption and preserve no and low-cost potable water resources.

## REQUIREMENTS

NC, CS, SCHOOLS, NC-RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, NC-HOSPITALITY, HEALTHCARE

Further reduce fixture and fitting water use from the calculated baseline in WE Prerequisite Indoor Water Use Reduction. Additional potable water savings can be earned above the prerequisite level using alternative water sources. Include fixtures and fittings necessary to meet the needs of the occupants. Some of these fittings and fixtures may be outside the tenant space (for Commercial Interiors) or project boundary (for New Construction). Points are awarded according to Table 1.

**Table 1. Points for reducing water use**

| Percentage Reduction | Points (BD+C) | Points (CS) | Points (Schools, Retail, Hospitality, Healthcare) |
|---|---|---|---|
| 25% | 1 | 1 | 1 |
| 30% | 2 | 2 | 2 |
| 35% | 3 | 3 | 3 |
| 40% | 4 | 4 | 4 |
| 45% | 5 | -- | 5 |
| 50% | 6 | -- | -- |

Schools, Retail, Hospitality, and Healthcare only

Meet the percentage reduction requirements above.

AND

**Appliance and Process Water.** Install equipment within the project scope that meets the minimum requirements in Table 2, 3, 4, or 5. One point is awarded for meeting all applicable requirements in any one table. All applicable equipment listed in each table must meet the standard.

Schools, Retail, and Healthcare projects can earn a second point for meeting the requirements of two tables.

Table 2. Compliant commercial washing machines

To use Table 2, the project must process at least 120,000 lbs. (57 606 kg) of laundry per year.

| *Washing machine* | *Requirement (IP units)* | *Requirement (SI units)* |
|---|---|---|
| On-premise, minimum capacity 2,400 lbs. (1 088 kg) per 8-hour shift | Maximum 1.8 gals per pound * | Maximum 7 liters per 0.45 kilograms * |

* Based on equal quantities of heavy, medium, and light soil laundry.

Table 3. Standards for commercial kitchen equipment

To use Table 3, the project must serve at least 100 meals per day of operation. All process and appliance equipment listed in the category of kitchen equipment and present on the project must comply with the standards.

| *Kitchen equipment* | | *Requirement (IP units)* | *Requirement (SI units)* |
|---|---|---|---|
| Dishwasher | Undercounter | ENERGY STAR | ENERGY STAR or performance equivalent |
| | Stationary, single tank, door | ENERGY STAR | ENERGY STAR or performance equivalent |
| | Single tank, conveyor | ENERGY STAR | ENERGY STAR or performance equivalent |
| | Multiple tank, conveyor | ENERGY STAR | ENERGY STAR or performance equivalent |
| | Flight machine | ENERGY STAR | ENERGY STAR or performance equivalent |
| Food steamer | Batch (no drain connection) | ≤ 2 gal/hour/pan including condensate cooling water | ≤ 7.5 liters/hour/pan including condensate cooling water |
| | Cook-to-order (with drain connection) | ≤ 5 gal/hour/pan including condensate cooling water | ≤ 19 liters/hour/pan including condensate cooling water |
| Combination oven, | Countertop or stand | ≤ 1.5 gal/hour/pan including condensate cooling water | ≤ 5.7 liters/hour/pan including condensate cooling water |
| | Roll-in | ≤ 1.5 gal/hour/pan including condensate cooling water | ≤ 5.7 liters/hour/pan including condensate cooling water |
| Food waste disposer | Disposer | 3-8 gpm, full load condition, 10 minute automatic shutoff; or 1 gpm, no-load condition | 11–30 lpm, full load condition, 10-min automatic shutoff; or 3.8 lpm, no-load condition |
| | Scrap collector | Maximum 2 gpm makeup water | Maximum 7.6 lpm makeup water |
| | Pulper | Maximum 2 gpm makeup water | Maximum 7.6 lpm makeup water |

| | | | |
|---|---|---|---|
| | Strainer basket | No additional water usage | No additional water usage |

gpm = gallons per minute
gph = gallons per hour
lpm = liters per minute
lph = liters per hour

Table 4. Compliant laboratory and medical equipment

To use Table 4, the project must be a medical or laboratory facility.

| *Lab equipment* | *Requirement (IP units)* | *Requirement (SI units)* |
|---|---|---|
| Reverse-osmosis water purifier | 75% recovery | 75% recovery |
| Steam sterilizer | For 60-inch sterilizer, 6.3 gal/U.S. tray<br>For 48-inch sterilizer, 7.5 gal/U.S. tray | For 1520-mm sterilizer, 28.5 liters/DIN tray<br>For 1220-mm sterilizer, 28.35 liters/DIN tray |
| Sterile process washer | 0.35 gal/U.S. tray | 1.3 liters/DIN tray |
| X-ray processor, 150 mm or more in any dimension | Film processor water recycling unit | |
| Digital imager, all sizes | No water use | |

Table 5. Compliant municipal steam systems

To use Table 5, the project must be connected to a municipal or district steam system that does not allow the return of steam condensate.

| *Steam system* | *Standard* |
|---|---|
| Steam condensate disposal | Cool municipally supplied steam condensate (no return) to drainage system with heat recovery system or reclaimed water |
| OR | |
| Reclaim and use steam condensate | 100% recovery and reuse |

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

Core and Shell (CS) projects now earn up to 4 points under WE credit Indoor Water Use Reduction. CS projects can now earn one additional point under WE credit Outdoor Water Use Reduction and one additional point under WE credit Optimize Process Water Use; this re-allocation intends to better align WE points available with the typical scope of work of CS projects.

**Further Explanation**

Occupant Types

Refer to the LEED v4 reference guide, with the following addition for projects pursuing a usage-based calculation:

If the project includes separate gender neutral and/or ADA restrooms without urinals, assume that 5% of male occupants and 5% of female occupants use these restrooms. Enter 95% into the percent of males expected to use restrooms with urinals in the Indoor Water Use Reduction Calculator. Alternately, estimate this percentage based on the project's restroom layout and anticipated usage patterns or weighted fixture counts.

Campus or Municipal Alternative Water Sources

Projects may count future infrastructure for reclaimed water systems in Water Efficiency credit calculations if:

- the future systems will be functional within 2 years of project occupancy,
- the project provides documentation, such as a signed contract, confirming that the reclaimed water will be provided to the project within a 2-year period from project occupancy, and
- the project provides confirmation that the reclaimed water supplier has agreed to supply the volume of treated wastewater or seawater claimed by the project.

International Tips

- The EU A label for residential appliances is an acceptable alternative to ENERGY STAR. The EU Ecodesign and Labelling framework establishes minimum performance standards for the energy and environmental performance of appliances and products.

Referenced Standards

Refer to the LEED v4 reference guide, with the following modification:

Delete “Consortium for Energy Efficiency” from the list of referenced standards.

Exemplary Performance

Achieve 55% savings.

Connection to Ongoing Performance

- LEED O+M WE credit Water Performance: Selecting efficient fixtures, fittings and appliances in the design phase helps ensure that projects will use less water throughout the building life cycle, which may help improve a project’s water performance score. The use of alternative water sources for appropriate end uses can further reduce demand for potable water and strain on the local utility.

# WE Credit: Optimize Process Water Use

This credit applies to

- BD+C: New Construction (1-2 points)
- BD+C: Core & Shell (1-3 points)
- BD+C: Schools (1-2 points)
- BD+C: Retail (1-2 points)
- BD+C: Data Centers (1-2 points)
- BD+C: Warehouses & Distribution Centers (1-2 points)
- BD+C: Hospitality (1-2 points)
- BD+C: Healthcare (1-2 points)

## INTENT

To conserve low cost potable water resources used for mechanical processes while controlling, corrosion and scale in the condenser water system.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE,

Option 1. Cooling Tower and Evaporative Condenser Cycles of Concentration (1-2 points except CS, 1-3 points CS)

For cooling towers and evaporative condensers, conduct a one-time potable water analysis, measuring at least the five control parameters listed in Table 1.

Table 1. Maximum concentrations for parameters in condenser water

| *Parameter* | *Maximum level* |
|---|---|
| Ca (as $CaCO_3$) | 600 ppm |
| Total alkalinity | 500 ppm |
| $SiO_2$ | 150 ppm |
| $Cl^-$ | 300 ppm |
| Conductivity | 3300 µS/cm |

ppm = parts per million
µS/cm = micro siemens per centimeter

Calculate the maximum number of cooling tower cycles by dividing the maximum allowed concentration level of each parameter by the actual concentration level of each parameter found in the potable makeup water analysis. Limit cooling tower cycles to avoid exceeding maximum values for any of these parameters.

The materials of construction for the water system that come in contact with the cooling tower water shall be of the type that can operate and be maintained within the limits established in Table 1.

Table 2. Points for cooling tower cycles

| *Cooling tower cycles* | *Points (all except CS)* | *Points (CS)* |
|---|---|---|

| | | |
|---|---|---|
| Maximum number of cycles achieved without exceeding any maximum concentration levels or affecting operation of condenser water system | 1 | 1 |
| Meet the maximum calculated number of cycles to earn 1 point, and increase the number of cycles by a minimum of 25% by increasing the level of treatment and/or maintenance in condenser or make-up water systems<br><br>OR<br><br>Meet the maximum calculated number of cycles to earn 1 point and use a minimum 20% recycled nonpotable water | 2 | 2 |
| Meet the maximum calculated number of cycles to earn 1 point, and increase the number of cycles by a minimum of 30% by increasing the level of treatment and/or maintenance in condenser or make-up water systems<br><br>OR<br><br>Meet the maximum calculated number of cycles to earn 1 point and use a minimum 30% recycled nonpotable water | -- | 3 |

Minimum percentage recycled nonpotable water used in cooling tower makeup should be based on water use during the month with the highest demand for make-up water.

Projects may consider using water reclaimed from another process as a source of makeup water for evaporative cooling equipment as long as the resultant circulating water chemistry conforms to the parameters established in Table 1.

Projects whose cooling is provided by district cooling systems are eligible to achieve Option 1 if the district cooling system complies with the above requirements.

OR

Option 2. Optimize Water Use for Cooling (1-2 points except CS, 1-3 points CS)

To be eligible for Option 2, the baseline system designated for the building using ASHRAE 90.1-2016 Appendix G Table G3.1.1 must include a cooling tower (systems 7, 8, 11, 12, and 13)

Achieve increasing levels of cooling tower water efficiency beyond a water-cooled chiller system with axial variable-speed fan cooling towers having a maximum drift of 0.002% of recirculated water volume and three cooling tower cycles. Points are awarded according to Table 3.

Table 3. Points for reducing annual water use compared to Water-Cooled Chiller System

| Percentage Reduction | Points (BD+C) | Points (CS) |
|---|---|---|
| 25% | 1 | 1 |
| 50% | 2 | 2 |
| 100% | - | 3 |

Projects whose cooling is provided by district cooling systems are eligible to achieve Option 2 if the district cooling system complies with the above requirements.

AND/OR

Option 3. Process Water Use (1-2 points except CS, 1-3 points CS)

Demonstrate that the project is using minimum 20% recycled alternative water to meet process water demand for 1 point, or using minimum 30% recycled alternative water to meet process water demand for 2 points. Ensure that recycled alternative water is of sufficient quality for its intended end use.

Minimum percentage of recycled alternative water used should be based on water use during the month with the highest water demand.

Process water uses eligible for achievement of Option 3 must represent at least 10% of total building regulated water use and may not include water used for cooling. Eligible subsystems may include:

- Boilers
- Humidification systems
- Other subsystems using process water

Projects served by district systems are eligible to achieve Option 3 if the district system complies with minimum thresholds for recycled alternative water use.

Core and Shell projects:
Demonstrate that the project is using minimum 20% recycled alternative water to meet process water demand for 1 point, using minimum 30% recycled alternative water to meet process water demand for 2 points, or using minimum 40% recycled alternative water to meet process water demand for 3 points. Ensure that recycled alternative water is of sufficient quality for its intended end use.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

Evaporative cooling is the most energy efficient method to reject heat from a process (1 lb. of water removes almost 1,000 BTU's (970 BTU/lb.) with the added benefit of reducing greenhouse gas emissions. Cooling towers and evaporative condensers utilize evaporative cooling to operate with maximum energy efficiency; to preserve this energy savings, it is important to conserve the water these system use, especially in water stressed regions. In some climate zones, heat rejection system designs can help to decrease the water intensity of the building cooling process using a combination of wet, dry, or adiabatic cooling. In some cases, 100% dry operation is possible.

For wet cooling systems, this credit addresses water conservation strategies while still saving energy. This strategy includes maximizing cycles of concentration in cooling towers and evaporative condensers and make-up water reduction strategies including the use of reclaimed water and hybrid cooling.
The use of alternative recycled water to meet process water demands can further reduce building potable water use.

Updates to this credit recognize regional variations in the quality of local water supply and recognize additional strategies for reducing potable water use for diverse project types.

Core and Shell projects can now earn up to 3 points under WE credit Optimize Process Water Use. One point was re-allocated from WE credit Indoor Water Use Reduction to this credit, to better align WE points available with the typical scope of work of Core and Shell projects and to reward incremental process water savings.

**Step-by-Step Guidance**

Option 1. Cooling Tower and Evaporative Condenser Cycles of Concentration

Refer to the v4 BD+C reference guide with the following addition:

Step 6. Address construction materials for cooling system
Share the results of the potable water analysis with the cooling system manufacturer and ensure that the materials of construction for all components of the water-cooled system that come in contact with the cooling loop can operate and be maintained within the limits established in Table 1. The evaporative cooled system equipment must be designed to accommodate the targeted cycles of concentration calculated for the cooling tower or evaporative condenser.

Option 2. Optimize Water Use for Cooling
Option 2 is limited to projects that use water-cooled systems in the ASHRAE 90.1-2016 baseline design. ASHRAE 90.1 Appendix G identifies baseline system types that are standard practice for similar, newly constructed buildings.

Step 1. Determine baseline system for building cooling.
Confirm that at least one of the baseline system(s) designated for the building using ASHRAE 90.1-2016 Appendix G Table G3.1.1 includes a cooling tower or evaporative condenser (systems 7, 8, 11, 12, and 13).

If the above conditions are met and the project team eliminates the need for cooling towers or evaporative condensers in the proposed building design, then the project team may document a 100% reduction in water use for cooling.

Step 2. Develop building cooling systems design.
Consider viable on-site alternatives to 100% evaporative cooled water-cooled systems for the building and the impacts of the cooling systems design on building energy use. Hybrid water-cooled system options may be used to reduce water usage while saving energy.

Step 3. Document compliance.
If the project includes systems that use the latent heat of evaporative cooling, calculate annual water savings as compared to a 100% water-cooled chiller system, based on proposed cooling loads for spaces served by systems 7, 8, 11, 12, or 13 in the baseline. The system performance for the reference shall be calculated based on a 100% water-cooled chiller system with axial variable-speed fan cooling towers having a maximum drift of 0.002% of recirculated water volume and three cooling tower cycles.

Some energy simulation software has the capability of simulating cooling tower water usage within the software. To perform the calculations within the energy model, the proposed case model shall be modeled consistent with the project design to demonstrate the total water usage associated with evaporative cooling in the proposed design.

To determine the reference case performance, the proposed case model shall be updated with a water-cooled chilled water system serving all spaces served by systems 7, 8, 11, 12, or 13 in the ASHRAE 90.1 Baseline model. All proposed parameters (such as fan power, fan control, economizer control, demand control ventilation, energy recovery, dedicated outside air supply, quantity of systems, etc.) shall remain identical, except that the cooling type shall be revised to water-cooled chillers matching those stipulated in ASHRAE 90.1 Appendix G.

If performing the cooling tower water usage calculations outside the energy model, cooling tower and evaporative condenser manufacturers have water usage programs based on design conditions, building load and water chemistry. To calculate the water usage with the manufacturer's data, the design cooling loads from the proposed model for spaces served by systems 7, 8, 11, 12, or 13 in the baseline shall be exported from the energy model, and supplemental calculations shall be documented based on the proposed building cooling load and water use data sheets from equipment suppliers. Any assumptions used for the calculations shall be submitted with the calculations.

The manufacturer's program used for calculating water usage must incorporate the hourly load profile from the energy model or be based on climate-specific load profiles for the project's building type. If hourly load profiles and hourly weather profiles are not used, the calculations shall include "bins" that account for variations in the load profile and water usage dependent on outdoor air drybulb temperature, outdoor air wetbulb temperature, and building cooling load. The load profile must be identical in the proposed and reference case.

Option 3. Process Water Use

Step 1. Identify water subsystems.
Eligible subsystems may include boilers, humidification systems, or other subsystems using process water that represent at least 10% of total regulated building water use. Water used for cooling is not eligible for Option 3.

- Consider minimum required quality of make-up water for water subsystems.

Step 2. Identify sources of recycled alternative water.
Identify recycled alternative water sources that could be used to meet process water subsystem demand.

Alternatives water sources include municipally supplied reclaimed wastewater ("purple pipe" water), graywater, rainwater, stormwater, treated seawater, water recovered from condensate, foundation dewatering water, treated blowdown from process water, reverse osmosis reject water, and other recycled water sources. Well water, groundwater, and naturally occurring surface bodies of water (such as streams, lakes, or rivers) do not contribute to recycled alternative water sources.

Step 3. Calculate subsystem water use.
Calculate the water use of subsystems using manufacturer information and anticipated operating conditions.

- To be eligible for Option 3, the subsystem must represent at least 10% of total building regulated water use annually. Total building water includes all indoor water consumption associated with the project in the design case and excludes outdoor landscape water use.
- Calculate subsystem water use during each month; identify the month with the highest water demand.

Step 4. Calculate quantity of recycled alternative water source.
Calculate the quantity of alternative water sources available for reuse each month. Address the cistern storage capacity for on-site alternative water systems. For municipally supplied alternative water systems, demonstrate that the municipality has approved to supply the volume of recycled water required by the project.

Step 5. Select alternative water source to meet subsystem demand.
Confirm that alternative water source is of sufficient quantity to meet at least 20% of water subsystem demand during the month with the highest water demand. If the alternative water is used for multiple applications—for example, boilers, flush fixtures, and landscape irrigation—a sufficient quantity must be available to meet the demands of all uses. Teams cannot apply the same alternative water to multiple credits unless the recycled alternative water source has sufficient volume to cover the demand of all the uses (e.g., boilers, irrigation plus toilet-flushing demand).

Confirm that alternative water source is of sufficient quality to meet intended use or treat alternative water source.

- Minimum requirements for make-up water quality vary by subsystem.
- When selecting alternative sources of water, target the uses that require the least treatment first.
- As needed, treat alternative water sources to be of sufficient quality for intended end use.

## Project Type Variations

## District Energy Systems

### Option 2. Optimize Water Use for Cooling

For projects connected to a district cooling system, the project shall demonstrate that any on-site cooling equipment meets the credit requirements and that upstream systems meet the credit requirements.

To pursue this option, the baseline system designated for the building in accordance with ASHRAE 90.1-2016 Appendix G Table G3.1.1 (prior to modeling purchased energy) must include a cooling tower (systems 7 &, 8, 11, 12, and 13).

For upstream equipment from the District Energy System, provide a narrative describing how the system is operated and specifically describing the district energy cooling equipment, including capacities, equipment type, etc.

If cooling towers, evaporative condensers, evaporative cooling systems, and other evaporative cooling systems are not used in the district cooling system serving the project, or are used in conjunction with compressor-based cooling equipment to supply no more than 10% of the total cooling energy generated by the District Energy System, then the project automatically qualifies for 2 points under the credit (Core and Shell projects automatically qualify for 3 points) and does not need to provide calculations. Provide a narrative description of how the district cooling system is operated and confirm that there is no evaporative cooling equipment in the district energy system.

If the district cooling system does use evaporative cooling, the project team must provide calculations demonstrating achievement of the Option 2 requirements based on total district cooling capacity and cooling load profile for the entire district system (building cooling loads shall not be used to document performance).

The program or supplemental calculations used for calculating water usage must either incorporate the hourly load profile from the District Energy System, or include “bins” that account for variations in the District Energy Plant load profile and water usage dependent on outdoor air drybulb temperature, outdoor air wetbulb temperature, and District Energy thermal cooling load. The load profile must be identical in the proposed and reference case.

### Option 3. Process Water Use

For projects where heating is provided by a district heating system, the project team must pro-rate the district heating system’s total water usage to the building to determine whether it represents at least 10% of total building regulated water use.

For example, if the district heating system consumes 500,000 gallons of water annually and the LEED project uses 1% of the district heating system annual heat generation, the total prorated water consumption from the district heating system is 500,000 gallons x 1% = 5,000 gallons. This must represent at least 10% of the total building water consumption, meaning that the total building consumption must be less than or equal to 50,000 gallons.

**Further Explanation**

Required Documentation

| Documentation | Option 1 | | Option 2 | Option 3 |
|---|---|---|---|---|
| | 1 point | 2 points | | |
| Potable water analysis results | x | X | | |
| Potable water analysis narrative | x | X | | |
| Cycles of concentration calculations | x | X | | |
| Recycled Nonpotable water calculations | | X | | |
| Water treatment calculations | | X | | |
| Nonpotable water analysis (if using 100% nonpotable water) | | X | | |
| Documentation showing that project Baseline system is designated as systems 7, 8, 11, 12, or 13 under ASHRAE 90.1-2016 Appendix G Table G3.1.3 | | | x | |
| Calculations demonstrating percent reduction in cooling tower water usage for systems where the proposed design uses the latent heat of evaporative cooling of water | | | x | |
| Site or mechanical systems plan, energy model or other showing project design | | | x | x |
| Water subsystem monthly demand calculations | | | | x |
| Recycled alternative water source quantity calculations and plumbing drawings/schematics of the alternative water system. For municipally supplied alternative water, provide documentation that the municipality has agreed to supply the volume of recycled alternative water claimed by the project | | | | x |
| Manufacturer information for water subsystem | | | | x |

Exemplary Performance

- Option 2. Demonstrate a 100% reduction in annual water use compared to a water-cooled chiller system.
- Option 3. Use minimum 40% recycled alternative water to meet process water demand (all projects except Core and Shell). Core and Shell: use minimum 50% recycled alternative water to meet process water demand.

Referenced Standards

- ASHRAE Standard 90.1-2016

Connection to Ongoing Performance

- LEED O+M WE credit Water Performance: Designing building cooling systems and other water subsystems to minimize potable water and reuse alternative water sources can significantly reduce the project's water footprint over the building life cycle, which may help improve a project's water performance score. Additionally, treating and maintaining the quality of makeup water used to meet process water demands can preserve the performance and efficiency of water using subsystems, reducing the frequency of replacement and repairs.

# WE Credit: Water Metering

This credit applies to

- BD+C: New Construction (1 point)
- BD+C: Core & Shell (1 point)
- BD+C: Schools (1 point)
- BD+C: Retail (1 point)
- BD+C: Data Centers (1 point)
- BD+C: Warehouses & Distribution Centers (1 point)
- BD+C: Hospitality (1 point)
- BD+C: Healthcare (1 point)

## INTENT

To conserve low cost potable water resources and support water management and identify opportunities for additional water savings by tracking water consumption.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Install permanent water meters for two or more of the following water subsystems, as applicable to the project:

- *Irrigation.* Meter water systems serving at least 80% of the irrigated landscaped area. Calculate the percentage of irrigated landscape area served as the total metered irrigated landscape area divided by the total irrigated landscape area. Landscape areas fully covered with xeriscaping or native vegetation that requires no routine irrigation may be excluded from the calculation.

- *Indoor plumbing fixtures and fittings.* Meter water systems serving at least 80% of the indoor fixtures and fitting described in WE Prerequisite Indoor Water Use Reduction, either directly or by deducting all other measured water use from the measured total water consumption of the building and grounds.

- *Domestic hot water.* Meter water use of at least 80% of the installed domestic hot water heating capacity (including both tanks and on-demand heaters).

- *Boiler with aggregate projected annual water use of 100,000 gallons (378 500 liters) or more, or boiler of more than 500,000 BtuH (150 kW).* A single makeup meter may record flows for multiple boilers.

- *Reclaimed water.* Meter reclaimed water, regardless of rate. A reclaimed water system with a makeup water connection must also be metered so that the true reclaimed water component can be determined.

- *Other process water.* Meter at least 80% of expected daily water consumption for process end uses, such as humidification systems, dishwashers, clothes washers, pools, and other subsystems using process water.

Healthcare Projects only

In addition to the requirements above, install water meters in any five of the following:

- purified water systems (reverse-osmosis, de-ionized);
- filter backwash water;
- water use in dietary department;
- water use in laundry;
- water use in laboratory;
- water use in central sterile and processing department;

- water use in physiotherapy and hydrotherapy and treatment areas;
- water use in surgical suite;
- closed-looped hydronic system makeup water; and
- cold-water makeup for domestic hot water systems.

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following additions and modifications:

**Further Explanation**

Connection to Ongoing Performance

- LEED O+M WE credit Water Performance: Submetering water subsystems helps facility managers track changes in water usage over time and provides the data necessary to identify opportunities for water savings by end use, which may help improve a project's water performance score. Submetering is an important component of a successful water management program; metered data enables monitoring of consumption and costs as well as progress reporting throughout the building life cycle.

# EA Prerequisite: Fundamental Commissioning and Verification

This prerequisite applies to

- BD+C: New Construction
- BD+C: Core & Shell
- BD+C: Schools
- BD+C: Retail
- BD+C: Data Centers
- BD+C: Warehouses & Distribution Centers
- BD+C: Hospitality
- BD+C: Healthcare

## INTENT

To support the design, construction, and eventual operation of a project that meets the owner's project requirements for energy, water, indoor environmental quality, and durability.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

### Commissioning Process Scope

Complete the following commissioning (Cx) process activities for mechanical, electrical, plumbing, and renewable energy systems and assemblies, in accordance with ASHRAE Guideline 0-2013 and ASHRAE Guideline 1.1–2007 for HVAC&R Systems, as they relate to energy, water, indoor environmental quality, and durability.

- Develop the OPR.
- Develop a BOD.

The commissioning authority (CxA) must do the following:

- Review the OPR, BOD, and project design.
- Develop and implement a Cx plan.
- Confirm incorporation of Cx requirements into the construction documents.
- Develop construction checklists.
- Develop a system test procedure.
- Verify system test execution.
- Maintain an issues and benefits log throughout the Cx process.
- Prepare a final Cx process report.
- Document all findings and recommendations and report directly to the owner throughout the process.

Requirements for exterior enclosures are limited to inclusion in the owner's project requirements (OPR) and basis of design (BOD), as well as the review of the OPR, BOD and project design. ASTM E2947-16: Standard Guide for Building Enclosure Commissioning provides additional guidance.

The review of the exterior enclosure design may be performed by a qualified independent member of the design or construction team (or an employee of that firm) who is not directly responsible for design of the building enclosure for the project.

### Commissioning Authority Qualifications

By the end of the design development phase, engage a commissioning authority with the following qualifications.

- The CxA must have documented commissioning process experience on at least two building projects with a similar scope of work. The experience must extend from early design phase through at least 10 months of occupancy;
- The CxA may be a qualified employee of the owner, an independent consultant, an employee of the design or construction firm who is not part of the project's design or construction team, or a disinterested subcontractor of the design or construction team.
    - For projects smaller than 20,000 square feet (1 860 square meters), the CxA may be a qualified member of the design or construction team.

  In all cases, the CxA must report his or her findings directly to the owner.

### Current Facilities Requirements and Operations and Maintenance Plan

Prepare and maintain a current facilities requirements and operations and maintenance plan that contains the information necessary to operate the building efficiently. The plan must include the following:

- a sequence of operations for the building;
- the building occupancy schedule;
- equipment run-time schedules;
- setpoints for all HVAC equipment;
- set lighting levels throughout the building;
- minimum outside air requirements;
- any changes in schedules or setpoints for different seasons, days of the week, and times of day;
- a systems narrative describing the mechanical and electrical systems and equipment;
- a preventive maintenance plan for building equipment described in the systems narrative; and
- a commissioning program that includes periodic commissioning requirements, ongoing commissioning tasks, and continuous tasks for critical facilities.

<u>Data Centers only</u>
For small projects with computer room peak cooling loads less than 2,000,000 Btu/h (600 kW) or a total computer room peak cooling load less than 600,000 Btu/h (175 kW), the CxA may be a qualified employee of the design or construction team.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

### Beta Update

Updated referenced standards.

**Further Explanation**

### Commissioning Authority Qualifications

Delete the phrase "If the project is pursuing fundamental commissioning only" in the second paragraph.

In Table 1. Who can be the CxA:

- Revise the heading "be CxA for…" to "be CxA" in the right column
- Delete the subheading "fundamental Cx" in the right column
- Delete subheading "enhanced Cx" and all rows beneath it in the far right column of the table

### Related Credit Tips

Refer to the LEED v4 reference guide, with the following modification:

- EA credit Renewable Energy. Renewable energy systems installed on-site must be commissioned under this prerequisite.

### Referenced Standards:

- ASHRAE Guideline 0–2013, The Commissioning Process
- ASHRAE Guideline 1.1–2007, HVAC&R Technical Requirements for the Commissioning Process
- ASTM E2947 – 16: Standard Guide for Building Enclosure Commissioning

### Connection to Ongoing Building Performance

- LEED O+M EA credit Energy Performance: Testing building systems after installation is fundamental to ensuring that systems function as designed. The development of a commissioning plan ensures that the building owner and facility managers have the information necessary to operate the building efficiently.

# EA Prerequisite: Minimum Energy Performance

This prerequisite applies to

- BD+C: New Construction
- BD+C: Core & Shell
- BD+C: Schools
- BD+C: Retail
- BD+C: Data Centers
- BD+C: Warehouses & Distribution Centers
- BD+C: Hospitality
- BD+C: Healthcare

## INTENT

To promote resilience and reduce the environmental and economic harms of excessive energy use and greenhouse gas emissions that disproportionately impact frontline communities by achieving a minimum level of energy efficiency for the building and its systems.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Comply with ANSI/ASHRAE/IESNA Standard 90.1–2016, with errata or a USGBC-approved equivalent standard.

ASHRAE 90.1-2016 Compliance pathways in Section 4.2.1.1 include compliance with all mandatory provisions, and compliance with one of the following:

- Prescriptive provisions of Sections 5 through 10
- Section 11 *Energy Cost Budget Method*
- Normative Appendix G *Performance Rating Method*. When using Appendix G, the Performance Cost Index (PCI) shall be less than or equal to the Performance Cost Index Target ($PCI_t$) in accordance with the methodology provided in Section 4.2.1.1. Document the PCI, $PCI_t$, and percentage improvement using metrics of cost or greenhouse gas (GHG) emissions.
- Exception to Mandatory Measures requirements: For ASHRAE 90.1-2016 mandatory provisions where the Appendix G *Performance Rating Method provides a methodology for demonstrating savings between the Proposed Building Performance (PBP) and the Baseline Building Performance (BBP)*, projects may model the *Proposed Building Performance* as designed in lieu of compliance with the mandatory provisions.
- Exceptional Calculations modeled in accordance with Section G2.5 may be modeled to document minimum prerequisite compliance.
- Only on-site or on-campus renewable energy that meets ASHRAE Standard 90.1-2016 Section G 2.4.1 requirements for on-site renewable energy may be used to meet ASHRAE Standard 90.1-2016 performance requirements.

## GUIDANCE

The following guidance addresses both EA Prerequisite Minimum Energy Performance and EA Credit Optimize Energy Performance since the requirements and LEED documentation are closely linked for the Prerequisite and Credit.

Refer to the LEED v4 reference guide, EA Prerequisite Minimum Energy Performance for the referenced sections.

### Beta Update

Updated referenced standards and added a new greenhouse gas emissions metric ensure that LEED continues to be a global leadership standard for energy performance and encourage owners to directly consider and address building carbon emissions.

### Step-by-Step Guidance

ASHRAE Standard 209 provides a step-by-step methodology for applying energy modeling to inform the design process. Project teams are encouraged, though not required, to apply the guidance in ASHRAE Standard 209 as a best-practice approach for informing design through energy modeling. Following the guidance in Standard 209 will help project teams document achievement of LEED EA prerequisite Minimum Energy Performance Prerequisite, EA credit Optimize Energy Performance, and the energy modeling requirements for IP credit Integrative Process.

#### Step 1. Determine climate zone

Identify the project's climate zone according to ASHRAE 90.1–2016, Annex 1 (see *Further Explanation, Climate Zone Determination*).

#### Step 2. Review and address ASHRAE mandatory requirements

Early in the design process, review the mandatory provisions of ANSI/ASHRAE/IESNA Standard 90.1–2016, with errata (or a USGBC-approved equivalent standard for projects outside the U.S.). Read through Sections 5.4, 6.4, 7.4, 8.4, 9.4, and 10.4 to understand how the building design must respond to these requirements. Many mandatory requirements can easily be incorporated to the project in early design but are much harder to incorporate later in design and/or during construction.

- Typically, the architect is responsible for Section 5.4, Building Envelope; the mechanical engineer and plumbing designer are responsible for Sections 6.4, HVAC, and 7.4, Service Water Heating; and the electrical engineer is responsible for Sections 8.4, Power, and 9.4, Lighting. Compliance with Section 10.4 requires coordination across multiple disciplines.
- Ensure that the project complies with the mandatory measures throughout the design, construction, and commissioning process, particularly when major design decisions are implemented.
- Confirm that compliant components are included in the final construction documents.
- If compliance with ASHRAE 90.1-2016 mandatory provisions will be a hardship for the project, and the project intends to demonstrate compliance using the Appendix G Performance Rating Method, identify whether Appendix G Performance provides a method for quantifying savings of these mandatory provisions in the Proposed design as compared to the Baseline. For mandatory measures where Appendix G provides a methodology for demonstrating savings between the Proposed Building Performance (PBP) and the Baseline Building Performance (BBP), in lieu of compliance with the mandatory provisions, the Proposed Building efficiencies and controls may be modeled as designed, while the Baseline Building efficiencies and controls are modeled consistent with ASHRAE 90.1-2016 Appendix G requirements. Examples include:
    - In lieu of complying with mandatory daylighting and occupancy sensor control requirements, document the proposed model without credit for lighting controls, with lighting schedules modeled identically to the baseline model.
    - If the exterior lighting power allowance exceeds the mandatory allowance, model the proposed exterior lighting power as designed, and model the Baseline consistent with Appendix G.
    - If the HVAC efficiency does not meet the mandatory provisions, model the proposed efficiency as designed, and model the Baseline consistent with Appendix G.
- The following additional exceptions to mandatory measures may also be applied:
    - Section 5.4.3.4 Vestibules: The project may apply ASHRAE 90.1-2016 Addendum bf, Section 5.4.3.4, which adds exceptions for:

        - Self-closing doors in buildings in Climate Zone 0, 3, and 4 that have an air curtain complying with Addendum bf, Section 10.4.5.
        - Self-closing doors in buildings 15 stories or less in Climate Zones 5 through 8 that have an air curtain complying with Addendum bf, Section 10.4.5.

    Note that the air curtain energy must be included in the Proposed design model and not in the Baseline if applying the Appendix G Performance Rating Method.

    - Section 8.4.2 Automatic Receptacle Control:
        - Path 1. Projects Using the Appendix G Performance Rating Method may model a penalty in the energy model for the spaces where mandatory ASHRAE 90.1 receptacle controls are not implemented. The following modeling requirements apply:
            - The Proposed receptacle power density modeled for these spaces shall be the greater of 0.75 Watts per square foot (8.1 Watts per square meter) or the design coincident peak receptacle power density (if known)
            - The receptacle schedule modeled in the Proposed design for these spaces shall have a minimum Equivalent Full Load Hours of operation no less than: the ASHRAE 90.1-2016 User's Manual default schedule for office occupancy (2,920 Equivalent Full Load Hours per year); or 120% of the occupied hours of operation for the facility; or detailed justification shall be provided supporting an alternate schedule.
            - The Proposed model shall include either a 20% increase in the receptacle power density for these spaces OR a 20% increase in the scheduled receptacle Equivalent Full Load Hours of Operation versus the Baseline model.
        - Path 2: Projects must demonstrate that the project has implemented efficiency measures that will achieve an equal or greater reduction in receptacle energy consumption and will persist for a similar timeframe to those achieved by ASHRAE 90.1-2016 Section 8.4.2. It is recommended that a Credit Interpretation Request be submitted when pursuing this approach. The project must provide documentation regarding the receptacle equipment controls that will be implemented for the project; and must provide justification supporting the claim that the savings over the life of the efficiency measure will be similar to those anticipated for a project compliant with Section 90.1-2016 Section 8.4.2. Note: the project is not eligible for any further receptacle savings in these spaces using the Appendix G Exceptional Calculation Method or using the Prescriptive path for measures relying on ENERGY STAR eligible equipment features.

(See Further Explanation, Table 1. Changes in ASHRAE 90.1 mandatory requirements, 2010 to 2016).

### Step 3. Identify energy use target for building

This step is required for all projects pursuing credit under IP credit Integrative Process and recommended for all other projects.

Set an energy goal for the project early in the design process. Identifying an energy goal can help prioritize efficiency strategies, integrate systems, reduce first costs, and improve building performance.

For IP Credit Integrative Process, the target must be established using one of the following metrics:

- kBtu per square foot-year (kWh per square meter-year) of site energy use
- kBtu per square foot-year (kWh per square meter-year) of source energy use
- pounds per square foot-year (Kg per square meter-year) of greenhouse gas emissions
- energy cost per square foot-year (cost per square meter-year)

For building types such as manufacturing, if a different metric is more appropriate for benchmarking building energy consumption (e.g. kBtu per pound of finished product (kWh per kilogram of finished project)), project teams may use that metric in lieu of the metrics above. When using a different metric, provide a brief narrative supporting that the metric used is a more appropriate means of benchmarking building energy consumption for the building type and function.

Consider using ENERGY STAR's Target Finder to develop the EUI goal that will meet the credit requirements.

Consider applying the guidance in ASHRAE Standard 209 Section 5.4 and Informative Appendix B (Benchmark Information) when establishing the energy goal for the project.

### Step 4. Select option for credit compliance.

Select the appropriate option in EA credit Optimize Energy Performance for the project (see *Further Explanation, Selecting an Option*). Review the requirements for EA credit Optimize Energy Performance before making a selection.

- Option 1. Energy Performance Compliance is available to all projects. This option is the best method for informing design decisions throughout the design process, and has the greatest number of points available under EA credit Optimize Energy Performance. For projects using this method, a Baseline Building Performance Model and Proposed Building Performance model are developed consistent with ASHRAE 90.1-2016 Appendix G, Performance Rating Method.
- Options 2 and 3 are for projects intending to apply simple upgrades to mechanical, envelope, lighting, appliances, and/or process equipment. Projects with minimal scope, such as Core and Shell projects with scope limited to the building envelope and exterior lighting often apply this option, since prerequisite compliance may be documented based solely on the project scope, and Optimize Energy Performance credit may be documented for the specific elements that are within the project scope.

  Projects must demonstrate compliance with EA prerequisite Minimum Energy Performance using the ASHRAE 90.1-2016 prescriptive compliance pathway to apply these options. Projects pursuing this option should work with the architect and engineers to assess the prescriptive requirements of ANSI/ASHRAE/IESNA Standard 90.1–2016, with errata (or a USGBC-approved equivalent standard for projects outside the U.S.) and ensure that the design will comply with envelope, HVAC, service water-heating, and lighting requirements, per Sections 5.5, 6.5, 7.5, 9.2.2 for all elements within the project scope of work. Compliance with prescriptive ASHRAE 90.1-2016 requirements and prescriptive EA credit Optimize Energy Performance requirements should be verified early in the design process, with ongoing verification of compliance throughout the design and construction process.
    - Option 2: Project teams may pursue a limited number of points under EA credit Optimize Energy Performance. The eligible project types for Option 2 include the following:
        - Small to medium office buildings, less than 100,000 square feet (9 290 meters)
        - Medium to large box retail buildings, 20,000 to 100,000 square feet (1 860 to 9 290 square meters)
        - School buildings, any size
        - Large hospitals, more than 100,000 square feet (9 290 square meters)
        - Grocery stores
    - Option 3 is a prescriptive option available for projects with less than 2,000 square feet (186 square meters) of data center space, laboratory space, or manufacturing space.

- For projects using the BD+C Data Center rating system, Option 4 may be used to demonstrate system optimization of the Data Center Mechanical and Electrical equipment using ASHRAE 90.4 2016.
- If the project is not pursuing any points under EA credit Optimize Energy Performance, the project may demonstrate EA prerequisite Minimum Energy Performance compliance using ASHRAE 90.1-2016 Section 11 Energy Cost Budget. This option uses energy modeling with trade-offs but has different Baseline building modeling requirements than the normative Appendix G performance rating method.
- Refer to the LEED Credit Library *Pilot alternative compliance paths (ACP)* for additional options for demonstrating EA Prerequisite Minimum Energy Performance and EA Credit Optimize Energy Performance. Pilot ACPs test credits that achieve a similar intent to the referenced credit by applying a new strategy. For EAp Minimum Energy Performance and EAc Optimize Energy Performance, these may include alternative metrics for evaluating decarbonization and energy efficiency using ASHRAE 90.1-2016 Appendix G, entirely new compliance paths intended to streamline the analysis and documentation process, or compliance paths that reference alternative standards.

### Step 5. Develop preliminary energy model or alternate energy analysis

To achieve EA credit Optimize Energy Performance, project teams must analyze efficiency measures during the design process, focusing on load reduction and HVAC-related strategies or passive measures appropriate for the facility, and account for the results during design decision making.

For projects using Option 1. Energy Performance Compliance, the best approach for analyzing efficiency measures is a preliminary energy model, which evaluates heating and cooling load reduction strategies, passive HVAC strategies, and HVAC efficiency and control strategies (see *Further Explanation, Developing a Preliminary Energy Model* and *Further Explanation, Modeling HVAC Systems)*. ASHRAE Standard 209 provides a standardized methodology which may be used for developing preliminary energy models that are used to inform the design process (See ASHRAE 209 Sections 6.3 - Load Reduction Modeling and 6.4 - HVAC System Selection Modeling).

- Developing an early model of the proposed design will help the design team explore the energy consequences of design options and will provide an early estimate of energy performance.
- When evaluating energy usage in different scenarios, consider strategies for lighting and daylighting, envelope, orientation, and passive conditioning and ventilating systems, in terms of projected energy savings and capital costs as they relate to all building systems. If pursuing the Integrative Process Credit, evaluate these parameters at a concept level early in design.

Project teams may also use past energy analyses of similar buildings or published energy modeling results, such as the ASHRAE Advanced Energy Design Guides (AEDGs) to guide decision making in lieu of a preliminary energy model, though the results will be less project-specific. The AEDGs were designed around specific building types and sizes by climate zone, making the recommendations most appropriate for projects with attributes similar to those specified types, sizes, and locations.

### Step 6. Ongoing iterations of Design Phase Energy Model (Option 1. Energy Performance Compliance), or Prescriptive compliance documentation (Options 2 or 3).

#### Option 1. Energy Performance Compliance

For projects pursuing EA credit Optimize Energy Performance Option 1. Energy Performance Compliance:

Once the HVAC system and other design parameters are established, build or update the proposed building energy model to reflect the anticipated design (see *Further Explanation, Building the Proposed Energy Model*).

- Update the proposed model to reflect changes that occur throughout the design process to optimize energy performance and assist with design decisions.
- Ensure that all efficiency strategies are analyzed well before design documents are finalized.
- For elements or systems that cannot be readily modeled by the software or to document credit for unregulated loads, use the Exceptional Calculation Method (see *Further Explanation, Exceptional Calculation Method* and v4 Reference Guide, *Further Explanation, Common Issues with Energy Modeling*).
- Document credit for qualifying renewable energy in the proposed energy model (see *Further Explanation, Applying Renewable Energy Savings*)

For projects pursuing EA credit Optimize Energy Performance, Option 1. Energy Performance Compliance:

Build a baseline model that reflects the minimum requirements according to ASHRAE 90.1–2016, Appendix G (see *Further Explanation, Building the Baseline Performance Model*).

- When modifications are made to the proposed energy model, update the baseline accordingly.
- Consider constructing the baseline model early in the design process so that the design team can see the effect of design changes on the percentage savings relative to ASHRAE 90.1. This will contribute toward achieving more points under the related credit.
- Use the Minimum Energy Performance Calculator to help create the baseline model. This tool was designed to help project teams create a baseline model in alignment with Appendix G requirements.

Update the proposed energy model as necessary to reflect final construction details and specifications and make any necessary corresponding updates to the baseline model.

Use the results from the baseline and proposed models and the Building Performance Factor to determine the anticipated energy cost and greenhouse gas emissions savings (see *Further Explanation, Calculations*, *Energy Cost* and *Greenhouse Gas Emissions*). Either the cost or the GHG emissions metric may be used to show prerequisite compliance.

### Prerequisite Compliance Only – ASHRAE 90.1-2016 Section 11 Energy Cost Budget

For projects that are not pursuing EA credit Optimize Energy Performance, and are documenting compliance using ASHRAE 90.1-2016 Section 11, Energy Cost Budget, complete the ASHRAE 90.1 Section 11 design energy cost and energy cost budget models, and complete the ASHRAE 90.1 ECB forms demonstrating compliance.

### Option 2, 3, or 4. Prescriptive Compliance

Prepare final ASHRAE 90.1 documentation confirming compliance with the mandatory and prescriptive requirements of ASHRAE 90.1-2016.

For projects pursuing Optimize Energy Performance, see Step-by-Step Guidance, Prescriptive Compliance.

## Further Explanation

### Calculations

For projects using ASHRAE 90.1-2016 Appendix G, Performance Rating Method, the following equations apply:

Equation 1. Section G1.2.2: Performance Cost Index

Performance Cost Index = Proposed building performance / Baseline building performance.

where Proposed building performance and Baseline building performance are calculated in accordance with ASHRAE 90.1-2016 Appendix G.

Equation 2. Section 4.2.1. Performance Cost Index

$PCI_t$ = [BBUEC + (BPF x BBREC)] / BBP

where:
PCI = Performance Cost Index calculated in accordance with ASHRAE 90.1-2016 Section G1.2 as described above.
BBUEC = Baseline Building Unregulated Energy Cost, the portion of the annual energy cost of a baseline building design that is due to unregulated energy use.
BBREC = Baseline Building Regulated Energy Cost, the portion of the annual energy cost of a baseline building design that is due to regulated energy use.
BPF = Building Performance Factor from Table 4.2.1.1. For building area types not listed in Table 4.2.1.1 use “All others.” Where a building has multiple building area types, the required BPF shall be equal to the area-weighted average of the building area types. The Building Performance Factors from Table 4.2.1.1 (BPF) represent the average ratio of ASHRAE 90.1-2004 versus ASHRAE 90.1-2016 regulated energy cost for a given building type and climate. For example, a BPF of 0.59 represents an ASHRAE 90.1-2016 regulated energy cost that is 59% of the 90.1-2004 regulated cost for the given building type and climate. Table 4.2.1.1 lists
BBP = Baseline Building Performance.

Equations 1 and 2 adjustments for greenhouse gas emission metric:
When using Greenhouse gas emissions as the metric, replace all ASHRAE 90.1-2016 references to cost with Greenhouse Gas Emissions (CO2 equivalent emissions). Rather than using utility rates, use the appropriate greenhouse gas emission coefficients for each energy source (See *Further Explanation, Greenhouse Gas Emissions*)

Total LEED points for EAc Optimize Energy Performance are determined by summing the points documented in Table 1 (cost metric) PLUS the points documented in Table 2 (GHG emissions metric), where points for each Table are determined based on the project percent improvement PCI below the $PCI_t$ documented for each metric.

For Table 1:

- Percent cost PCI below $PCI_t$ = 1-PCI/$PCI_t$

For Table 2, calculate PCI and $PCI_t$ using greenhouse gas emissions instead of cost.

- Percent GHG Emissions PCI below $PCI_t$ = 1-PCI/$PCI_t$

If a project consists of a combination of New Construction and either Major Renovation or Healthcare, use Equation 1 to determine the appropriate percentage improvement target from Table 1 or Table 2 (points for percentage improvement in energy performance).

Equation 3. Target energy savings for combination of New Construction, Major Renovation, and/or Healthcare (HC).

Target percentage = {(existing or HC floor area / total floor area) x target percentage of savings for Major Renovation or Healthcare} + {(new non-HC floor area / total floor area) x target percentage of savings for New Construction}

### Climate Zone Determination

Determining the right climate zone for the project is essential since the requirements are specific to each climate zone. ASHRAE 90.1–2016 defines eight climate zones (Miami is in climate zone 1; Anchorage is in climate zone 8) and three climate types: A (moist), B (dry), and C (marine).

To find the project's climate zone and type, consult ASHRAE 90.1–2016, Annex 1. For projects in the U.S, refer to the appropriate state and county in Table Annex 1-1. For projects in Canada, refer to the province and location in Table Annex 1-2. For locations outside of the U.S. and Canada, refer to the closest or most similar location in Table Annex 1-3. International projects may also refer to ASHRAE Standard 169-2020 to determine the project's climate zone based on historical weather data for the project's location.

### Selecting an Option

Determining which option is most appropriate for the project requires knowing the extent of energy performance feedback desired during the design process.

- If detailed feedback is important during the design process, or the project is targeting a high level of energy performance and low greenhouse gas emissions, then the performance option (1) is most appropriate. Energy modeling generates information on the potential savings associated with various efficiency measures, both in isolation and in combination with other measures. Often this includes estimates of overall energy use, greenhouse gas emissions, or cost savings for the project, which can help gauge progress toward an energy savings and greenhouse gas emissions goal or achievement of points under the related credit.
- If the owner or design team requires only limited feedback, and the project is not targeting significant energy savings then one of the prescriptive options (2, 3, or for Data Centers - 4) may be more appropriate. These options are best suited for projects with standard systems and provide only limited feedback, in that all efficiency measures must be incorporated to achieve the prescribed threshold for energy performance.

*Performance Path*

The following factors could indicate that Option 1 would be advantageous to the project:

- The project is targeting a high level of energy performance
- None of the Optimize Energy Performance prescriptive pathways are available to the project because of the building's type or size.
- The project has an HVAC system that is not covered by one of the prescriptive options.
- The project team wants to explore the energy performance and load reduction effects of several envelope and lighting designs and mechanical systems.
- The project team is planning to maximize the number of points available through EA credit Optimize Energy Performance.
- The project team wants to achieve efficiency trade-offs between systems, offsetting the lower efficiency of one system by the improved efficiency of another.
- The owner is interested in commercial building federal tax credits or state, local, or utility incentives that require energy modeling. The modeling requirements for such incentive programs may be different from the ASHRAE 90.1–2016 requirements, however.
- The owner wants an estimate of the carbon reductions or lower operating costs (energy savings, demand charge savings) from energy strategies, beyond a simple calculation for individual energy conservation measures.

Project teams pursuing Option 1 should consider referencing ASHRAE Standard 209-2018, Energy Simulation Aided Design for Buildings except Low Rise Residential Buildings, which defines best practices and minimum requirements for providing energy design assistance using building energy simulation and analysis.

Before undertaking energy modeling as part of the performance path, consider the timing of the simulation preparation and presentation, and understand the costs and benefits of energy modeling as it relates to the project. When energy modeling is conducted late in design, its value is very limited, except as a compliance tool: the model can only estimate the energy savings of the design.

In contrast, if initiated early and updated throughout the design process, energy modeling can be a decision-making tool, giving feedback as part of the larger analysis of building systems and components. The best value will be seen when energy modeling is used as a tool in an integrated design process because it enables a more informed, cost-effective selection of efficiency strategies.

Note: Early design phase analysis is required to earn points under EA credit Optimize Energy Performance.

Develop clear expectations for the presentations of modeling results and their integration into the project schedule. Ideally, iterations of the model will be presented to the team during each stage of design, beginning as early as possible, when the project goals are incorporated into preliminary plans. Updates should be presented as the design is developed further to incorporate engineering and architectural details, and again when the construction documents are being prepared.

Regardless of the project design phases, energy modeling can still be performed as the design progresses. However, the potential benefit of energy modeling decreases as the design becomes finalized and opportunities for incorporating changes are lost. Ask the project's energy modeler to provide a schedule that integrates energy modeling into the design process, with appropriate milestones.

To develop an accurate and compliant energy model, it is important that the energy modeler read and understand ASHRAE 90.1–2016 (Appendix G and all mandatory measures from each Section in particular) in its entirety, not just the portions that apply to the project. This will enable a more complete understanding of the energy modeling protocols and methodologies required for LEED projects (see *Further Explanation, ASHRAE 90.1, 2016 versus 2010*). The energy modeler should also consider reading the ASHRAE 90.1–2016 User's Manual, which provides examples and further guidance relevant to Appendix G.

*Prescriptive paths*
The following factors could indicate that Option 2 or Option 3 would be advantageous to the project:

- The project budget and timeline would benefit from simplified decision making and analysis during the project design.
- The additional cost of energy modeling would not be warranted.

Although the prescriptive paths are applicable to some large or complex projects, such as hospitals, they were designed primarily for smaller projects, for which the cost of energy modeling would represent a high percentage of the project budget.

The prescriptive paths are available only for projects that meet certain criteria. Review the project's eligibility for the ASHRAE 50% Advanced Energy Design Guides and/or Option 3. Systems Optimization, and Option 4: Data Centers Only – System Optimization. If these prescriptive option do not fit the project type, the team must pursue Option 1 in order to achieve points under EA credit Optimize Energy Performance.

If the project is eligible for both of the prescriptive options, determine which is more appropriate based on the specific option requirements as well as future credit goals. The building type, for example, may not match those in the AEDGs, or the Option 3 prescriptive requirements may align better with the project's goals and design.

Option 2. ASHRAE 50% AEDG, delivers a 50% savings over ASHRAE 90.1–2004 when all requirements in all categories are met.  Have the mechanical engineer review the applicable AEDG requirements for the project type. If the project is expected to have unique systems, potential equipment is not listed, or the system capacity is not likely to fall within the ranges in the AEDG, then the project team cannot pursue Option 2, and must pursue Option 1, Option 3, or (for Data Centers) Option 4.

Option 3. Systems Optimization savings vary dependent on the efficiency strategies, climate zone and building type.

### Energy Modeler Qualifications

Refer to the LEED v4 reference guide.

### Developing a Preliminary Energy Model

Refer to the LEED v4 reference guide, with the following addition:

- See ASHRAE 209 Sections 6.3 - Load Reduction Modeling for further guidance.

### Modeling HVAC Systems

Refer to the LEED v4 reference guide, with the following addition:

- See ASHRAE 209 Section 6.4 - HVAC System Selection Modeling for further guidance.

### Building the Proposed Building Performance Model

A team that has already prepared a preliminary model may update it to reflect the newest design information throughout the project.

Create or update proposed building characteristics based on the latest information and specifications on systems, assemblies, and equipment in the current design. This can be accomplished as early as design development to estimate projected savings, and later updated when the construction documents are complete. Then analyze remaining efficiency strategies that the team would like to consider before the design documents are finalized. For example, the proposed building performance energy model could be used to evaluate the performance and cost implications of value engineering decisions.

In most cases, the ASHRAE 90.1 proposed building performance model will exactly mirror the project design. However, ASHRAE 90.1 Appendix G indicates some specific cases where the modeled parameters may vary from the actual design. Examples include:

1. All conditioned spaces in the proposed design, with the exception of a few space types must be simulated as being both heated and cooled even if a heating or cooling system is not installed (Table G3.1(Proposed)(1)(b)).
2. HVAC fans used for ventilation shall be cycled on and off to meet heating loads during unoccupied hours, even if the systems are scheduled to remain off during unoccupied hours in the project design (Table G3.4(Proposed)(4)).
3. Lighting in unfinished spaces shall be modeled as meeting ASHRAE 90.1-2016 Table 9.5.1 prescriptive requirements.

### Building the Baseline Building Performance Model

Developing the baseline building performance model is a detailed process that requires a good working knowledge of ASHRAE 90.1–2016, Appendix G. The baseline model represents a typical design for a building of the same size, function, and number of floors as the proposed building. It meets the prescriptive and mandatory requirements of ASHRAE 90.1-2004 for a building with standard practice HVAC, lighting, plumbing and envelope systems.

In general, baseline building performance energy model development begins by changing the inputs for all the components, assemblies, systems, and controls of the proposed building performance energy model to values, types, and controls prescribed in accordance with 90.1–2016 Appendix G. Whereas previous versions of ASHRAE 90.1 Appendix G required the energy modeler to determine Baseline parameters by referring to the prescriptive requirements in Sections 5 through 10 of the standard, ASHRAE 90.1-2016 Appendix G is self-contained, and includes the relevant referenced requirements within the Appendix. This should simplify the Baseline modeling process for projects using Appendix G.

Determine or update all relevant baseline inputs for the appropriate climate zone, building type, and building area.

When developing the baseline building performance model, ensure that additional HVAC system types in addition to the predominant HVAC system type are modeled as required in G3.1.1 (b) through (h). Spaces that are served by a different HVAC system in the proposed design due to load or schedule variances, different building functions, or cross-contamination requirements, will also often be served by a different system type in the baseline building due to the requirements stipulated in G3.1.1(b) through (h). Examples include:

- Per G3.1.1(b), a security office operating 24x7 and a kitchen with high peak summer cooling loads located in a midrise office building will each be modeled with a single zone system in the Baseline due to peak thermal loads that differ by 10 Btu/h*ft2 or more from the average of other spaces served by the system, and/or schedules that differ by more than 40 equivalent full-load hours from other spaces served by the system.
- Laboratory spaces in buildings with significant laboratory exhaust will be modeled as a single VAV system serving only those spaces per G3.1.1(d).
- A mixed use residential and non-residential building will be modeled with both residential and non-residential system types if the total area associated with each space type exceeds 20,000 square feet per G3.1.1(b).
- A heated only warehouse space will be modeled with a heated-only system (System type 9 or 10) while the adjacent office area will be modeled with both cooling and heating per G3.1.1(e).

If the energy simulation software automates some or all the baseline generation, review the automated baseline model inputs against the expected baseline values and confirm consistency (see *Further Explanation, Common Issues with Energy Modeling*).

Preparation of the initial baseline building performance model is best undertaken during the design development phase, after major design decisions have been made, so that modeling can evaluate whether the project is likely to meet energy savings targets (or achieve points under the related credit). The baseline building performance model will typically need to be updated upon completion of the final project design.

### Schedules

If anticipated operating schedules are unknown, helpful guidance for determining model inputs for occupancy, lighting, HVAC system, receptacle power, and service hot water consumption values can be found in the ASHRAE 90.1–2016 User's Manual, Appendix G.

Align the time steps used in the modeled schedules with the time steps used for determining peak demand. For elevators, the modeled peak power for the elevator motors must either be scaled down from the instantaneous peak by an equal factor in the baseline and proposed design to represent the hourly peak, or the fractional schedule modeled for elevators shall have a peak operating percentage that aligns with the peak hourly demand as a fraction of the peak instantaneous demand. For example, if the peak elevator motor power for the proposed design is 100 kW, the peak elevator motor power for the baseline design is 120 kW, and the peak hourly demand for the proposed elevators is 5 kW, the elevator motor power shall either be modeled as: hourly schedules that peak at 100% of design power, and peak hourly demand modeled as 5 kW in the Proposed Design and 6 kW in the Baseline design; or hourly schedules that peak at 5% (including for Baseline HVAC system sizing), and peak hourly demand modeled as 100 kW in the Proposed Design and 120 kW in the Baseline design.

Similar schedule or peak hourly load adjustments apply for receptacle power (with maximum connected load versus peak hourly demand) and service water heating (with maximum instantaneous flow versus peak hourly demand).

Schedules must be identical in both the baseline and the proposed cases unless documented in an exceptional calculation or specifically allowed by ASHRAE 90.1–2016 Appendix G (see *Further Explanation, Exceptional Calculation Method*).

Certain space types may require specific schedules based on anticipated operation and may vary by space type. For example, a server room may have different temperature schedules than an occupied space. Exceptions to Section G3.1.1 may require modeling of a different baseline HVAC system type in spaces with schedules that vary significantly from the rest of the building.

Different lighting schedules should be used for a project with both office and retail occupancy when the space-by-space method is used, or when the building area method is used with multiple building type classifications. Different schedules cannot be used, however, if an average lighting power density is applied to the whole project.

### Energy Cost

For EA Prerequisite Minimum Energy Performance and EA Credit Optimize Energy Performance, baseline and proposed costs must be determined on an energy cost basis using actual utility rates or the state's average energy prices referencing US Energy Information Administration (EIA) state average annual rates per fuel source for the most recent year for projects in the U.S., or the most recent published national or provincial average annual rates per fuel source for projects outside the U.S.

For each energy source serving the building, the utility rates or tariffs must be identical for the Baseline and Proposed building models.

For projects using actual rates:

- The modeled rates shall include all components of the rates applicable to the building (i.e. consumption charges, demand charges, monthly or time-of-use variations in rates, distribution and transportation charges, etc.). Monthly or average annual rates shall be limited to applications where this is the only information available to the project (i.e. campus projects where blended rates are calculated for the whole campus).
- If the baseline model has a fuel source not included in the proposed design (i.e. natural gas or propane), the rates shall be determined based on current rates available in the project location (e.g. a current natural gas tariff applicable to similar buildings that have natural gas service in the project location).

Energy cost savings is referenced as a metric for overall building energy efficiency:

- It aligns with the energy modeling procedures in ASHRAE 90.1–2016, Appendix G
- It captures the relative effects of various efficiency measures on energy demand and long-term operating costs—valuable metrics for the owner in determining the overall cost-effectiveness of selected efficiency strategies.
- It can help designers understand energy consumption because in many cases, cost and environmental impacts of each fuel source are correlated.

For the cost metric, on-site renewable energy that complies with ASHRAE 90.1-2016 Section G2.4.1 requirements may be documented for credit under EA Prerequisite Minimum Energy Performance and EA Credit Optimize Energy Performance. Off-site renewable energy and any on-site renewable energy not meeting the criteria of Section G2.4.1 is ineligible for credit when applying the cost metric (See Further Explanation, Applying Renewable Energy Savings).

### Greenhouse Gas Emissions

LEED v4.1 incorporates greenhouse gas emissions (also referred to as CO2 equivalent emissions) as a metric for building energy performance. Understanding greenhouse gas emissions from building energy use and prioritizing building emissions reductions is critical for addressing climate change.

The total greenhouse gas emissions metric, in terms of carbon dioxide equivalents, shall be calculated for the baseline building performance rating and for the proposed building performance rating, and the percentage improvement shall be determined using carbon dioxide equivalent emissions. For each energy source serving the building, the GHG emission factors must be identical for the Baseline and Proposed building models.

Greenhouse gas emissions factors per fuel source shall be determined as follows (the most recently available annual data shall be used unless otherwise indicated):

- United States or Canada:
    - Use U.S. Environmental Protection Agency's (EPA) Greenhouse Gas Factors for the most recently available year (see Energy Star Portfolio Manager Technical Reference: Greenhouse Gas Emissions or https://www.epa.gov/egrid/data-explorer).
        - For electricity, use indirect greenhouse gas emission factors per eGRID region in the U.S., and indirect greenhouse gas emission factors per province in Canada.
        - For fuel (including biomass), use direct GHG emissions factors per fuel source, as applicable.
        - For purchased heating or purchased chilled water, use indirect GHG emissions factors per fuel source.

    OR

    - Continental US (required if documenting Optimize Energy Performance Credit greenhouse gas emissions savings for Tier 2 new off-site renewables)
        - Electricity hourly emissions factors: Use hourly Cambium Levelized Long-Run Marginal Emission Rates published by NREL for the project's Generation and Emission Assessment (GEA) region with characteristics as defined in the *LEED Hourly Cambium, Demand Adjusted Energy Metrics Calculator*. The hourly electricity consumption is multiplied by the hourly $CO_2e$ emissions factor to determine the hourly $CO_2e$ emissions.
        - Other Fuels: Use the total $CO_2e$ emissions factors that include both direct and indirect $CO_2e$ referenced in the *LEED Hourly Cambium, Demand Adjusted Energy Metrics Calculator*.

      Note: *These references account for both indirect and direct emissions (i.e. combustion + pre-combustion), leading to higher reported GHG emissions for fossil fuel and for the portion of eGRID electricity generated by fossil fuel).*

- European Union:
    - European Environment Agency (EEA) – National emissions reported to the United Nations Framework Convention on Climate Change (UNFCCC) and complete energy balances from Eurostat. (https://www.eea.europa.eu).

- All other locations, and EU countries without EEA data reporting
    - Climate Transparency - Enerdata national emissions factors (https://www.climate-transparency.org; https://www.enerdata.net/).

For references above that report only electricity emissions factors, use the U.S. Environmental Protection Agency's (EPA) direct GHG emissions per fuel source published in the Energy Star Portfolio Manager Technical Reference: Greenhouse Gas Emissions for all non-electric fuel sources.

Refer to *Further Explanation, Applying renewable savings* for further guidance on demonstrating renewable energy savings within the energy model. For projects in the continental United States, note that the contract for Tier 2 New Off-site renewable energy must include sufficient information to identify the grid region, and a reasonable estimation of the hourly generation profile to contribute to GHG emissions savings in EAc Optimize Energy Performance.

*Custom GHG Emissions factors:*

Projects outside the U.S. may document custom GHG Emissions factors to be approved on a case-by-case basis for published national or regional CO2 equivalent emissions per fuel source, particularly references that include hourly electric emissions factors. Supplemental documentation shall be provided to demonstrate that the methodology for calculating the emissions factors, and assumptions per fuel input source are derived consistently. For reporting methods that separate "renewable" and "non-renewable" emissions (e.g. for wood fuel classified as renewable in the project location; or for national average electric emissions that separately report renewable versus non-renewable emissions), the total renewable plus non-renewable emissions factors shall be used. For non-electric fuel sources, if the electricity emissions factors are calculated based on fuel inputs that include both indirect and direct emissions (i.e. combustion + pre-combustion), use the total CO2e emissions factors that include both direct and indirect CO2e referenced in the *LEED Hourly Cambium, Demand Adjusted Energy Metrics Calculator*.

*Electricity hourly emissions factors:*

For a more granular picture of greenhouse gas emissions reduced through building efficiency, renewables procurement, and grid harmonization strategies, projects are encouraged to use hourly electricity emissions profiles when available. In the continental United States, NREL has published Cambium hourly long run marginal emissions profiles estimated based on prospective power sector scenarios for each Generation and Emission Assessment (GEA) region. The specific power sector scenario and characteristics used for LEED documentation are referenced in the *LEED Hourly Cambium, Demand Adjusted Energy Metrics Calculator*.

Hourly emissions for baseline electricity, baseline unregulated electricity, and proposed electricity are calculated by multiplying the hourly electricity greenhouse gas emission factors from the project's grid region by the hourly electric consumption from the energy simulation for the baseline design, baseline design unregulated electricity, and proposed design respectively. The hourly electric emissions for each case are summed together to determine the associated annual greenhouse gas emissions. Hourly emissions for qualifying Tier 2 off-site renewable energy are determined based on the renewable asset's GEA grid region and hourly electricity generation from the renewable asset (See Further Explanation, Applying renewable savings).

Some energy software can include this hourly emissions calculation directly into the energy model (similar to a utility rate), while other energy software may require post-processing of hourly electric consumption to perform the simple calculation. For projects in the continental United States, the *LEED Hourly Cambium, Demand Adjusted Energy Metrics Calculator* completes this post-processing based on hourly electricity data and monthly non-electric energy data imported into the calculator from the energy model. Most energy simulation software provides hourly and monthly energy outputs in a delimited format and can be quickly imported into the calculator.

For prerequisite compliance, only renewable energy meeting the ASHRAE 90.1-2016 definition for on-site renewable energy may be modeled for credit when using the GHG metric for compliance. For Optimize Energy Performance credit compliance, Tier 2 off-site renewable energy may also be modeled for credit. For projects claiming credit for GHG emissions reductions associated with Tier 2 off-site renewable energy in EA credit Optimize Energy Performance, building GHG emissions and avoided GHG emissions from Tier 2 off-site renewable energy can be modeled using the hourly generation profile from the project's grid region and the renewable generation grid region in locations where hourly emissions factors are available.

### Applying Renewable Energy Savings

Credit for on-site and new off-site renewable energy may be documented as follows, either directly in the proposed energy model, or applying post-processing of the proposed energy model results.

- On-site renewable energy:
  Energy costs and greenhouse gas emissions savings associated with on-site or on-campus renewable energy systems may be documented for EA Prerequisite Minimum Energy and EA Credit Optimize Energy Performance when the following criteria are met:

- Per ASHRAE 90.1-2016 Section G2.4.1, the renewable systems are included on the building permit and used in the building. LEED also recognizes renewable systems that are on a master site permit for a contiguous campus that includes the LEED project when the renewable energy is used in the contiguous campus.
- Energy is generated from renewable sources produced at the building site or master site per ASHRAE 90.1-2016 definitions.
- All associated environmental attributes are retained by the building owner.

*Note:* earlier versions of LEED allowed some biofuels produced off-site to qualify as on-site renewable energy. However, based on the clarifications provided in ASHRAE 90.1-2016 for on-site renewable energy, and the clearer distinction between on-site and off-site renewable energy in LEED v4.1, biofuels are only considered on-site renewable systems when the renewable source is harvested on site or on a contiguous campus, and used for on-site generation of electric or thermal energy. Furthermore, the renewable system must be part of the LEED project scope of work (or campus development scope of work including the project) under the ASHRAE 90.1-2016 requirements. Therefore, electric generation or thermal generation from renewable fuels sourced off-site and transported to the building site are not considered on-site renewable generation.

The renewable energy generation shall be documented using a method that accounts for all losses, with relevant design criteria and local climatic conditions incorporated into the calculations. Free web-based tools produced by U.S. national laboratories are available for estimating annual, monthly, and hourly energy generation from solar photovoltaics. For on-site renewable generation of electricity, projects using net metering may claim credit for all electric generation on an annual basis, up to 100% of the electricity documented in the energy model (including electricity associated with District Energy Systems serving the project, and documented using v4 Reference Guide, *Further Explanation, Project Type Variations, District Energy Systems, Full DES Performance Accounting*). For on-site renewable generation of thermal energy, documentation shall be provided to support that the hourly thermal energy generation, available thermal storage capacity, and relevant thermal losses are evaluated in conjunction with the hourly thermal load profile.

ASHRAE 90.1-2016 Section G2.4 states that on-site renewable energy "shall be subtracted from the *proposed design energy* consumption prior to calculating the *proposed building performance.*"

- Cost Metric: The equivalent cost of the on-site renewable energy system can be calculated in two ways, virtual rate or actual utility tariff.
  - Virtual rate. The project team may use the virtual energy rate determined by the proposed building energy model used for EA Credit Optimize Energy Performance. The virtual rate accounts for both consumption and demand charges. Project teams that use the Energy Information Administration's average energy prices must use the virtual rates to determine the renewable energy system cost.
  - Actual utility tariff. Calculate the expected savings in both consumption and demand charges, based on the rates charged by the utility that serves the project. If a project is served by a utility that uses time-dependent valuation to set rates, the team must provide hourly calculations for the value of generated energy. Some energy modeling software may calculate the savings from renewable energy systems if the utility rates include consumption, demand, time-dependent valuation, time-of-use, ratchets, and other factors.

Annual cost savings for renewable electricity generation shall not exceed 100% of the annual electricity cost documented in the proposed energy model before applying renewable savings.

- Greenhouse gas emissions metric: the proposed emissions associated with the on-site renewable generation shall be calculated using the same methodology as the proposed design (i.e. annual average GHG emissions factors per energy source, or hourly electric emissions). If using hourly electric emissions, the project must document the hourly renewable generation profiles for any on-site renewable electric generation. Annual GHG emissions savings for on-site renewable electric generation on an annual basis shall not exceed 100% of the annual electric GHG emissions documented in the energy model before applying renewable savings.

- Tier 2 New Off-site renewable energy:
Greenhouse gas emissions offset by Tier 2 New off-site renewable energy systems qualifying under EA credit Renewable Energy may be included in the model for achievement of points using the greenhouse gas emissions calculation under EA credit Optimize Energy Performance, but may not be included in the model for EA Prerequisite Minimum Energy Performance compliance.

Hourly GHG Emission requirements:
Projects located in the continental United States or in any other location where hourly GHG electric greenhouse gas emissions factors are available must document performance for the baseline, proposed design, and renewable generation using hourly electric emissions factors. Therefore, for projects in the continental United States, the contract for the renewable asset must include sufficient information to identify the grid region, and a reasonable estimation of the hourly generation profile for the renewable asset. Many larger contracts include the renewable project location and renewable generation hourly profile in the contract documents, as a set of twelve monthly profiles, indicating the typical 24-hour generation profile for each month of the year. For smaller contracts, if the renewable asset location and characteristics are indicated on the contract, the hourly generation profile can be estimated:
  - Photovoltaic generation: If the photovoltaic generation location, module type, array type, system losses, tilt, and azimuth are known, NREL's free online PVWatts tool may be used to calculate the hourly solar generation profile.
  - Wind generation: If the wind generation location and annual generation amount are known, hourly wind generation data from the US Hourly electricity grid monitor for the balancing authority closest to the project generator may be used to generate an hourly profile, calculating the hourly wind generation as a percentage of total annual wind generation for that location (https://www.eia.gov/electricity/gridmonitor/).

Avoided hourly GHG emissions from Tier 2 New off-site renewable energy are calculated by multiplying the hourly electricity greenhouse gas emission factors from the renewable asset's grid region by the hourly electric generation from the renewable energy system. For projects in the continental United States, these hourly calculations are performed automatically in the *LEED Hourly Cambium, Demand Adjusted Energy Metrics Calculator* based on data inputs indicating the hourly renewable generation and the renewable asset's grid region. Annual GHG emissions savings for renewable electric generation shall not exceed 100% of the annual electric GHG emissions documented in the proposed energy model before applying renewable savings.

- Tier 1 on-site renewable energy systems that do not meet the contractual requirements of ASHRAE 90.1-2016 Section G2.4 may document achievement of points using the greenhouse gas emissions calculation under EA credit Optimize Energy Performance using the guidance for Tier 2 New off-site renewable energy systems.

### Exceptional Calculation Method

Refer to the LEED v4 reference guide, with the following modifications:

- Replace all instances of ASHRAE 90.1–2010 with ASHRAE 90.1–2016
- Delete the first paragraph in the *Additional guidance* section
- Delete the *Changes from earlier versions of ASHRAE and LEED* section
- Refer to Rating System Variations, Data Centers for exceptional calculations that may be applied to data centers that comprise a portion of the project area.
- Refer to Rating System Variations, Retail for exceptional calculations that may be applied to commercial cooking equipment, appliances, or commercial refrigeration.

### ASHRAE 90.1-2016 versus 2010

The referenced standard for building the baseline model for this prerequisite has been updated to ASHRAE 90.1–2016, which represents a substantial increase in efficiency from ASHRAE 90.1–2010. Some of the major changes are described in Tables 1 and 2. Detailed changes between ASHRAE 90.1-2010 and ASHRAE 90.1-2013 are described in ASHRAE 90.1-2013 Appendix F. Detailed changes between ASHRAE 90.1-2013 and 90.1-2016 are summarized in ASHRAE 90.1-2016 Informative Appendix H.

Table 1. Changes in ASHRAE 90.1 mandatory requirements, 2010 to 2016

| Building Envelope Requirement | ASHRAE 90.1-2016 |
|---|---|
| Heated or Cooled Vestibule requirement (6.4.3.9) | Requires heated or cooled vestibules to limit setpoint temperatures, and automatically shut off heating when outdoor air temperature exceeds a certain level. |
| Verification of Envelope requirements (4.2.4, 4.2.5, 5.2.1, 5.2.9) | Adds verification requirements for envelope components including insulation, air leakage, and other properties. |
| **HVAC & Refrigeration Requirement** | **ASHRAE 90.1-2016** |
| Refrigerators and Freezers (Tables 6.8.1-12 and 6.8.1-13) | Maximum energy consumption regulated for some commercial refrigerators and freezers |
| HVAC Equipment (Tables 6.8) | Increased efficiencies for HVAC equipment, and increased capacity control for some packaged equipment |
| Humidification and Dehumidification (6.4.3.6) | Increased control requirements prohibiting the use of fossil fuel and electricity for humidification above 30% RH and dehumidification below 60% RH in most circumstances. |
| Demand Control Ventilation (6.4.3.8) | Reduces the occupancy threshold where DCV is required from 40 people per 1,000 ft$^2$ to 25 people per 1,000 ft$^2$ |
| Heating and Cooling Setbacks (6.4.3.3) | Requires heating setback at least 10°F (6°C) below occupied heating setpoint, and cooling setback at least 5°F (3°C) above occupied cooling setback.<br><br>*Note: These setbacks must be part of the Baseline and Proposed schedules modeled using the Performance method.* |
| Optimum start control (6.4.3.3.3) | Optimum start controls required for more building types |
| Duct Insulation (6.4.4.1.2) | Increases ductwork insulation requirements |

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|---|---|
| DDC control (6.4.3.10) | DDC Control required for a much larger array of building applications |
| HVAC alterations (6.1.1.3.1) | Requires replacement HVAC&R equipment to meet most requirements |
| Pool Dehumidifier (6.4.1.1) | Establishes efficiency requirements for indoor pool dehumidifier |
| Fault Detection (6.4.3, 6.4.3.12) | Adds fault detection requirements |
| **Power Requirement** | **ASHRAE 90.1-2016** |
| Automated receptacle control (8.4.2) | Expands the spaces where automated receptacle control is required and provides further details regarding acceptable methods for receptacle controls |
| Electrical Monitoring (8.4.3) | Adds monitoring requirements to submeter tenant energy and electric end uses |
| Automated receptacle control (8.4.4) | Adds transformer performance requirements |
| **Lighting Requirement** | **ASHRAE 90.1-2016** |
| Daylighting Controls (9.4.1.1) | Requirements updated for areas where mandatory daylighting controls are required. |
| Automatic shutoff of lighting and switched receptacles in hotel guestrooms (9.4.1.3) | Adds requirements for automated shutoff of lights and switched receptacles in hotel/motel guestrooms |
| Lighting Controls (9.4.1.1) | Additional lighting controls requirements including partial automatic ON, inclusion of emergency circuits in scheduled shutoff requirements, additional shutoff controls for exterior lighting, increased parking garage occupancy controls. |
| Lighting Efficacy (9.4.1) | Adds efficacy requirements for residential dwelling unit lighting |
| Lighting Alterations (9.1.2) | Increases requirements for alterations to existing building lighting systems |
| Exterior Lighting Power (9.4.2) | Reduces exterior lighting power allowances |
| **Motor Requirement** | **ASHRAE 90.1-2016** |
| Motor Efficiency (10.4.1) | Increases motor efficiencies |
| Escalators (10.4.3 and 10.4.4) | Adds requirements for escalators, moving walkways, and elevators |
| Whole Building energy monitoring (10.4.5) | Adds requirement to monitor whole building energy use for energy supplied by a utility, energy provider, or plant not located in the building |

Table 2. Changes in ASHRAE 90.1 prescriptive requirements, 2010 to 2016

| Building Envelope Requirement | ASHRAE 90.1-2016 |
|---|---|
| Opaque and Fenestration Efficiencies (Tables 5.5-1 through 5.5-8) | More stringent insulation levels for opaque elements in most climate zones.<br><br>Fenestration: More stringent U-factor requirements for most assemblies, more stringent SHGCs in warmer climates. Additional fenestration framing types added. |
| Fenestration area by orientation (5.5.4.5) | Specific limitations added for fenestration area by orientation |

| | |
|---|---|
| Fenestration Visible Transmittance (5.5.4.6) | Minimum visible transmittance to solar heat gain coefficient ratio added. |
| **HVAC & Refrigeration Requirement** | **ASHRAE 90.1-2016** |
| Heat Rejection Fan Control (6.5.5.2) | Fan control required for multi-cell heat rejection equipment |
| Cooling tower flow turndown (6.5.5.4) | Cooling towers with multiple or variable speed condenser water pumps have added controls requirements associated with flow rate |
| Small motors (6.5.3.5) | Most motors under 1 hp required to be electrically commutated or have minimum efficiency of 70%. |
| Boiler Turndown (6.5.4.6) | Large boilers required to have minimum turndown ratio |
| Fan Power Allowance (Table 6.5.3.1B) | Changes to fan power pressure adjustments. Some allowances previously allowed to be used for a broad range of systems such as fully ducted return and exhaust are limited to specific systems. |
| Dehumidification (6.5.2.3) | Requires most reheat used for dehumidification to be from recovered or site-generated sources |
| Fluid Flow (6.5.4.1 through 6.5.4.3) | Requires automatic shutoff of pumps and boilers when fluid flow through the chillers or boilers is not operating, reduces low flow limit exceptions, requires variable flow in more hydronic system applications |
| Computer rooms (6, 6.6) | Adds requirements specific to computer rooms, including air and water economizer requirements |
| Transfer air (6.5.7.1) | Limits conditioned supply of transfer air between spaces |
| VFD Return and Relief Fans (6.5.4.1, 6.5.4.3) | Requires VFD control of return and relief fans larger than 0.5 hp. |
| Fan Powered VAV control | Specifics control of fans in fan-powered parallel VAV boxes |
| Energy Recovery (Tables 6.5.6.1-1 and 6.5.5.6.1-2) | Revises minimum threshold for energy recovery |
| Water-side economizers | Requires water-side economizers for radiant cooling or passive chilled beam systems |
| **Lighting Requirement** | **ASHRAE 90.1-2016** |
| Interior Lighting Power Density (Tables 9.5.1 and 9.6.1) | Extensive changes to the Interior Lighting Power Density requirements. |
| Decorative Lighting (9.6.2) | Reduces additional lighting allowance for decorative lighting |

Table 3. Changes in ASHRAE 90.1 Performance Rating Method Requirements, 2010 to 2016

| General Requirement | ASHRAE 90.1-2016 Appendix G |
|---|---|
| Performance Rating Method Scope (G1.1) | Appendix G can be used to demonstrate code compliance (Previously it only applied to demonstrate above-code performance). |
| Performance Rating Calculation (G1.2.2 / 4.2.1.1) | A stable baseline that references ASHRAE 90.1-2004 prescriptive values is introduced.<br><br>Performance Cost Index Target ($PCI_T$) is calculated using Building Performance Factors (BPF) for each building type and climate zone in conjunction with Baseline Building Unregulated Energy Consumption (BBUEC) and Baseline Building Performance (BBP). |

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| | Building Performance Factors represent the ratio of regulated energy cost for a 90.1-2016 versus a 90.1-2004 compliant building.<br><br>This allows relatively few changes to the Baseline Building modeling methodology between code cycles, with the major change being the BPF determinations. |
| Self-contained references | The Baseline modeling requirements are contained within ASHRAE 90.1-2016 Appendix G, and do not require references to the prescriptive requirements of Sections 5 through 10. |
| Unmodified existing building components (Table G3.1#2(Baseline)) | Unmodified existing building components are required to follow the same rules as new and modified building components.<br><br>Previously some existing building components (such as existing building envelope components) could be modeled using existing unrenovated performance in the Baseline and as-designed with renovations in the Proposed. |
| Unfinished spaces | For unfinished spaces, the proposed efficiencies, controls, lighting power densities, etc. are modeled consistent with the ASHRAE 90.1-2016 prescriptive requirements, and are not modeled identically to the Baseline. |
| Schedules | ASHRAE 90.1-2016 Appendix G |
| HVAC setpoint schedules (Table G3.1#4) | Projects may adjust schedules to demonstrate credit for HVAC systems that automatically provide occupant thermal comfort via means other than direct control of air dry-bulb and wet-bulb temperature. |
| Building Envelope Requirement | ASHRAE 90.1-2016 Appendix G |
| Vertical Fenestration Area (Table G3.1#5(Baseline)(c)) | Vertical fenestration area modeled in the Baseline is less than 40% for many building occupancies.<br><br>Credit is allowed when the proposed vertical fenestration area is lower than the values shown in Table G3.1.1-1 for applicable building types. |
| Infiltration (Table G3.1#5(Proposed)(b), G3.1.1.4) | Specific infiltration rates are required to be modeled. Credit is allowed for improved infiltration for projects performing air leakage testing. |
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| HVAC & Refrigeration Requirement | ASHRAE 90.1-2016 Appendix G |
| HVAC System Type (G3.1.1, Table G3.1#10, Table G3.1.1-3, Table G3.1.1-4) | Baseline system heating type is dependent on climate zone rather than predominant heating source used in the building. Baseline systems in climate zone 0 to 3A are modeled with electric heating and baseline systems in climate zones 3B through 8 are modeled with fossil fuel heating.<br><br>Baseline fossil fuel heating systems shall always be modeled using natural gas, or propane in locations where natural gas is not available. Previous versions of Appendix G required the fuel type to be the same in the Baseline and Proposed case. |

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| | Further clarity is provided for identifying the order of priority for determining the Baseline HVAC system types applicable for the building.<br><br>Additional HVAC system type categorizations added for public assembly, retail buildings up to two floors, hospitals, computer rooms. |
| HVAC equipment efficiencies (G3.1.2.1) | Projects are required to model both part load and full load efficiencies per Tables G3.5.1 through G3.5.6 where applicable.<br><br>A clear method is provided for calculating the modeled Baseline cooling and heating COP for packaged equipment. |
| Night-time fan cycling (G3.1.2.4) | For System 6 and 8 (Parallel fan-powered VAV terminals with electric heating), the terminal unit fan and reheat coil are energized to meet the heating unoccupied setpoint in the space rather than the entire VAV system serving the floor. |
| Computer room fluid economizer (G3.1.2.6.1) | Computer room fluid economizers required for computer rooms where the Baseline system type is system 11. |
| Baseline Humidity Controls (G3.1.3.18 and Table G3.1#10(Baseline) | If the Baseline system type does not comply with humidistatic control requirements, then only 25% of system reheat energy shall be included in the baseline building performance.<br><br>If the proposed design includes humidification, the baseline design shall use adiabatic humidification |
| Baseline Preheat (G3.1.3.19) | Preheat is required to be modeled for Baseline Systems 5 through 8, and controlled to a fixed setpoint 20°F (11°C) less than the design room heating temperature set point. Modeling of preheat in the Baseline is no longer dependent on the presence of preheat in the Proposed design. |
| Baseline Refrigeration (Table G3.1#17) | Refrigeration equipment is required to be modeled as specified. |
| **Lighting Requirement** | **ASHRAE 90.1-2016 Appendix G** |
| LPD Modeling Method (Table G3.1#6(Baseline)) | All building spaces are modeled using the Space-by-Space Method. (Previous versions of ASHRAE allowed projects to use the space-by-space or building-area methods). |
| Automated Controls (Table G3.1#6(Proposed)) | Control credit is modeled in the Proposed design for all spaces where applicable controls are included (including mandatory controls required by 90.1-2016). |
| **Service Water Heating** | **ASHRAE 90.1-2016 Appendix G** |
| Baseline System Type (Table G3.1.1-2) | Baseline service water heating system type is determined based on building type, with electric resistance point-of-use for convenience store, electric resistance storage for most commercial applications with low service water heating usage, and gas storage water heaters for residential buildings and commercial applications with high service water heating usage. In previous versions of ASHRAE, the service water heating type was modeled identically in the Baseline and Proposed Case |
| Service Water Heating Loads (Table G3.1#11(Baseline)(h) | A specific methodology is used for determining service water heating loads. Loads must be modeled identically in the baseline and proposed case, except when calculations show savings associated |

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| | with reduced fixture flow, reduced required temperature of service mixed water, heat recovery for makeup water, etc. |
| **Power and Equipment Requirement** | **ASHRAE 90.1-2016** |
| Computer room equipment schedule (G3.1.3.16) | The computer room equipment schedule is varied monthly between 25% and 100% of full load as noted. |
| Elevators (G3.9.2, Table G3.1#16) | A specific methodology is provided for calculating baseline and proposed annual elevator energy consumption, Baseline elevator peak motor power, baseline elevator cab ventilation, and baseline elevator lighting power density. |

### Additional Energy Modeling Guidance

Thoroughly review both ASHRAE 90.1–2016 and the 90.1–2016 User's Manual. The manual presents extended explanations and also includes examples of the concepts and requirements within the standard.

The Pacific Northwest National Laboratory (PNNL) ANSI/ASHRAE/IES Standard 90.1-2016 Performance Rating Method Reference Manual also provides detailed modeling guidance which can be used when developing a 90.1-2016 Baseline and Proposed model (https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-26917.pdf).

### Rating System Variations

Core and Shell

Refer to the LEED v4 reference guide, with the following modifications:

- Replace instances of ASHRAE 90.1–2010 with ASHRAE 90.1–2016
- Energy cost savings are based on a building's total annual energy consumption, rather than on the owner's scope of work, so the owner of a core and shell project may have only a limited opportunity to improve energy savings. The percentage improvement thresholds for achievement of Option 1 in EA credit Optimize Energy Performance are therefore lower for Core and Shell projects than for New Construction.
- For unfinished spaces, the proposed efficiencies, controls, lighting power densities, etc. are modeled consistent with the ASHRAE 90.1-2016 prescriptive requirements, and are not modeled identically to the Baseline.

Retail

For all process loads, define a clear baseline for comparison with the proposed improvements.  the baseline and design as follows:

- Commercial kitchen equipment addressed by California EnergyWise energy cost calculators may use the energy savings and percentage annual cost savings documented in these calculators to determine the Baseline annual energy consumption and Proposed annual energy consumption associated with the equipment, without additional documentation. Commercial kitchen equipment that has California EnergyWise options for natural gas or electricity may optionally be modeled using natural gas in the baseline and electricity in the proposed design, or may be modeled using the same energy source in the baseline and proposed.
- *Appliances and equipment.* For appliances and equipment not covered by California EnergyWise energy cost calculators, indicate hourly energy use for proposed and budget equipment, along with estimated daily use hours. Use the total estimated appliance/equipment energy use in the energy simulation model as a plug load. Reduced use time (schedule change) is not a category of energy improvement in this credit. ENERGY STAR ratings and evaluations are a valid basis for performing this calculation.
- *Display lighting.* For display lighting, use the space-by-space method of determining allowed lighting power under ANSI/ASHRAE/IESNA Standard 90.1–2016, with errata (or a USGBC-

approved equivalent standard for projects outside the U.S.), to determine the appropriate baseline for both the general building space and the display lighting.
- *Refrigeration.* For hard-wired refrigeration loads, model the effect of energy performance improvements with a simulation program designed to account for refrigeration equipment.

<u>Data Centers</u>
Refer to the LEED v4 reference guide, with the following modifications:
- Replace the *Modeling requirements* section with the section below.
- The computer room equipment schedule is varied monthly between 25% and 100% of full load as noted in ASHRAE 90.1-2016.

*Modeling requirements*
Energy modeling is required for all data center projects.

*IT equipment energy and electrical infrastructure energy savings*
Because of the high process loads associated with IT equipment and its electrical infrastructure, many project teams look to these traditionally unregulated energy end uses for energy savings. Though not required, if the project team is attempting to claim energy savings from these end uses, the data center calculator may provide a simplified method (see *Data Center Calculator*, below).

The reduced energy consumption of the IT and electrical equipment can help reduce HVAC energy usage. Project teams have the option of claiming the process load savings in isolation or creating an additional energy model based on the adjusted loads to capture the associated HVAC energy savings.

To determine total energy cost savings, it may be necessary to create three energy models. Below is a list of the models that may need to be created. The specific requirements of each model are detailed below.

1. Proposed model with as-designed IT loading (normal performance rating method, PRM, model)
2. ASHRAE baseline model with as-designed IT loading (normal PRM model)
3. ASHRAE baseline model with "baseline" IT loading (optional)

If the project team is claiming energy savings related to the IT systems, the total energy savings are calculated between models 1 and 3.

*Proposed model with as-designed IT loading (model 1)*
The model of the building's energy cost must include all regulated energy end uses as listed in the prerequisite criteria, as well as any unregulated energy that is building-specific. The proposed design must use the IT loads and developed for the project and the schedule stipulated in ASHRAE 90.1-2016. The IT loads should be at the values for the intended final buildout of the facility. All electrical system components—examples include incoming transformers, switchgear, UPS systems, and power distribution units—must be modeled. Power losses associated with this equipment should be assigned to the spaces that house the equipment as an electrical load and as a thermal load input to the energy model. Model the quantity of power and cooling equipment designed to run during normal operation to include the effects of operating redundant equipment at partial loading on energy use.

In addition to the ASHRAE 90.1 mandatory compliance requirements, provide energy efficiency data for the following items:

- Generator block heaters (wattage required to keep the block at the design temperature)
- Power distribution wiring
- Battery charging

Submit documentation for the following items, showing efficiency data at initial and full system loading points (loading values are a percentage of total IT load):

- Service transformers
- Switchgear

Uninterruptible power systems

- Power distribution units

*ASHRAE model with full IT loading (model 2)*
Model using the same IT load as the Proposed design, with Baseline inputs consistent with ASHRAE 90.1-2016 Performance Rating Method requirements.

*ASHRAE Baseline model with "baseline" IT loading (model 3)*
This model is used to calculate IT energy savings due to low-energy servers, virtualization, and efficient electrical system design. In contrast to the standard application of exceptional calculation methods to the proposed model, for data center projects, the exceptional calculation is applied to the baseline (model 3). Rather than reducing the energy used in the proposed design, the baseline is increased to reflect the energy usage typical of a data center.

For IT equipment, the USGBC data center calculator provides baseline documentation; if used, additional justification for the baseline IT loads is not necessary. IT equipment input is defined as the IT load as measured at the point of connection of the IT device to the electrical power system. IT equipment input captures the actual power load of the IT device exclusive of any power distribution losses and loads beyond IT devices, such as rack-mounted fans.

The losses associated with all UPS equipment, including that which serves mechanical equipment to achieve continuous cooling during a loss of power (e.g., pumps, air-handling units, and compressors), is considered not part of the IT energy usage but part of the energy consumption required to operate the data center.

If a hydronic cooling system is used for IT cabinets or computers, the energy consumed by the fans built into the cabinet and coolant distribution pumps should be considered HVAC energy use, not IT energy use.

*Data Center Calculator*

Refer to the LEED v4 reference guide.

### *Project Type Variations*

District Energy Systems

Projects that are served by district energy systems (DES) may demonstrate compliance with EA Prerequisite Minimum Energy Performance and EA Credit Optimize Energy Performance by following one of the following methods.

- Path 1 ASHRAE 90.1-2016 Appendix G. No credit is documented for the purchased energy systems.
  - Path 1A. ASHRAE 90.1-2016 Appendix G.
  - Path 1B. ASHRAE 90.1-2016 Appendix G with ASHRAE 90.1-2022 Addendum a. (Revise the Appendix G methodology to remove the inherent penalty for DES)
- Path 2 Full DES performance accounting. Credit is documented for the purchased energy systems. The proposed design is modeled using a virtual plant consistent with the district energy system performance, and the baseline design is modeled with on-site systems from ASHRAE 90.1-2016 Appendix G for site generated thermal energy.
- Path 3 Large-scale District Energy Systems. GHG emissions savings associated with the upstream system are documented using the Large-Scale DES Calculator. No energy efficiency savings (using the cost or source energy metric) are documented for the upstream system.

The modeling path chosen by the project team may depend on the relative efficiency of the DES to which the project is connected, how much DES information is available, or whether an energy model already exists for the system. Whenever possible, incorporate system and equipment performance parameters directly into the energy simulation. Potential methods include developing efficiency curves and scheduling equipment operation and curves. Postprocessing of DES performance is acceptable if reasonable simulation methods are not available or are too onerous. All postprocessing methodologies must be fully documented.

*All Paths: Scope of DES equipment inclusion*

All downstream equipment must be included in the scope of EA Prerequisite Minimum Energy Performance and EA Credit Optimize Energy Performance. Downstream equipment includes heat exchangers, steam pressure reduction stations, pumps, valves, pipes, building electrical services, and controls.

Upstream equipment is included or excluded depending on the chosen path.

*Path 1A. ASHRAE 90.1–2016, Appendix G*

Model the proposed and baseline designs using purchased energy according to ASHRAE 90.1–2010, Appendix G.

*Published purchased energy rates or conversion factors:*

Energy Cost: Per ASHRAE 90.1, model the purchased energy rates for each district energy source (purchased hot water, purchased steam, or purchased chilled water) identically in the baseline and proposed design based on actual utility rates, if actual utility rates are available.

GHG Emissions: For the GHG emissions metric, if the published reference for electricity and fossil fuel GHG emission factors also reports emission factors for district energy (purchased hot water, purchased steam, or purchased chilled water), model these published emission factors for each district energy source identically in the baseline and proposed design.

*Derivation of DES purchased energy rates or GHG emission factors when unpublished:*

If purchased energy rates and/or GHG emission factors are not published for the district energy sources serving the project, derive these purchased energy rates and/or emission factors leveraging the electricity or fossil fuel data. For fossil fuel, use natural gas if the building does not receive fossil fuel and the district energy fuel source is unknown.

- District Chilled Water (CHW):
  CHWFactor = ElectricityFactor x 0.325
- District Hot Water (HHW):
  HHWFactor = FossilFuelFactor x 1.65
- District Steam Water (Steam):
  SteamFactor = FossilFuelFactor x 1.85

Where:

- For the Cost Metric (See further guidance below for purchased energy rates)
  - CHWFactor = Chilled water purchased energy rate ($ / unit energy)
  - HHWFactor = Hot water purchased energy rate ($ / unit energy)
  - SteamFactor = Steam purchased energy rate ($ / unit energy)
  - ElectricityFactor = Electricity purchased energy rate ($ / unit energy)
  - FossilFuelFactor = Fossil Fuel purchased energy rate ($ / unit energy)
    Units of energy must be consistent throughout each equation (i.e. consistently $/kWh or $/kBtu)
- For the GHG Emissions Metric:
  - CHWFactor = Chilled water GHG emissions factor

- HHWFactor = Hot water GHG emissions factor
- SteamFactor = Steam GHG emissions factor
- ElectricityFactor = Electricity GHG emissions factor
- FossilFuelFactor = Fossil Fuel GHG emissions factor
  Units of each GHG emissions factor must be consistent (in weight of CO2eq emissions per unit of energy)

*Additional guidance: Cost Metric ElectricityFactor and FossilFuelFactor.*
For the cost metric, in a flat rate structure, in which the building cost per unit of electricity or building cost per unit of natural gas is the same throughout the year and there are no demand charges, then those flat rates become the ElectricityFactor and FossilFuelFactor for the project cost metric. If all energy rate structures are not flat, a preliminary run of the Option 1 baseline case energy model must first be completed to identify the virtual electric rate (ElectricityFactor) and fossil fuel rate (FossilFuelFactor) for the project.

To obtain the virtual fuel rate (FossilFuelFactor) when the connected building does not use fossil fuel but the DES central plant does, use a flat rate consistent with the central plant rates or the historic average local market rates.

*Path 1B. ASHRAE 90.1-2016 Appendix G with ASHRAE 90.1-2022 Addendum a.*
The project may apply ASHRAE 90.1-2022 Addendum a to the ASHRAE 90.1-2016 Appendix G criteria. This eliminates the inherent penalty in the ASHRAE 90.1-2016 Appendix G Performance Index Targets when modeling "purchased heat" and "purchased chilled water". Replace all ASHRAE 90.1-2022 Addendum a references to Section 6 prescriptive criteria for the *proposed building design* with ASHRAE 90.1-2016 Section 6. For the *baseline building design* HVAC systems, the project team must exclusively reference ASHRAE 90.1-2022 with Addendum a. Free read-only versions of ASHRAE 90.1-2022 are available at https://www.ashrae.org/technical-resources/standards-and-guidelines/read-only-versions-of-ashrae-standards.

90.1-2022 Addendum a criteria as applied to ASHRAE 90.1-2016 Appendix G:

- Model HVAC systems for the *baseline building design* per ASHRAE 90.1-2022 Appendix G criteria as if all heating and cooling generation equipment is on-site;
- Projects with purchased heat: Model the *proposed building design* using natural gas forced draft boilers that prescriptively comply with ASHRAE 90.1-2016 Section 6 in lieu of purchased heat. The number of boilers and boiler controls shall meet the requirements of ASHRAE 90.1-2022 Section G3.2.3.2 through G3.2.3.6, without exceptions. Forced draft boiler efficiencies shall be modeled per the mandatory and prescriptive requirements of ASHRAE 90.1-2016 Section 6. Boiler systems with design input exceeding 1,000,000 Btu/h may document credit for minimum turndown ratios per Table 6.5.4.1.
- Projects with purchased chilled water: Model the *proposed building design* using water-cooled chillers that prescriptively comply with ASHRAE 90.1-2016 Section 6 in lieu of purchased chilled water.
  - Model the type and number of water-cooled electric chillers per ASHRAE 90.1-2022 Table G3.2.3.7 based on the peak coincident cooling load of baseline HVAC systems using chilled water (See 90.1-2022 Section G3.2.3.7).
  - Model the chilled water (CHW) with a design supply temperature of 44 °F (7 °C) and return temperature of 56 °F (13.3 °C) (See 90.1-2022 Section G3.2.3.8)
  - Model each chiller with separate condenser-water and primary chilled-water pumps interlocked to operate with the associated chiller per ASHRAE 90.1-2022 G3.2.3.11. Model the CHW loop as constant-flow primary and variable-flow secondary with the pump power of each loop modeled per 90.1-2022 Section G3.2.3.10, without exceptions. Model secondary loops with a pump motor demand of 30% of design wattage at 50% of design flow per the prescriptive criteria of ASHRAE 90.1-2016 Section 6.5.4.2. For

systems with total modeled chilled water capacity exceeding 300,000 Btu/h (25 kW) utilizing DDC CHW control valves, model chilled water supply temperature reset based on valve positions until one valve is wide open or setpoint limits have been reached per ASHRAE 90.1-2016 Section 6.5.4.4.

- o Model heat rejection as an axial fan cooling tower with design fan power = 40.2 gpm/hp per ASHRAE 90.1-2016 Table 6.8.1-7, and with design supply temperature and leaving water temperature determined per ASHRAE 90.1-2022 G3.2.3.11. If the total fan power for the heat rejection equipment exceeds 5 hp, model the cooling tower fans with variable-speed fan controls that reduce fan motor demand to no more than 30% of design wattage at 50% of design air volume per ASHRAE 90.1-2016 Section 6.5.11.

*Path 2. Full DES performance accounting*

For path 2, the energy model scope accounts for both downstream equipment and upstream equipment and requires calculation of the district energy average efficiencies using engineering analysis or monitored data or a combination of both.

*Energy rates (Cost Metric)*

All DES electricity and fuel rates must be identical in both the baseline and the proposed cases. Use local electricity and fuel rates as they would normally apply to the building for the energy sources under consideration. If this information is not available, use representative market rates.

Exception: For District cooling or district heating plants without cogeneration or fuel cells that operate under specific and atypical electric rate structures and actively take advantage of those rates through strategies such as load management or energy storage, use the rate structures as they apply to the DES.

*Greenhouse Gas Emissions Factors*

See the guidance in Further Explanation, Greenhouse Gas Emissions.

*Baseline building systems*

For systems with thermal energy delivered from the district energy system, model the baseline case with on-site systems per ASHRAE 90.1-2022 Addendum a criteria described above.

*Proposed building plant*

Model the proposed case with a virtual DES-equivalent plant. Use the same efficiencies as the entire upstream DES heating, and cooling, and combined heat and power (CHP) systems, including all distribution losses and energy use.

Equipment efficiencies, distribution losses, and distribution pumping energy may be determined using any of the following methods:

- Monitored data
- Engineering analysis

Efficiencies and losses may be determined and modeled at any level of time resolution, from hourly to annual. However, the time resolution must be sufficiently granular to capture and reasonably represent any significant time- or load-dependent interactions between systems, such as thermal storage or CHP. Monitoring and analytical methods may be combined as necessary and appropriate. Monitoring data for heating, cooling, pumping, and cogeneration may be used only if the thermal loads that are monitored represent at least 90% of the load on the campus or district plant predicted after building occupancy. Whether using monitoring or an analytical method, the methodologies must be fully documented. The following specific requirements apply.

*Heating and cooling plants*
Efficiencies, whether determined through monitoring or analytically, must include all operational effects, such as standby, equipment cycling, partial-load operation, internal pumping, and thermal losses.

*Thermal distribution losses*
Use monitored data or an engineering analysis.

- Monitored data determine the distribution losses for the DES by measuring the total thermal energy leaving the plant and comparing it with the total thermal energy used by the buildings connected to the DES. Rate the plant efficiency accordingly in the energy model:

  Plant efficiency (%) x [100% – distribution loss (%)]
- An engineering analysis takes into consideration all distribution losses between the DES and the building. For distribution main losses, use a prorated amount based on load. For dedicated branch losses, use the total losses of the branch that feeds the building, including heat losses and steam trap losses. Compare the total losses with the total load of the building to get a percentage distribution loss relative to load and downgrade the plant's efficiency accordingly in the energy model.

  If thermal distribution losses are not measured or modeled, use the following default losses:

  - Chilled water district cooling, 5%
  - Hot water district heating, 10%
  - Closed-loop steam systems, 15%
  - Open-loop steam systems, 25%

    For steam systems that are partially open and partially closed, prorate between the above 15% and 25% losses in accordance with the fraction of expected or actual condensate loss.

*Pumping energy*
Whether through monitored data or engineering analysis, determine pumping energy for the project by prorating the total pump energy of the DES by the ratio of the annual thermal load of the building to the total annual DES thermal load. Model the pump energy as auxiliary electrical load. Pumping energy must be determined or estimated where it applies.

*District Energy Combined Heat and Power (CHP)*
To model the proposed design virtual plant, first monitor or model the total electricity generation, fuel input, and heat recovery associated with the District Energy Combined Heat and Power (CHP):

- Determine annual electricity generation using one of the following methods:
  - Monitor the total annual gross electricity generation. Also monitor the total annual parasitic loads, such as the annual electricity used for cooling the intake air for a turbine. Calculate the net annual electricity generation by subtracting all parasitic loads from the annual gross electricity generated.
  - Model the generators in energy simulation software per Appendix G. Use peak electricity efficiencies and generator curves that match the installed generators. Apply measured or estimated load profiles as process loads to reflect the estimated total electric and thermal loads on the district energy CHP system. Use the total energy generated and total fuel input from this analysis. Any parasitic loads must be included in the analysis and subtracted from the annual electricity generation.
- Calculate annual fuel input using one of the following methods:
  - Monitor the total annual fuel input to the generators.

    - Model the generators in energy simulation software per Appendix G. Use peak electricity efficiencies and generator curves that match the installed generators.
- Calculate waste heat recovery using one of the following methods:
    - Monitor the total waste heat recovered.
    - Model the generators in energy simulation software per Appendix G. Use peak electricity efficiencies and generator curves that match the installed generators. Model the thermal equipment served by the CHP waste heat, such as boilers and absorption chillers, using the installed equipment capacities, efficiencies, and efficiency curves, and reflecting the total heating and cooling loads on the plant as a process load. Use the energy modeling outputs to identify the total heat recovered.

For baseline CHP electricity output, follow the general procedures described in this section for the proposed case, and adjust the results as follows depending on the results of the DES electricity allocation and the total modeled electricity use of the building in the Path 2 proposed case, including the electricity consumption of district plant equipment serving the building:

- Scenario A. If the building's allocation of CHP-generated electricity is less than or equal to its modeled electricity consumption, no adjustment is necessary. The baseline building is charged with the energy used by its (non-CHP) systems at market rates using standard procedures.
- Scenario B. If the building's allocation of CHP-generated electricity exceeds its modeled electricity consumption, include the amount of excess CHP electricity case as described in CHP fuel input formulas.

For the proposed design's CHP electricity output, allocate the electricity generation to the building based on the fraction of thermal loads to the building for the DES sources that use recovered waste heat. For each DES source supplied to the building, determine the fraction of the recovered waste heat applied to that source as well as the amount serving the project building. For relatively simple DES systems, in which the recovered waste heat is used directly in the DES, and for which waste heat serves only heating loads in the connected buildings, use the formula for simple systems:

$$CHP\_ELEC_{BLDG}(\text{simple systems}) = (X_{HEAT} \times BLDG_{HEAT}) \times CHP\_ELEC_{TOTAL}$$

where

| | | |
|---|---|---|
| $CHP\_ELEC_{BLDG}$ | = | CHP electricity generation allocated to building |
| $X_{HEAT}$ | = | fraction of CHP plant's total production of waste heat applied to the DES directly |
| $BLDG_{HEAT}$ | = | fraction of total district heat provided to building |
| $CHP\_ELEC_{TOTAL}$ | = | total CHP electricity generated at DES plant |

For CHP plants in which a portion of the recovered heat is used to drive absorption chillers that provide cooling through a DES chilled-water loop, or a portion of the recovered heat is used for a third, separate district energy source (e.g., if the building connects to both a steam loop and a hot-water loop), calculate the electricity generation assigned to each building using the formula for heat recovery-driven chillers.

$$CHP\_ELEC_{BLDG} \text{ (heat recovery-driven chillers)} = (X_{HEAT} \times BLDG_{HEAT}) + (Y_{CHW} \times BLDG_{CHW}) + (Z_{SOURCE} \times BLDG_{SOURCE}) \times CHP\_ELEC_{TOTAL}$$

where

| | | |
|---|---|---|
| $CHP\_ELEC_{BLDG}$ | = | CHP electricity generation allocated to building |
| $X_{HEAT}$ | = | fraction of CHP plant's total production of waste heat applied to the DES directly |
| $BLDG_{HEAT}$ | = | fraction of total district heat provided to building |
| $Y_{CHW}$ | = | fraction of CHP plant's total production of waste heat applied to producing chilled water in DES |
| $BLDG_{CHW}$ | = | fraction of total district chilled water provided to building |
| $Z_{SOURCE}$ | = | fraction of CHP plant's total production of waste heat applied to third district energy source |
| $BLDG_{SOURCE}$ | = | fraction of third district energy source provided to building |
| $CHP\_ELEC_{TOTAL}$ | = | total CHP electricity generated at DES plant |

When modeling CHP fuel input, allocate the CHP input fuel to the project building based on a proration and assignment of the total input fuel according to the results of the CHP electricity allocation described above for CHP electricity output. Use the energy cost and greenhouse gas emissions factors associated with the fuels input to the CHP. For the proposed case (all projects), calculate the CHP input fuel allocated to the building as follows:

$$\text{Proposed } BLDG_{FUEL} = \left( \frac{CHP\_ELEC_{BLDG}}{CHP\_ELEC_{TOTAL}} \right) \times CHP_{FUEL}$$

where

| | | |
|---|---|---|
| Proposed $BLDG_{FUEL}$ | = | proposed case CHP input fuel allocated to building |
| $CHP\_ELEC_{BLDG}$ | = | CHP electricity generation allocated to building (from previous calculations) |
| $CHP\_ELEC_{TOTAL}$ | = | total CHP electricity generated at DES plant |
| $CHP_{FUEL}$ | = | total CHP fuel input for electricity generation at DES plant |

For the baseline (scenario B in CHP electricity output only): calculate the CHP input fuel allocated to the building as follows:

$$\text{Baseline BLDG}_{FUEL} = \left( \frac{\text{PROCESS\_ELEC}_{BLDG}}{\text{CHP\_ELEC}_{TOTAL}} \right) \times \text{CHP}_{FUEL}$$

with

$$\text{PROCESS\_ELEC}_{BLDG} = \text{CHP\_ELEC}_{BLDG} - \text{PROPOSED\_ELEC}_{BLDG}$$

where

| | | |
|---|---|---|
| Baseline $BLDG_{FUEL}$ | = | baseline case CHP input fuel charged to building |
| $PROCESS\_ELEC_{BLDG}$ | = | amount of allocated CHP electricity in excess of building's modeled annual electricity consumption (treated as process energy in model) |
| $CHP\_ELEC_{TOTAL}$ | = | total CHP electricity generated at DES plant |
| $CHP_{FUEL}$ | = | total CHP fuel input for electricity generation at DES plant |
| $CHP\_ELEC_{BLDG}$ | = | CHP electricity generation allocated to building (from previous calculations) |
| $PROPOSED\_ELEC_{BLDG}$ | = | modeled electricity consumption for building from proposed case |

The model must include CHP generator efficiencies, based on either ongoing operations (existing CHP) or design specifications (new CHP).

***Path 3 Large-scale District Energy System***

Path 3 provides a streamlined method for documenting improved greenhouse gas (GHG) emissions performance associated with large scale district energy systems.

Complete the baseline and proposed energy modeling consistent with the guidance for Path 1A. ASHRAE 90.1–2016, Appendix G.

Follow the additional instructions in the *Large-Scale DES Calculator* (uploaded in the Credit Resources section of the credit library) to demonstrate GHG emissions improvement associated with the district energy plant.

Optional: Projects may generate two sets of baseline and proposed models to separately document the greenhouse gas emissions metric using Path 1A. ASHRAE 90.1-2016 Appendix G with the large-scale district energy calculator, and the cost metric using Path 1B. ASHRAE 90.1-2016 Appendix G with ASHRAE 90.1-2022 Addendum a.

***Special Situations for DES Energy Models***

*Service water heating*
If service water is heated in full or in part by DES-supplied heat: For projects applying Path 1A or Path 3, model the energy source as purchased energy.

Projects applying Path 1B shall model the DES supplied service water heating in the Proposed building per 90.1-2022 addendum a replacing all ASHRAE 90.1-2022 Addendum a references to Section 7 mandatory and prescriptive criteria for the *proposed building design* with ASHRAE 90.1-2016 Section 7.

The Baseline shall be modeled per 90.1-2016 Appendix G requirements.

For projects applying Path 2, model the baseline service water heating matching ASHRAE 90.1-2016 Appendix G modeling guidance for a stand-alone on-site service water heating system, and use the Path 2 guidance to model the average efficiency for the proposed design.

*Heating converted to cooling*

Sometimes the district or campus system heating energy supply is converted to chilled water using absorption chillers or other similar technologies to serve cooling loads. In this circumstance, the equipment that converts heating to cooling may reside within the DES itself, (i.e., DES provides cooling to the building) or within the connected buildings (i.e., DES provides heating to the building; building converts heating to cooling). When the equipment that converts DES-supplied heat into cooling is part of the LEED project's scope of work, the project must apply either Path 1B, Path 2, or Path 3.

*Other DES systems*

DES also often incorporate special features, such as thermal storage, ground or surface water cooling, and waste heat recovery. These features should be incorporated into the proposed virtual plant to the greatest extent practical using the general principles presented in this guidance.

Combined Heat and Power (CHP) or other Non-Renewable Electricity Generation Systems

For projects with combined heat and power or other non-renewable electricity generation systems, amend ASHRAE 90.1-2016 G2.4.2 Annual Energy Costs as follows:

Where the proposed design includes on-site electricity generation systems other than on-site renewable energy systems, adjust the baseline and proposed model using one of the following methods:

1. No credit for on-site electricity generation:
    - Model on-site electricity generation systems including all fuel inputs and associated site-recovered energy identically in the baseline design and the proposed design, OR
    - Model purchased electricity instead of the on-site electricity generation. Model any site-recovered energy from the on-site electricity generation system identically in the baseline and proposed design (either crediting it towards the thermal loads for both the baseline and proposed design or ignoring the site-recovered energy contribution in both the baseline and proposed design).
2. Credit for on-site electricity generation:
   Model the baseline design using purchased electricity for all regulated energy sources except HVAC heating and/or service water heating modeled in accordance with Appendix G criteria. Model the proposed design to include the proposed on-site generation system including site-recovered energy. For the cost metric, natural gas or fuel rates for both the baseline and proposed design must be modeled using the current published rates for natural gas associated with the baseline design fuel usage excluding monthly meter charges and shall not be discounted for high fuel usage associated with on-site generation equipment.

## International Tips

Option 1. Energy Performance Compliance

Canada: Use the Provincial emissions factors (where available) reported in the National Inventory Report, submitted by Canada to the United Nations Framework Convention on Climate Change, to calculate GHG emissions by energy source; these emissions factors are readily found in the ENERGY

STAR Portfolio Manager Greenhouse Gas Emissions Technical Reference (https://portfoliomanager.energystar.gov/pdf/reference/Emissions.pdf).

Europe: The Europe ACP for ASHRAE 90.1 Mandatory Provisions Table provides further guidance for project teams in Europe wishing to use European standards in lieu of certain ASHRAE 90.1-2016 mandatory provisions in LEED v4.1. The guidance covers ASHRAE 90.1-2016 Mandatory Provision Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10. Column 1 of the table references the specific subsection used in ASHRAE 90.1-2016. Column 2 displays the requirement as written in ASHRAE 90.1-2016. Column 3 outlines the compliance pathway available for European projects. Column 4 includes, in some cases, further information about the proposal, differences between the proposal and the ASHRAE requirement, or a reference to further documentation.

Additionally, for projects using the Performance Option for compliance with EA prerequisite Minimum Energy Performance and EA credit Optimize Energy Performance, the documentation must also use the calculated U-factor for fenestration products including windows and skylights based on either the LBNL Windows 6 program, or a simulation software program that approximates the NFRC rating methodologies. Alternatively, a narrative shall be provided supporting the claim that the fenestration U-factor used in the model is similar to the values that would be achieved using the NFRC rating. The CE-marked fenestration does not account for thermal bridging and seasonal performance in the same way as the NFRC rating, and when accounted for in the energy model, has been observed to lead to savings that exceed those claimed for the same fenestration rated under the NFRC ratings.

### Referenced Standards

- ASHRAE 90.1–2016
- ASHRAE 50% Advanced Energy Design Guides
- ASHRAE 209-2018
- ANSI/ASHRAE/IES Standard 90.1-2016 Performance Rating Method Reference Manual, PNNL 2017
- Developing Performance Cost Index Targets for ASHRAE Standard 90.1 Appendix G - Performance Rating Method

### Required Documentation

| Documentation | Energy Performance Option | | |
|---|---|---|---|
| | 90.1-2016 Prescriptive Compliance | 90.1-2016 ECB Compliance (prerequisite only) | 90.1 Appendix G Compliance |
| Minimum Energy Performance Calculator (90.1-2016) with Appendix G energy modeling inputs | | | X |
| Input-output reports from modeling software | | X | X |
| Exceptional calculations (if applicable) | | | X |
| Energy consumption and demand for each building end use and fuel type | | | X |
| Description of energy utility rates for each energy source | | X | X (if using cost metric) |
| Greenhouse gas emissions calculations, including emissions factors used | | | X (if using GHG metric) |

| | | | |
|---|---|---|---|
| Documentation demonstrating compliance with ASHRAE 90.1-2016 Mandatory Measures and Prescriptive Measures | X | | |
| Documentation demonstrating compliance with ASHRAE 90.1-2016 Mandatory Measures and ECB | | X | |
| Data center calculator (if applicable) | | | X |
| On-site renewable energy plans indicating location of renewable energy system, and relevant design details (e.g. PV module capacity, quantity, inverter capacity, tilt, orientation, etc. for a photovoltaic array), and confirming that the renewable energy is part of the project scope of work (or campus scope of work for a campus development) | | | X |

### Connection to Ongoing Building Performance

- LEED O+M EA credit Energy Performance: Designing building systems to achieve a minimum level of energy efficiency provides the foundation for effective energy management, reduced greenhouse gas emissions from building energy use, and reduced operating costs throughout the building life cycle.

# EA Prerequisite: Building-Level Energy Metering

This prerequisite applies to

- BD+C: New Construction
- BD+C: Core & Shell
- BD+C: Schools
- BD+C: Retail
- BD+C: Data Centers
- BD+C: Warehouses & Distribution Centers
- BD+C: Hospitality
- BD+C: Healthcare

## INTENT

To support energy management and identify opportunities for additional energy savings by tracking building-level energy use.

## REQUIREMENTS

NC, Schools, Retail, Data Centers, Warehouses & Distribution Centers, Hospitality, Healthcare

Install new or use existing building-level energy meters, or submeters that can be aggregated to provide building-level data representing total building energy consumption (electricity, natural gas, chilled water, steam, fuel oil, propane, biomass, etc.). Utility-owned meters capable of aggregating building-level resource use are acceptable.

Commit to sharing with USGBC the resulting energy consumption data and electrical demand data (if metered) for a five-year period beginning on the date the project accepts LEED certification. At a minimum, energy consumption must be tracked at one-month intervals.

This commitment must carry forward for five years or until the building changes ownership or lessee.

CS

Install new or use existing base building-level energy meters, or submeters that can be aggregated to provide base building-level data representing total building energy consumption (electricity, natural gas, chilled water, steam, fuel oil, propane, etc.). Utility-owned meters capable of aggregating base building-level resource use are acceptable.

Commit to sharing with USGBC the resulting energy consumption data and electrical demand data (if metered) for a five-year period beginning on the date the project accepts LEED certification or typical occupancy, whichever comes first. At a minimum, energy consumption must be tracked at one-month intervals.

This commitment must carry forward for five years or until the building changes ownership or lessee.

## GUIDANCE

There are no substantive changes to the prerequisite requirements; refer to the LEED v4 reference guide, with the following addition:

**Further Explanation**

Connection to Ongoing Building Performance

- LEED O+M EA credit Energy Performance: Installing whole building energy meters is a simple yet critical strategy for understanding total energy use throughout the building life cycle. Tracking energy consumption on a regular basis supports effective energy management and provides data to help verify that building systems are operating as designed. Projects can submit data via the Arc platform to comply with the prerequisite requirement to share whole-project energy usage data with USGBC and get started on the path to recertification.

# EA Prerequisite: Fundamental Refrigerant Management

This prerequisite applies to

- BD+C: New Construction
- BD+C: Core & Shell
- BD+C: Schools
- BD+C: Retail
- BD+C: Data Centers
- BD+C: Warehouses & Distribution Centers
- BD+C: Hospitality
- BD+C: Healthcare

## INTENT

To reduce ozone depletion and global warming potential and support early compliance with the Kigali Amendment to the Montreal Protocol, while minimizing direct contributions to climate change.

## REQUIREMENTS

NC, CS, Schools, Retail, Data Centers, Warehouses & Distribution Centers, Hospitality, Healthcare

Do not use chlorofluorocarbon (CFC) or hydro chlorofluorocarbon (HCFC) -based refrigerants in new heating, ventilating, air-conditioning, and refrigeration (HVAC&R) systems. When reusing existing HVAC&R equipment, complete a comprehensive CFC and/or HCFC phase-out conversion before project completion. Phase-out plans extending beyond the project completion date will be considered on their merits.

Existing small HVAC&R units (defined as containing less than 0.5 pound [225 grams] of refrigerant) and other equipment, such as standard refrigerators, small water coolers, and any other equipment that contains less than 0.5 pound (225 grams) of refrigerant, are exempt.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following edits and additions:

### Behind the Intent

Hydrochlorofluorocarbons (HCFCs) have shorter atmospheric lives than CFCs, but they still contribute to ozone depletion. Similar to CFCs, HCFCs have phase-out dates scheduled under the Montreal Protocol.

Both HCFCs and CFCs must be addressed to meet this prerequisite. Wherever CFCs are mentioned in the LEED v4 reference guide, the guidance also applies to HCFCs.

**Further Explanation**

### Connection to Ongoing Building Performance

- LEED O+M EA credit Enhanced Refrigerant Management: Despite successful global adoption of the Montreal Protocol, large volumes of CFCs and HCFCs remain in circulation and contribute to stratospheric ozone depletion. Completing a comprehensive CFC phase-out conversion for HVAC&R equipment reused in the project helps ensure that refrigerants are correctly disposed of and do not escape into the atmosphere.

# EA Credit: Enhanced Commissioning

This prerequisite applies to

- BD+C: New Construction (2-6 points)
- BD+C: Core & Shell (2-6 points)
- BD+C: Schools (2-6 points)
- BD+C: Retail (2-6 points)
- BD+C: Data Centers (2-6 points)
- BD+C: Warehouses & Distribution Centers (2-6 points)
- BD+C: Hospitality (2-6 points)
- BD+C: Healthcare (2-6 points)

## INTENT

To further support the design, construction, and eventual operation of a project that meets the owner's project requirements for energy, water, indoor environmental quality, and durability.

## REQUIREMENTS

NC, CS, Schools, Retail, Data Centers, Warehouses & Distribution Centers, Hospitality, Healthcare

Implement, or have in place a contract to implement, the following commissioning process activities in addition to those required under EA Prerequisite Fundamental Commissioning and Verification.

Commissioning Authority Qualifications:

- The CxA must have documented commissioning process experience on at least two building projects with a similar scope of work. The experience must extend from early design phase through at least 10 months of occupancy;
- The CxA may be a qualified employee of the owner, an independent consultant, an employee of the design or construction firm who is not part of the project's design or construction team, or a disinterested subcontractor of the design or construction team.

Option 1. Enhanced Systems Commissioning (3-4 points)

Path 1: Enhanced Commissioning (3 points)

Complete the following commissioning (Cx) process activities for mechanical, electrical, plumbing, and renewable energy systems and assemblies in accordance with ASHRAE Guideline 0–2013 and ASHRAE Guideline 1.1–2007 for HVAC&R systems, as they relate to energy, water, indoor environmental quality, and durability.

The commissioning authority must do the following:

- Review contractor submittals.
- Verify inclusion of systems manual requirements in construction documents.
- Verify inclusion of operator and occupant training requirements in construction documents.
- Verify systems manual updates and delivery.
- Verify operator and occupant training delivery and effectiveness.
- Verify seasonal testing.
- Review building operations 10 months after substantial completion.
- Develop an on-going commissioning plan.

Include all enhanced commissioning tasks in the OPR and BOD.

OR

Path 2: Enhanced and Monitoring-Based Commissioning (4 points)

Achieve Path 1.

AND

Develop monitoring-based procedures and identify points to be measured and evaluated to assess performance of energy- and water-consuming systems.

Include the procedures and measurement points in the commissioning plan. Address the following:

- roles and responsibilities;
- measurement requirements (meters, points, metering systems, data access);
- the points to be tracked, with frequency and duration for trend monitoring;
- the limits of acceptable values for tracked points and metered values (where appropriate, predictive algorithms may be used to compare ideal values with actual values);
- the elements used to evaluate performance, including conflict between systems, out-of-sequence operation of systems components, and energy and water usage profiles;
- an action plan for identifying and correcting operational errors and deficiencies;
- training to prevent errors;
- planning for repairs needed to maintain performance; and
- the frequency of analyses in the first year of occupancy (at least quarterly).

Update the systems manual with any modifications or new settings, and give the reason for any modifications from the original design.

AND/OR

**Option 2. Building Enclosure Commissioning (2 points)**

Fulfill the requirements in EA Prerequisite Fundamental Commissioning and Verification as they apply to the building's enclosure in addition to mechanical and electrical systems and assemblies.

Complete the following commissioning (Cx) process activities for the building's thermal envelope in accordance with ASHRAE Guideline 0–2013 and ASTM E2947-16: Standard Guide for Building Enclosure Commissioning, as they relate to energy, air and water tightness, indoor environmental quality, and durability.

The qualified independent member of the design or construction team responsible for building enclosure commissioning must complete the following:

- Review contractor submittals.
- Verify inclusion of systems manual requirements in construction documents for enclosure systems.
- For specialty enclosure systems with controls and automation:
    - Verify inclusion of operator and occupant training requirements in construction documents.
    - Verify systems manual updates and delivery.
    - Verify operator and occupant training delivery and effectiveness.
    - Verify seasonal testing.
    - Review building operations 10 months after substantial completion.
- Develop an on-going enclosure commissioning plan for maintenance, renewal, and revitalization cycles.

<u>Data Centers only</u>

Projects that select Option 1 must complete the following commissioning process.

For small projects with peak cooling loads less than 2,000,000 Btu/h (600 kW), or a total computer room peak cooling load less than 600,000 Btu/h (175 kW), the CxA must perform the following activities:

- conduct at least one commissioning verification review of the owner's project requirements, basis of design, and design documents before mid-construction documents development;
- back-check the review comments in all subsequent design submissions; and
- conduct an additional full verification review at 95% completion of the design documents and basis of design.

For projects with peak cooling loads 2,000,000 Btu/h (600 kW) or more, or a total computer room peak cooling load 600,000 Btu/h (175 kW) or more, the CxA must conduct at least three verification reviews of the basis of design:

- one verification review of design documents before the start of design development;
- one verification review of design documents before midconstruction documents; and
- one final verification review of 100% complete design documents, verifying achievement of the owner's project requirements and adjudication of previous review comments.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications.

**Behind the Intent**

Beta Update

Updated referenced standards. Minor text revisions to Option 2. Building Enclosure Commissioning intend to clarify implementation for project teams.

Commissioning Authority criteria are expanded to include an employee of the design or construction firm who is not part of the project's design or construction team, or a disinterested subcontractor of the design or construction team.

**Further Explanation**

Building Enclosure Commissioning Basics

Refer to the LEED v4 reference guide, with the following modification:

- See ASTM E2947 – 16: Standard Guide for Building Enclosure Commissioning and ASTM E2813-12: Standard Practice For Building Enclosure Commissioning for additional guidance regarding envelope systems testing equipment and procedures.

Referenced Standards:

- ASHRAE Guideline 0–2013, The Commissioning Process
- ASHRAE Guideline 1.1–2007, HVAC&R Technical Requirements for the Commissioning Process
- ASTM E2947 – 16: Standard Guide for Building Enclosure Commissioning
- ASTM E2813-12: Standard Practice for Building Enclosure Commissioning

Connection to Ongoing Building Performance

- LEED O+M EA credit Energy Performance: Enhanced building commissioning expands the fundamental commissioning process to provide further oversight and verification of mechanical systems, which ensures ongoing building quality control and operations and may help improve the project's energy performance score. Monitoring-based commissioning is a powerful strategy for tracking building performance in real time. Building enclosure commissioning provides quality assurance for enclosure systems design and installation and provides the foundation for energy efficiency throughout the building life cycle.

# EA Credit: Optimize Energy Performance

This prerequisite applies to

- BD+C: New Construction (1-18 points)
- BD+C: Core & Shell (1-18 points)
- BD+C: Schools (1-16 points)
- BD+C: Retail (1-18 points)
- BD+C: Data Centers (1-18 points)
- BD+C: Warehouses & Distribution Centers (1-18 points)
- BD+C: Hospitality (1-18 points)
- BD+C: Healthcare (1-20 points)

## INTENT

To achieve increasing levels of energy performance beyond the prerequisite standard to reduce environmental and economic harms associated with excessive energy use and greenhouse gas emissions that disproportionately impact frontline communities.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Analyze efficiency measures during the design process and account for the results in design decision making. Use energy simulation of efficiency opportunities, past energy simulation analyses for similar buildings, or published data (e.g., Advanced Energy Design Guides) from analyses for similar buildings.

Analyze efficiency measures, focusing on load reduction and HVAC-related strategies (passive measures are acceptable) appropriate for the facility. Project potential energy savings and holistic project cost implications related to all affected systems.

Choose one of the options below.

**Option 1. Energy Performance Compliance (1–18 points except Schools and Healthcare, 1–16 points Schools, 1–20 points Healthcare)**

Demonstrate a Performance Cost Index (PCI)[1] below the Performance Cost Index Target ($PCI_t$) calculated in accordance with Section 4.2.1.1 of ANSI/ASHRAE/IESNA Standard 90.1-2016, Appendix G, Table 4.2.1.1. For mixed use buildings, the required PCI shall be calculated by using an area weighted average of the building types.

Calculate the PCI, $PCI_t$, and percentage improvement using metrics of cost and greenhouse gas (GHG) emissions.

Total LEED points for EAc Optimize Energy Performance are determined by summing the points documented in Table 1 (energy cost metric) plus the points documented in Table 2 (GHG emissions metric), where points for each Table are determined based on the project percent improvement PCI below the $PCI_t$ documented for each metric.

Table 1. Points for percentage improvement in energy performance – Percent Cost PCI below $PCI_t$ (1-9 points NC and CS, 1-8 points Schools, 1-10 points Healthcare)

| New Construction | Healthcare, Major Renovation, CS | Points BD+C (except Schools, Healthcare)* | Points Healthcare | Points Schools |
|---|---|---|---|---|
| 5% | 2% | 1 | 1 | 1 |
| 10% | 5% | 2 | 2 | 2 |
| 15% | 10% | 3 | 3 | 3 |
| 20% | 15% | 4 | 4 | 4 |
| 25% | 20% | 5 | 5 | 5 |
| 30% | 25% | 6 | 6 | 6 |
| 35% | 30% | 7 | 7 | 7 |
| 40% | 35% | 8 | 8 | |
| 45% | 40% | 9 | 9 | 8 |
| 50% | 45% | EP | 10 | EP |
| | 50% | | EP | |

Table 2. Points for percentage improvement in energy performance – Percent Greenhouse Gas Emissions PCI below $PCI_t$ (1-9 points NC, 1-8 points Schools, 1-10 points Healthcare)

| New Construction | Healthcare, Major Renovation, CS, | Points BD+C (except Schools, Healthcare)* | Points Healthcare | Points Schools |
|---|---|---|---|---|
| 5% | 2% | 1 | 1 | 1 |
| 10% | 5% | 2 | 2 | 2 |
| 16% | 10% | 3 | 3 | 3 |
| 24% | 16% | 4 | 4 | 4 |
| 32% | 24% | 5 | 5 | 5 |
| 40% | 32% | 6 | 6 | 6 |
| 50% | 40% | 7 | 7 | 7 |
| 65% | 50% | 8 | 8 | |
| 80% | 65% | 9 | 9 | 8 |
| 100% | 80% | EP | 10 | EP |
| | | | EP | |

Table 1 and Table 2 Notes:

1. BD+C projects except Data Centers with Proposed Building Unregulated Energy exceeding 50% of the total Proposed Building Performance for the referenced metric (cost or GHG emissions), and BD+C: Data Centers projects with at least 40% gross colocation data center area may use the "Healthcare, Major Renovation, CS" column in lieu of the "New Construction" column.
2. Renewable Energy:
   - On-site renewable energy: For Table 1 and Table 2, on-site or on-campus renewable energy that meets ASHRAE Standard 90.1-2016 Section G 2.4.1 requirements for on-site renewable may be subtracted from the Proposed Building Performance in accordance with ASHRAE Standard 90.1-2016 Section G 2.4.1.
   - For the Table 2 greenhouse gas emissions metric, Tier 2 New off-site renewables documented in EA Credit Renewable Energy may be subtracted from proposed greenhouse gas emissions for electricity prior to calculating proposed building performance. Projects in locations where hourly electric greenhouse gas emissions factors are available must document performance for the baseline, proposed, and renewable generation using hourly electric emissions factors.

DATA CENTERS ONLY

In addition to the requirements above, analyze efficiency measures focused on IT load reduction and HVAC-related strategies. Collocated data centers may use the CS percentage improvement thresholds in lieu of NC thresholds to earn points in Table 1 and Table 2.

OR

### Option 2. Prescriptive Compliance: ASHRAE Advanced Energy Design Guide (1–6 points, 1-4 points CS)

To be eligible for Option 2, projects must meet the Scope requirements of the applicable AEDGs (or combination of AEDGs for mixed use), and projects must use the ASHRAE 90.1-2016 Prescriptive compliance path in EA Prerequisite Minimum Energy Performance.

Implement and document compliance with the applicable recommendations and standards in Chapter 4, Design Strategies and Recommendations by Climate Zone, for the appropriate ASHRAE 50% Advanced Energy Design Guide and climate zone.

#### ASHRAE 50% Advanced Energy Design Guide for Small to Medium Office Buildings

- *Building envelope:* roofs, walls, floors, slabs, doors, continuous air barriers, and vertical fenestration (1 point, 2 points CS)
- *Interior and exterior lighting,* including daylighting and interior finishes (1 point).
- *Plug loads,* including equipment and controls (2 points, 0 points CS)
- *HVAC Systems and Controls (*2 points, 1 point CS).

#### ASHRAE 50% Advanced Energy Design Guide for Medium to Large Box Retail Buildings

- *Building envelope:* roofs, walls, floors, slabs, doors, vestibules, and fenestration – all orientations (1 point, 2 points CS)
- *Interior and exterior lighting,* excluding lighting power density for sales floor (1 point).
- *Additional interior lighting* for sales floor (1 point, 0 points CS)
- *Plug loads,* including equipment choices and controls (1 point, 0 points CS)
- *HVAC efficiency and control requirements* (2 points, 1 point CS).

#### ASHRAE 50% Advanced Energy Design Guide for K–12 School Buildings

(Not applicable for CS)

- *Building envelope:* roofs, walls, floors, slabs, doors, and vertical fenestration (1 point)
- *Interior and exterior lighting,* including daylighting and interior finishes (1 point)
- *Plug loads,* including equipment choices, controls, and kitchen equipment (2 points)
- *HVAC efficiency and control requirements* (2 points)

ASHRAE 50% Advanced Energy Design Guide for Large Hospitals

- *Building envelope:* roofs, walls, floors, slabs, doors, vestibules, continuous air barriers, and vertical fenestration (1 point, 2 points CS)
- *Interior and exterior lighting,* including daylighting (form or nonform driven) and interior finishes (1 point).
- *Plug loads,* including equipment choices, controls, and kitchen equipment (1 point, 0 points CS)
- *HVAC and Service Water Heating Systems and Equipment (2 points) (*1 point CS.)

ASHRAE 50% Advanced Energy Design Guide for Grocery Stores

- *Building envelope:* roofs, walls, floors, slabs, doors, vestibules, continuous air barriers, and vertical fenestration (1 point) (2 points – CS)
- *Interior and exterior lighting, including sales floor (1* points)
- *Refrigeration, Plug, and Process loads,* including equipment choices and controls (2 points) (0 points CS)
- *HVAC efficiency and control requirements (1 point) (*1 point CS.)

Option 3. Systems Optimization (1-6 points)

To be eligible for Option 3, projects must use the ASHRAE 90.1-2016 Prescriptive compliance path in EA Prerequisite Minimum Energy Performance, and must not have more than 2,000 square feet of data center space, laboratory space, or manufacturing space.

Demonstrate an improvement beyond ASHRAE/ASHRAE/IESNA Standard 90.1–2016, with errata, for the following systems as applicable to the project scope: Interior and Exterior Lighting; Daylight controls; Building envelope; HVAC and service water heating equipment efficiency; and Equipment and appliances.
Use any combination of the strategies in any or all of the categories below, for a maximum of up to 6 points.

- *Interior and Exterior Lighting:*
  - 15% lighting power reduction (1 point)
  - 30% lighting power reduction (1 point)
  - 45% lighting power reduction (1 point)

- *Daylight controls:*
  Install daylight-responsive controls for a given percentage of connected lighting load (lighting in non-regularly occupied space with occupant sensor controls may be excluded from connected lighting load).
  - 40% (1 point)

- *Building envelope:*
  - Climate Zones 1 – 2: Achieve 2 of the 3 strategies below for 1 point.
    - Thermal Mass Enclosure: More than 70% of opaque above-grade wall area meets ASHRAE 90.1-2016 definition for "mass wall"; and more than 70% of floor area meets ASHRAE 90.1-2016 definition for "mass floor"
    - 25% Envelope UA reduction
    - 50% SHGC reduction (including window shade factors)
  - Climate Zones 3 – 8: Achieve 2 of the 3 strategies below for 1 point.
    - 25% Envelope UA reduction
    - 50% Envelope UA reduction
    - 25% reduction in air infiltration measured during commissioning

- *HVAC and Service Water Heating Equipment Efficiency*:
  - Reduction in total fan power allowance of:
    - 20% (1 point)
  - Improvement in efficiency for at least 75% of the combined cooling, heating, and service water heating capacity
    - 20% (1 point)

  - *Electric resistance heating except heat pump auxiliary heat must be included in total capacity.*

- *Equipment and Appliances*:
  Install a percentage (by rated power) of eligible equipment and appliances meeting the following requirements:
  - *ENERGY STAR* equipment including appliances, office equipment, electronics, and commercial food service equipment (lighting and building envelope products are excluded from this credit). (Electronic Product Environmental Assessment Tool (EPEAT) equipment may be used in lieu of Energy Star equipment where applicable).
  - Prescriptive commercial kitchen and refrigeration equipment requirements listed in Appendix 3, Table 1.

The project scope of work must include at least 0.25 Watts per square foot of eligible equipment to apply this strategy.

Percent of Eligible Equipment Installed by Rated Power:
- 75% (1 point)

OR

Option 4. Data Centers only– System Optimization (1-3 points)

Calculate an Overall *Systems* Design Value as the sum of the maximum *design Mechanical Load Component (MLC)* and maximum *design Electrical Load Component (ELC)* in accordance with ASHRAE 90.4-2016 Section 6.2, Section 8.2, and Section 11. Document that the Overall Systems Design value is less than the Maximum Overall Systems Value by:

- 10% (1 point)
- 20% (2 points)
- 30% (3 points)

**If the electrical system design is incomplete, the design values shall be assumed to match the values in Table 8.2.1.1 and 8.2.1.2.*

*Collocated data centers:* document that the Overall Systems Design value is less than the Maximum Overall Systems Value by:

- 6% (1 point)
- 12% (2 points)
- 18% (3 points)

## GUIDANCE

Refer to the consolidated guidance within EA Prerequisite Minimum Energy Performance, since the requirements and LEED documentation are closely linked for EA Prerequisite Minimum Energy Performance and EA Credit Optimize Energy Performance:

**Behind the Intent**

See EA Prerequisite Minimum Energy Performance, *Behind the Intent.*

Beta Update

Updated referenced standards and a new greenhouse gas emissions metric ensure that LEED continues to be a global leadership standard for energy performance and encourages owners to directly consider and address building carbon emissions. Revised prescriptive options to expand applicability to a broader set of projects. Require design phase analysis for all Optimize Energy Performance options, including prescriptive and performance options.

**Step-by-Step Guidance**
See EA Prerequisite Minimum Energy Performance.

Assure that the additional Optimize Energy Performance requirement credit requirements are met:

- Analyze efficiency measures during the design process, focusing on load reduction and HVAC-related strategies (including passive measures) appropriate for the facility, project potential energy savings and holistic project cost implications, and account for the results in design decision making.

These requirements apply regardless of whether the project is using the performance path (Option 1) or prescriptive path (Options 2, 3 or 4) to document credit compliance.

The best approach for analyzing efficiency measures is a preliminary energy model, which evaluates heating and cooling load reduction strategies, passive HVAC strategies, and HVAC efficiency and control strategies (see EA prerequisite Minimum Energy Performance, *Further Explanation, Developing a Preliminary Energy Model* and *Further Explanation, Modeling HVAC Systems*). ASHRAE Standard 209 provides a standardized methodology which may be used for developing preliminary energy models that are used to inform the design process (See ASHRAE 209 Sections 6.3 - Load Reduction Modeling and 6.4 - HVAC System Selection Modeling).

Projects may also opt to use the AEDGs where applicable, and/or use modeling analyses previously performed for similar projects to meet the design phase analysis requirements.

## Further Explanation

### Calculations

See EA Prerequisite Minimum Energy Performance, *Further Explanation, Calculations* for calculation of the Performance Cost Index (PCI) and Performance Cost Index Target ($PCI_t$) using units of cost and GHG emissions.

### Applying Renewable Energy Savings

See EA Prerequisite Minimum Energy Performance, *Further Explanation, Applying Renewable Savings*
Only projects pursuing Option 1 of this credit may count savings from renewable energy systems.

### Rating System Variations

Data Centers

See EA prerequisite Minimum Energy Performance, *Further Explanation, Rating System Variations.*

Co-located data centers may use the percentage improvement thresholds for Healthcare, Major Renovation, and CS in Table 1. Points for percentage improvement in energy performance - % Cost PCI below $PCI_t$ and in Table 2. Points for percentage improvement in energy performance - % Greenhouse gas emissions PCI below $PCI_t$ to determine points achieved under this credit.

### Referenced Standards

- ASHRAE 90.1–2016
- ASHRAE 90.4-2016
- ASHRAE 50% Advanced Energy Design Guides
- ANSI/ASHRAE/IES Standard 90.1-2016 Performance Rating Method Reference Manual, PNNL 2017
- ASHRAE 209-2018
- Developing Performance Cost Index Targets for ASHRAE Standard 90.1 Appendix G - Performance Rating Method

Exemplary Performance

Option 1.

- Achieve 50% savings in the cost metric (45% for CS, Major Renovation, and Multifamily Residential), or
- Achieve 100% savings in the greenhouse gas emissions metric, or
- Use actual utility rates including all applicable seasonal, TOU, and demand components when calculating cost savings AND hourly greenhouse gas emissions factors when calculating greenhouse gas emissions savings.

Required Documentation
In addition to the documentation required for EA prerequisite Minimum Energy Performance, the following documentation is required for credit compliance

| Documentation | Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|---|
| Narrative or report that includes:<br>• The energy target set for the project, the date the energy target was set, and confirmation the target was set no later than schematic design<br>• A summary of the design phase energy analysis performed for the project including how the results were used for design decision making | X | X | X | X |
| Target Finder results and summary | X (for applicable building types) | | | |
| Greenhouse gas emissions calculations that include credit for new off-site renewable energy (as applicable) | X (where applicable) | | | |
| AEDG compliance tables | | X | | |
| Calculations demonstrating achievement of systems optimization requirements (e.g. ASHRAE 90.1 lighting power density calculations, lighting fixture calculations demonstration portion of lighting power with daylighting control, etc.) | | | X | |

| | | | | |
|---|---|---|---|---|
| ASHRAE 90.4 Calculations (consistent with documentation requirements listed in ASHRAE 90.4) | | | | X |

### Connection to Ongoing Building Performance

- LEED O+M EA credit Energy Performance: Designing for higher levels of energy efficiency helps decrease building operating costs and reduces the environmental and economic harms associated with excessive energy use throughout the building life cycle; this may help improve the building's energy performance score.

# EA Credit: Advanced Energy Metering

This prerequisite applies to

- BD+C: New Construction (1 point)
- BD+C: Core & Shell (1 point)
- BD+C: Schools (1 point)
- BD+C: Retail (1 point)
- BD+C: Data Centers (1 point)
- BD+C: Warehouses & Distribution Centers (1 point)
- BD+C: Hospitality (1 point)
- BD+C: Healthcare (1 point)

## INTENT

To support energy management and identify opportunities for additional energy savings by tracking building-level and system-level energy use.

## REQUIREMENTS

NC, Schools, Retail, Data Centers, Warehouses & Distribution Centers, Hospitality, Healthcare

Install *advanced energy metering* for the following:

- all whole-building energy sources used by the building; and
- any individual energy end uses that represent 10% or more of the total annual consumption of the building.

The advanced energy metering must have the following characteristics.

- Meters must be permanently installed, record at intervals of one hour or less, and transmit data to a remote location.
- Electricity meters must record both consumption and demand. Whole-building electricity meters should record the power factor, if appropriate.
- The data collection system must use a local area network, building automation system, wireless network, or comparable communication infrastructure.
- The system must be capable of storing all meter data for at least 36 months.
- The data must be remotely accessible.
- All meters in the system must be capable of reporting hourly, daily, monthly, and annual energy use.

CS

Install meters for future tenant spaces so that tenants will be capable of independently metering energy consumption (electricity, chilled water, etc.) for all systems dedicated to their space. Provide a sufficient number of meters to capture total tenant energy use with a minimum of one meter per energy source per floor.
Install *advanced energy metering* for all base building energy sources used by the building.
The advanced energy metering must have the following characteristics.

- Meters must be permanently installed, record at intervals of one hour or less, and transmit data to a remote location.
- Electricity meters must record both consumption and demand. Whole-building electricity meters should record the power factor, if appropriate.
- The data collection system must use a local area network, building automation system, wireless network, or comparable communication infrastructure.
- The system must be capable of storing all meter data for at least 36 months.
- The data must be remotely accessible.

- All meters in the system must be capable of reporting hourly, daily, monthly, and annual energy use.

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following addition:

**Further Explanation**

Connection to Ongoing Building Performance

- LEED O+M EA credit Energy Performance: Submetering energy subsystems helps facility managers track changes in energy usage over time and provides the performance data necessary to identify opportunities for energy savings by end use.  Submetering is an important component of a successful energy management program; metered data enables monitoring of consumption and costs as well as progress reporting throughout the building life cycle.

# EA Credit: Grid Harmonization

This credit applies to

- BD+C: New Construction (1-2 points)
- BD+C: Core & Shell (1-2 points)
- BD+C: Schools (1-2 points)
- BD+C: Retail (1-2 points)
- BD+C: Data Centers (1-2 points)
- BD+C: Warehouses & Distribution Centers (1-2 points)
- BD+C: Hospitality (1-2 points)
- BD+C: Healthcare (1-2 points)

## INTENT

To increase participation in demand response technologies and programs that make energy generation and distribution systems more affordable and more efficient, increase grid reliability, and reduce greenhouse gas emissions.

## REQUIREMENTS

NC, CS, Schools, Retail, Data Centers, Warehouses & Distribution Centers, Hospitality, Healthcare

Design building and equipment for participation in demand response programs through load shedding or shifting. On-site electricity generation does not meet the intent of this credit.

Case 1. Demand Response Program Available and Participation (2 points)

- Participate in an existing demand response (DR) program and complete the following activities. Design a system with the capability for real-time, fully-automated DR based on external initiation by a DR Program Provider. Semi-automated DR may be utilized in practice.
- Enroll in a minimum one-year DR participation amount contractual commitment with a qualified DR program provider, with the intention of multiyear renewal, for at least 10% of the annual on-peak electricity demand. On-peak demand is determined under EA Prerequisite Minimum Energy Performance. The on-peak demand may vary based on the utility climate and pricing structures.
- Develop a comprehensive plan for meeting the contractual commitment during a Demand Response event.
- Include the DR processes in the scope of work for the commissioning authority, including participation in at least one full test of the DR plan.
- Include the DR program and any installed technologies in the building systems manual or include in the current facilities requirements and operations and maintenance plan if the project is not pursuing EA credit Enhanced Commissioning.
- Initiate at least one full test of the DR plan.

OR

Case 2. Demand Response Capable Building (1 point)

Have infrastructure in place to take advantage of future demand response programs or dynamic, real-time pricing programs and complete the following activities:

- Install interval recording meters and have equipment capable of accepting an external signal.
- Develop a comprehensive plan for shedding at least 10% of the annual on-peak electricity demand. On-peak demand is determined under EA Prerequisite Minimum Energy Performance.
- Include the DR processes in the scope of work for the commissioning authority, including participation in at least one full test of the DR plan.

- Include the DR program and any installed technologies in the building systems manual or include in the current facilities requirements and operations and maintenance plan if the project is not pursuing EA credit Enhanced Commissioning.
- Contact local utility representatives to discuss participation in future DR programs.

AND/OR

Case 3. Load Flexibility and Management Strategies (1-2 points)

Analyze the building's annual load shape and peak load based as calculated for EA prerequisite Minimum Energy Performance.  Review the regional grid load profile using the metric of peak load or peak carbon emissions. The U.S. Environmental Protection Agency's (EPA) AVoided Emissions and geneRation Tool (AVERT) provides regional grid emissions data; local utilities may also provide this data.

Coordinate review of building load shape and peak load with review of the regional grid profile to identify the best value load management strategies that the building can provide.

Implement one or more of the load flexibility and management strategies described below. All projects must install interval recording meters and have equipment capable of accepting an external signal.

Load Flexibility and Management Strategies:

- Peak Load Optimization: demonstrate that strategy reduces on-peak load by at least 10% as compared to peak electrical demand referenced to the ASHRAE 90.1-2016 compliant case (1 point)
- On-site thermal and/or electricity storage: demonstrate that strategy reduces on-peak load by at least 10% as compared to peak electrical demand (1 point)

Include installed technology in the scope of work for the commissioning authority. Include load flexibility and management strategies and installed technologies in the building systems manual, or include in the current facilities requirements and operations maintenance plan if the project is not pursuing EA credit Enhanced Commissioning.

Contact local utility representatives to discuss participation in future DR programs and to inform utility of building load flexibility and management strategies.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

### Behind the Intent

As the number of distributed energy resources, or grid-connected power generation from individual buildings, increases, the utility must integrate these resources while continuing to manage overall grid capacity and generation. Too much distributed generation that is not integrated into the energy system can impair grid operation. Buildings have the opportunity to support effective grid management by designing on-site electricity systems that are integrated components of the energy system, serving as resources for the grid rather than disruptors.

In addition to participation in a utility's demand response program, projects can install storage technologies and implement operational strategies that support effective grid management and increase grid reliability.  Eligible technologies may include battery storage, flywheel energy storage, or thermal energy storage; load management strategies may include load shifting or flexible operating scenarios.

### Beta Update

Updates intend to address projects where no demand response program is available from the local utility and recognize new distributed energy resources technologies and grid harmonization strategies.

**Step-by-Step Guidance**
Refer to Steps 1 – 5 in the LEED v4 reference guide, with the following addition:

Step 6. Include demand response in commissioning and in building systems manual
Coordinate with the CxA to include a review of the DR plan in the commissioning of the building's system test procedures, to verify the ability to handle an externally initiated demand response event. The Cx plan must include at least one performance test of the full DR plan to verify that all equipment responds as planned and that all responsible parties understand their roles.

Include demand response program and any installed technologies in the building systems manual.

### Case 1. Demand Response Program Available

Refer to the LEED v4 reference guide EAc Demand Response, with the following addition:

Step 2. Initiate at least one full test of the DR plan.
Execute at least one performance test of the full DR plan as defined in the Cx plan. All relevant DR operations team members must participate, and address and mitigate any issues identified as a result of the performance test.

### Case 2. Demand Response Capable Building

Refer to the LEED v4 reference guide, Case 2. Demand Response Program Not Available, with the following change:

Under the LEED v4.1 update, project eligibility for Case 2 is no longer restricted to applications where a demand response program is not available. However, the project team must still contact the utility service provider to discuss potential participation in a current or future DR program.

### Case 3. Load Flexibility and Management Strategies

Step 1. Analyze building load shape

Analyze building load shape as calculated for EA prerequisite Minimum Energy Performance; compare building load shape with the regional grid profile using the metric of peak load or peak carbon emissions. The U.S. Environmental Protection Agency's AVoided Emissions and geneRation Tool (AVERT) provides hourly regional grid emissions data or contact the local utility to request this data.

Step 2. Identify highest-value strategies

Based on the analysis of building load shape, peak load and regional grid peak load or peak carbon emissions, identify storage technologies or load management strategies that the building can implement at the lowest cost while providing the greatest value to the grid.

Step 3. Implement strategies

Implement one or both of the strategies identified during step 2.

Eligible strategies include peak load optimization achieved by reducing on-peak load by at least 10% compared to peak electrical demand, or installation of on-site thermal energy storage for heating and cooling and/or electricity storage capable of reducing on-peak load by at least 10% as compared to peak electrical demand. On-site storage enables the building to store energy and use it during peak demand times, increasing annual energy savings and reducing strain on the grid.

Step 4. Include load flexibility and management system in commissioning and in building systems manual

Coordinate with the CxA to include a review of the load management system and supporting technologies in the commissioning of the building's system test procedures. The Cx plan must include at least one performance test of the full system to verify that all equipment operates as planned and that all responsible parties understand their roles.

Include the system and any installed technologies in the building systems manual.

Step 5. Contact local utility

Contact the local utility or service provider to express interest in participation in a future demand response program, and to inform the utility of building load flexibility and management strategies.

**Further Explanation**

On-Peak Electricity Demand

On-peak electricity demand can be determined as one of the following for the purposes of credit compliance:

1. Building peak electricity demand
2. Building demand load coinciding with regional grid peak demand
3. Building demand load coinciding with regional grid peak carbon emissions

Grid Harmonization

Energy efficient and grid-interactive buildings save money and resources while supporting broader grid-scale decarbonization. Savings to building owners accrue from a combination of demand charge reductions, lower annual energy use, utility incentives, and increased grid resilience.

There are a number of methods by which projects can comply with the requirement in Case 2 and Case 3 to install equipment capable of responding to an external signal. External signals can be sent from a variety of sources such as the electric utility, the electricity Independent System Operator (ISO), or a third-party automation organization. The signal can be used to indicate specific events such as a critical price peaks, grid reliability events, high grid demand, or high grid GHG emissions factors; or a continuous signal reporting price, reliability, GHG emissions, or other factors. This equipment may be part of a building automation system, stand-alone equipment, or equipment that is directly integrated with the building system(s) used to achieve the credit, e.g. a packaged rooftop HVAC system.

Peak Load Optimization

To demonstrate that the peak load optimization strategy reduces on-peak load by at least 10% as compared to peak electrical demand, the baseline should be referenced to the ASHRAE 90.1-2016 compliant case. The "Performance Demand Index Target" and "Performance Demand Index" shall be calculated using the same methodology as the PCIT and PCI calculated per ASHRAE 90.1-2016 Appendix G:

Performance Demand Index Target = [Baseline Building Unregulated Electric Demand + (BPF x Baseline Building Regulated Electric Demand)] / Baseline Building Demand

For example, if the ASHRAE 90.1-2016 Building Performance Factor is 0.58, the Baseline regulated demand is 75 kW, and the Baseline unregulated demand is 25 kW for an Office building in climate zone 4A, the Performance Demand Index Target would be calculated as:

Performance Demand Index Target = [25 + (0.58 x 75)]/(25+75) = 0.69

The proposed demand would need to show a 10% improvement beyond this Performance Demand Target. Therefore, for this application:

Proposed demand <= (0.69 x 100) x 90% = 62.1 kW

In cases where the proposed case incorporates electrification of space heating and/or service water heating compared to the baseline case, project teams have two options for demonstrating peak load optimization:

- If able to demonstrate 10% on-peak load reduction with fuel switching, the project team may complete the calculation without applying corrections to the baseline.
- If unable to demonstrate 10% on-peak load reduction with fuel switching, the project team may increase the baseline building demand by the baseline case fossil fuel heating and service water heating demand divided by 2.0.

### On-site Thermal and/or Electricity Storage

The reference case for demonstrating peak demand reduction via the On-site thermal and/or electricity storage strategy is the Proposed design from the Optimize Energy Performance energy model without the thermal and/or electricity storage strategy in place.

### Single Strategy, Multiple Points

In some cases, a single design or operational strategy may meet the criteria for more than one strategy. For example, a set of demand reduction strategies used to achieve Case 2. Demand Response Capable Building may also meet the criteria for Case 3. Load Flexibility and Management Strategies for Peak Load Optimization.

### Project Type Variations

### District Energy Systems

When district energy is modeled for credit in EA credit Optimize Energy Performance, the district energy system (DES) electric demand modeled there must be included in the total demand reported for this credit. When the DES system is included in the EA credit Optimize Energy Performance model, grid harmonization strategies applied to the DES system may be used to document achievement at the building level.

The interval recording meter and building automation system communications may be located in the DES – and not in the building – if strategies in the DES are used to demonstrate full achievement of the credit requirements at the building level.

### Required Documentation

| Documentation | Case 1 | Case 2 | Case 3 |
|---|---|---|---|
| Proof of enrollment in DR program | X | | |
| Evidence of ability to shed 10% of on-peak demand | X | X | X |
| Confirmation that system is capable of receiving and acting on external signal | X | X | X |
| Action plan for meeting reduction requirement during event | X | X | X |
| Inclusion of DR in CxA systems testing plan | X | X | X |
| Inclusion of DR and/or grid harmonization technologies in building systems manual | X | X | X |
| Documentation of one full test of the DR plan | X | | |
| Narrative or report that includes: summary of building annual load shape and regional grid profile analysis; description of building load flexibility and/or management strategies implemented | | | X |
| Documentation of technologies serving the project, as applicable | | | X |

### Connection to Ongoing Building Performance

- Participation in a demand response program enables projects to support efficient energy generation and distribution systems, increase grid reliability, and reduce greenhouse gas emissions. For projects where no demand response program is available, implementing load flexibility and management strategies can help to achieve the same outcomes and support effective electrical grid management.

### Exemplary Performance

Achieve Case 1 with the capability for at least a 20% peak demand savings, or achieve at least three points under Case 1 and Case 3, or achieve at least three points under Case 2 and Case 3.
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# EA Credit: Renewable Energy

This prerequisite applies to

- BD+C: New Construction (1-5 points)
- BD+C: Core & Shell (1-5 points)
- BD+C: Schools (1-5 points)
- BD+C: Retail (1-5 points)
- BD+C: Data Centers (1-5 points)
- BD+C: Warehouses & Distribution Centers (1-5 points)
- BD+C: Hospitality (1-5 points)
- BD+C: Healthcare (1-5 points)

## INTENT

To reduce the environmental and economic harms associated with fossil fuel energy and reduce greenhouse gas emissions by increasing the supply of renewable energy projects and foster a just transition to a green economy.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Use on-site renewable energy systems or procure renewable energy from offsite sources for all or a portion of the building's annual energy use.

Choose one or more strategies for renewable energy procurement from the categories below. Points achieved in each category may be added for a total of 5 points.

- Tier 1: On-site renewable energy generation
  - On-site renewable energy generation, environmental attributes (e.g. RECs) retained
- Tier 2: New off-site renewable energy
  - Off-site renewable electricity that is produced by a generation asset(s) built within the last five years or contracted to be operational within two years of building occupancy.
  - Green-e Energy certification or equivalent is required for one-time purchase and delivery of EACs of more than 100% of the project's annual electricity use.
- Tier 3: Off-site renewable energy
  - Off-site renewable electricity that is Green-e Energy certified or equivalent or captured bio-methane

Ownership of Environmental Attributes: All environmental attributes associated with renewable energy generation must be retired on behalf of the LEED project in order for the renewable energy procurement to contribute to credit achievement.

The default contract length for renewable energy procurement is 10 years. Contract lengths less than 10 years may be pro-rated.

For Tier 2, the age of the generation asset(s) is assessed at the beginning of the contract, and the generation asset(s) retain this attribute for the duration of the initial contract or lease term.

Off-site renewable energy must be generated by renewable electricity projects located in the same country or region where the LEED project is located. Methane capture in the form of biogas that is both captured and used on-site may qualify as a Tier 1 renewable energy resource.

Points are awarded according to Table 1, based on the percentage of total site energy use. Renewable electricity and EAC procurement can only be applied to project electricity use or district energy use. Captured bio-methane can only be applied to project fuel use.

Table 1. Points for Renewable Energy Procurement

| Points | Tier 1 | | Tier 2 | | Tier 3 | |
|---|---|---|---|---|---|---|
| | BD+C (Except CS) | CS | BD+C (Except CS) | CS | BD+C (Except CS) | CS |
| 1 | 2% | 1% | 10% | 3% | 35% | 10% |
| 2 | 5% | 3% | 20% | 6% | 70% | 20% |
| 3 | 10% | 5% | 30% | 9% | 100% | 30% |
| 4 | 15% | 10% | 40% | 12% | | |
| 5 | 20% | 15% | 50% | 15% | - | - |

## GUIDANCE

### Behind the Intent

Renewable energy criteria in v4.1 has been expanded to recognize the variety of procurement strategies that help to add renewable energy to the grid.  Renewable energy generation can contribute to greenhouse gas emission reductions and offer local environmental benefits by reducing air pollution and increasing resilience. Renewable energy produced on-site protects projects from energy price volatility while reducing wasted energy lost in transmission.

Additionally, the voluntary market can be an effective catalyst for encouraging energy generators and utility companies to develop clean energy sources and help address climate change. Purchasing off-site renewable energy allows buildings that use nonrenewable power to create market demand for renewable energy and support the development of renewable infrastructure.

### Beta Update

This new credit combines Green Power and Renewable Energy Production into one credit, recognizing the wide spectrum of renewable energy procurement. The credit adds new categories of renewables and updates performance requirements. The credit structure incentivizes self-supply of renewable energy and development of new renewables and provides further opportunities for building and portfolio owners to select the renewable procurement strategies that are most appropriate for the project application.

### Step-by-Step Guidance

Step 1. Explore opportunities for renewables procurement.
(See Further Explanation, *Renewable Resource Considerations*)

- Step 2. Compare requirements for renewable energy systems and off-site methods of procurement.
  Carefully evaluate the space requirements (for on-site systems), costs, financial incentives, and efficiencies for each potential renewable technology or contract.

- Local funding, financing, and incentives for renewable generation projects may be available for certain technologies and may be a significant factor. When considering funding options, ensure that the terms of the contract will address all renewable attributes to be retained by the project.
- For on-site systems, excess energy, beyond the building's energy demand at a given point, can be sold to the utility company (net metering). The building owner receives the market rate, however, and cannot charge a premium for the renewable energy. In effect, the grid serves as a storage system and frees the project from hosting a storage system on site. Alternatively, project teams may consider including a storage system to increase resiliency, facilitate further control of building energy costs, and reduce renewable energy curtailment.
- Tying into an existing community system or creating a community system may lower cost barriers through economies of scale, because unit costs may decrease as system sizes increase. Community systems can also take advantage of time-shifted demand: one building that is occupied during the day and another building that is occupied at night could both take advantage of the same biofuel-fired heating system. Ensure that the terms of the community renewable energy contract will address all renewable attributes to be retained by the project.
- For buildings that are part of a portfolio of buildings, renewable energy may be available from a third-party system, or the project team may enter an arrangement in which a third party owns a system that serves the project. In such cases, project teams must take additional steps to ensure that the arrangement continues for the contract period required in the credit, and that the renewable attributes are retained throughout the duration of the contract.
- Undertake a cost-benefit analysis to understand the financial and environmental benefit of all available options.
- When considering any financing mechanism or contract for renewable energy procurement, project teams must ensure that renewable attributes associated with the renewable energy generation will be retained by the project (See Further Explanation, *Energy Attribute Certificates*).
- Consider the additional criteria required to demonstrate EAp Minimum Energy Performance and/or EAc Optimize Energy Performance credit for Tier 1 or Tier 2 renewable energy using the ASHRAE 90.1 Appendix G Performance Rating Method or approved equivalent standard. Note that some Tier 1 and Tier 2 systems do not qualify for additional credit under EAp Minimum Energy Performance and/or EAc Optimize Energy Performance (See EAp Minimum Energy Performance, *Further Explanation, Applying Renewable Energy Savings*):

Step 3. Set target for renewable energy procurement.

Select one or more procurement strategies, for a total of up to 5 points. Each procurement strategy must meet or exceed the minimum target based on the percentage of total site energy use specified in the credit language.

To establish the target renewable energy system size for the project, estimate the annual site energy use for the project (See Further Explanation, Total Site Energy Use).

Review credit point thresholds and establish the renewable procurement goals for the project.

Step 4. Finalize Renewable Energy Procurement.

Purchase and install the renewable energy systems, and/or finalize the contract to procure renewable energy or Energy Attribute Certificates (EACs). Assure that the contract is signed by both parties, and that the contract terms confirm all credit requirements.

For on-site renewable energy system(s), review the contract to confirm that the renewable system(s) are scheduled to be operational at the time of building occupancy. On-site renewable systems must also be commissioned per the requirements of LEED EA prerequisite Fundamental Commissioning and Verification and EA credit Enhanced Commissioning, as applicable.

For Tier 2 renewable energy procurement, review the contract to confirm that the renewable system(s) are scheduled to be operational within two years of building occupancy.

**Further Explanation**

## Calculations

Percentage of renewable energy purchased

Use Equation 1 to determine the percentage of renewable energy generated or purchased. Calculate the percentage of renewable energy generated or purchased for each Tier.

Equation 1: Percentage of energy generated or purchased

% energy generated or purchased = (annual quantity of renewable energy in kWh) / (annual building site energy use in kWh)

Use Equation 2 to estimate annual energy use offset by captured biomethane:

Equation 2: Annual energy usage offset by captured bio-methane

% fuel energy use offset = (annual quantity of captured bio-methane procured in kBtu) / (annual building site energy use in kBtu)

Use Equation 3 to calculate the number of points achieved for Tier 2 and Tier 3 when the contract term is different than ten years, and/or when procuring renewable energy from multiple Tiers.

Equation 3: Proration of Off-site renewables

Prorated Annual Renewable Percent = (Contract Term (in years)/ 10 years) x Annual Renewable Energy Generation / Annual Building Site Energy Consumption

Where:

- Annual Renewable Energy Generation and Annual Building Energy Consumption use consistent units of site energy (e.g. kWh/year)
- For a one-time purchase, contract term is listed as “one year”, and annual renewable energy generation is reported as the total renewable energy generation.

## Total Site Energy Use

Total site energy includes all electricity, fossil fuel, district thermal energy, and other site energy delivered to the project.

Projects complying with EA prerequisite Minimum Energy Performance using energy simulation (i.e. Normative Appendix G Performance Rating Method, Section 11 Energy Cost Budget Method, or approved equivalent standard) must use the modeled total site energy documented for the Proposed design before excluding renewable energy as the basis of the renewable energy credit calculations (See Further Explanation, Example 1).

Projects complying with EA prerequisite Minimum Energy Performance through a prescriptive path must use the most recent building Energy Use Intensity by Property Type data from the ENERGY STAR Portfolio Manager Technical Reference to calculate total annual site energy for the renewable energy credit calculations. The site energy must be broken down into electric and non-electric consumption. This is calculated using the total source energy and total site energy reported in the ENERGY STAR Portfolio Manager Technical Reference, and the US source-to-site ratios for electricity and natural gas. If the project is all-electric with no combustion sources for heating, water heating, cooking, etc. in the project and base building, the total site EUI value may be considered as electricity. This energy source calculation is included the LEED v4.1 Renewable Energy Calculator (See Further Explanation, Example 2).

### Sum of points from multiple procurement sources

Using Table 1, add up the applicable points from equation 1, for on-site and off-site renewable energy; and equation 2 for captured bio-methane as applicable, for a total not to exceed 5 points.

This summation is performed in the LEED v4.1 Renewable Energy Calculator. For points documented in Tier 2 and Tier 3, total annual electricity procurement is limited to the total proposed annual site energy consumption from electricity and district thermal energy, excluding any Tier 1 electric generation.

Renewable Resource Considerations

The renewable energy credit seeks to increase overall demand for renewable energy and the use of grid-source renewable energy projects, with the goal of supporting broader grid-scale decarbonization. Criteria rewards renewable energy investments that have a high probability of causality (i.e. support development and installation of new renewables) and demonstrate long-term commitment. Project teams should follow a hierarchy for selecting renewable energy sources to meet credit requirements:

- First, on-site generation;
- second, local generation, such as community solar or wind, in instances where it will have a beneficial decarbonizing impact;
- third, offsite generation projects with high probability of causality, e.g. power purchase agreements;
- fourth, renewables from an existing renewable energy project, e.g. utility green tariff or direct access to wholesale markets
- last, energy attribute certificates (EACs)

The U.S. EPA's Guide to Purchasing Green Power provides additional information on the process of and strategies for procuring renewable energy.

### Tier 1 On-Site Renewable Energy System Considerations

On-site renewable energy generation, when combined with careful consideration of building energy time of use and grid peak demand, and storage in some grid regions, can reduce annual greenhouse gas emissions, increase building resilience, and support effective grid management.

Eligible On-Site Renewable Energy Systems

To qualify as an on-site system, the renewable energy must be generated on-site from renewable sources produced at the building or contiguous campus site.

Allowable sources for on-site renewable energy include the following:

- Photovoltaic
- Solar thermal
- Wind
- Biofuel harvested on-site and used on-site for thermal and/or electric generation, excluding:
    - Combustion of municipal solid waste
    - Forest biomass waste, with the exception of the following harvested on site: clean urban wood waste, invasive species, habitat restoration programs, clean industrial wood waste (pallets), and tree tops left over from logging operations.
    - Wood coated with paints, plastics, or laminate

- Wood treated for preservation with materials containing halogens, chlorine compounds, halide compounds, chromated copper arsenate, or arsenic; if more than 1% of the wood fuel has been treated with these compounds, the energy system is ineligible

- Geothermal energy, such as electricity or heat generated from subterranean steam or hot water, excluding any geothermal energy used in conjunction with a vapor compression cycle.

Examples of on-site renewable energy generation include:

- A photovoltaic array located on the project site.
- A wind tower located on a contiguous campus owned by the same entity as the project building.
- Landfill gas processed in digesters on a contiguous campus owned by the same entity as the project building and used to produce thermal energy in the project building.

Note: earlier versions of LEED allowed some biofuels produced off-site to qualify as on-site renewable energy. However, based on the clarifications provided in ASHRAE 90.1-2016 for on-site renewable energy, and the clearer distinction between on-site and off-site renewable energy in LEED v4.1, biofuels are only considered on-site renewable systems when the renewable source is harvested on site, and used for on-site generation of electric or thermal energy.

Only usable energy generated from the on-site renewable system shall be considered towards the on-site renewable energy contribution. Usable energy is defined as the output energy from the system less any transmission and conversion losses, such as standby heat loss, losses when converting electricity from DC to AC, or waste heat in a cogeneration system that is exhausted to the atmosphere during periods of low thermal demand. Excess energy, beyond the building's energy demand at a given point, can be sold to the utility company (net metering) when Energy Attribute Certificates (EACs are retained by the project). Net metered electricity may count toward EA Renewable Energy credit up to 100% of annual electricity and district energy use.

A project team should use web resources and other tools available to determine the feasibility of renewable systems, given the project site's climate, context, and infrastructure. Consider the features of the site, such as solar availability, wind patterns, and other renewable energy sources, and any seasonal or daily variations in its supply. Certain project types may have special opportunities: office or university campuses typically have available land, for example, and warehouse projects may have large roof areas.

Match the project's energy needs with renewable energy output when selecting a renewable system. For example, a sunny site is a good candidate for solar thermal hot water, but this type of renewable resource is most cost-effective if the building has a constant demand for hot water. Accordingly, a hotel or a multifamily project may be a better match for a solar thermal hot water system than an office complex.

Daily and seasonal variations in loads also factor into the investigation of renewable energy. For example, a residential project with low daytime electricity demand may require battery storage to benefit from a photovoltaic (PV) array; an office building with high daytime demand may not.

On-site renewable systems must be installed and commissioned prior to the final LEED construction phase project submission to qualify for on-site renewable energy generation credit.

### Tier 2 New Off-Site Renewables

Tier 2 off-site renewables are defined as those that have come online within the last five years or are contracted to be operational within two years of building occupancy.

Age of the generation asset(s) is assessed at the beginning of the contract, and the generation asset(s) retain these attributes for the duration of the contract or lease term. Therefore, a contract initiated for a new renewable asset for a portfolio of projects with EACs assigned to the project building would be considered "New renewable" even if the contract period initiated more than five years prior to project occupancy. EACs assigned to the project shall be from the remaining contract duration on or after the year of project occupancy.

Community renewable energy cooperatives, larger-scale investments, such as direct, voluntary purchases in the form of power purchase agreements (PPAs), virtual PPAs, or renewable energy investment trusts, qualify as new off-site renewables provided documentation demonstrates that they meet the criteria described above. Contracts for these investments must indicate the specific system used to generate the renewable energy, with sufficient information available to confirm the renewable system generation capacity and allocation of the EACs (see *Further Explanation, Renewable Attributes*). If the LEED project contracts for a one-time purchase or short-term contract less than ten years for EACs exceeding 100% of the project's annual electricity and district thermal site energy use, the EACs must be Green-e Energy certified or equivalent.

Investment in new off-site renewables creates new renewable energy supply and has the potential to displace energy and emissions from fossil fuel-powered generators, particularly in regions where the grid mix is a higher percentage of fossil fuels.

To qualify as a new renewable system, the contract length shall be a minimum of ten years, or the annual renewable energy generation shall be prorated based on the contract term length. A commitment to renew does not qualify as a new renewable resource.

### Tier 3 Off-Site Renewables

Tier 3 off-site renewables are defined as those contracted from an existing renewable energy provider or off-site renewable systems that were contracted for the building after the renewable system came online and came online more than five years before building occupancy.

Existing off-site renewables, which may include utility green tariff programs or direct access to wholesale markets, may be more widely available depending on project location or budget. Investment in existing renewable resources and utility programs remains an important strategy for sustaining market demand for renewables and ensuring financial viability of existing projects.

The contract length shall be a minimum of ten years, or the annual energy renewable energy generation shall be prorated based on the contract term length. Alternatively, Tier 3 procurement only, project teams may show compliance with the ten year minimum contract term by demonstrating the following:

- The project has an executed contract for a minimum of one year, OR where contracts are not available per regulatory requirements, document that the project has been enrolled in the Green-e or equivalent utility tariff for a minimum of one month.
  AND
- The building owner must provide a signed letter of commitment indicating that the project will remain continuously enrolled in the 100% renewable Green-e or equivalent utility tariff, or alternate Green-e or equivalent procurement source for a minimum of ten years (or the number of years documented for credit if less than 10 years).

### Energy Attribute Certificates

An Energy Attribute Certificate (EAC) is a transferrable certificate, record or guarantee that provides information about the environmental attributes of one megawatt hour (MWh) of electricity. Renewable generators can sell EACs together with the electricity (bundled), or separately from the electricity (unbundled). EACs are also referred to as Renewable Energy Certificates (RECs) or Guarantees of Origin (GOs).

Retirement of environmental attributes of renewable electricity generation is substantiated through EACs. The owner of the building seeking LEED certification shall contract for renewable energy and demonstrate that the EACs are retained, owned, or retired on behalf of the party who has financial or operational control over the building's electricity use. Note that while the previous versions of LEED allowed EAC arbitrage for on-site systems, LEED v4.1 requires the owner to retain the environmental attributes of renewable energy that is generated on-site in order to for the generation to qualify for credit.

### Demonstrating Green-e Equivalency

Projects not using Green-e certified products must demonstrate equivalency to the Green-e Energy standard requirements in the following areas:. To be considered equivalent to Green-e Energy, the EACs retired on behalf of the LEED project must be

- Certified under an eco-label or similar program developed by an independent organization with transparent accounting process and standards in place
- Certified under an eco-label developed by an independent organization with transparent accounting processes and standards
- Eligible renewable energy source (see Green-e Framework for Renewable Energy Certification, Section IIIA, "Renewable Resource Types", and additional regional requirements as applicable, i.e. Appendix D: Green -e Renewable Energy Standard for Canada and the United States, Section II (Eligible Sources of Supply)
- Renewable resources are from projects that have come online within the last fifteen years
- Verifiable chain of custody
- Mechanism to prevent double-counting

The executed contract must specify the purchasing goals consistent with the Green-e equivalency requirements and be valid for the duration indicated in the credit documentation.

### Captured Bio-methane

Biogas from landfills, sewage treatment plants, and farm methane capture that is captured off-site and delivered to the LEED project for combustion on-site is considered "captured bio-methane" in LEED v4.1. Captured bio-methane may be used to offset fuel energy usage and qualify as Tier 3 off-site renewable energy provided that the biogas contract meets the minimum requirements for contract length. For procurement of captured bio-methane where a ten-year contract is not available, procurement shall be prorated based on the contract term length.

Retirement of environmental attributes of renewable gas is substantiated through certificates specific to gas production and use. The LEED project owner shall contract for renewable gas and demonstrate that the environmental attribute certificates are retained, owned, or retired on behalf of the LEED project.

### Documenting Savings for EAp Minimum Energy Performance and EAc Optimize Energy Performance

Refer to EAp Minimum Energy Performance, Further Explanation, Applying Renewable Energy Savings.

## Rating System Variations

Core and Shell

CS projects shall determine total site energy use in the same manner as other BD+C projects, including the total site energy associated with the base building and future tenant fit outs (see Further Explanation, Total Site Energy Use).

*Note:*
The total site energy reference is aligned with EAc Renewable Energy Production from previous versions of LEED, which evaluates the Core and Shell renewable energy percentage based on total building energy use. The credit does not include provisions for calculating a lower "core and shell building energy" based on Core and shell floor area as was previously allowed in EAc Green Power and Carbon Offsets.

Project Type Variations

### District Energy Systems (DES)

The method for documenting EA Renewable Energy credit must be consistent with the method for documenting EAp Minimum Energy Performance. If the project is using a prescriptive path to document EAp Minimum Energy Performance, OR applies ASHRAE 90.1 Appendix G to model district energy using identical purchased energy rates (i.e. $/unit of delivered energy) and Greenhouse gas emissions factors (i.e. lb CO2eq emissions per unit of delivered district energy) in the Baseline and Proposed case for EAp Minimum Energy Performance, renewable electricity and EACs may be applied to offset the site energy use of the district energy (e.g. district steam, district hot water, district chilled water) in EAc Renewable Energy.

If the project documents a performance improvement for the district energy system within EAp Minimum Energy Performance using the LEED District Energy Guidance Path 2 or 3, the modeled results in the EAp Minimum Energy Performance will indicate the estimated natural gas, electricity, and/or other fuels associated with the district energy generation; and district energy will not be reported as an energy source in the modeled results. In this case, renewable electricity and EACs may only be applied to electricity (either in the building or associated with the district energy system) and captured bio-methane may only be applied to the fossil fuel or other fuel used in the building or associated with the district energy systems.

## Required Documentation

| Documentation |
|---|
| LEED v4.1 Renewable Energy Calculator |
| Renewable system rated capacity |
| Calculations to determine energy generated |
| Confirmation of renewable attribute ownership (for on-site systems owned by building owner) or contract indicating duration and renewable attribute ownership (for on-site systems owned by a third party) |
| Contract indicating percentage ownership, lease, or allocation of Tier 2 off-site renewable system |
| Purchase letter or contract of commitment showing renewable energy for targeted point threshold |
| Eco-label documentation showing Green-e Energy equivalency if not Green-e certified |

### Exemplary Performance

Tier 1: renewable energy generation meets or exceeds 25% of total site energy use.

Tier 2: renewable energy procurement meets or exceeds 60% of total site energy use.

Exemplary performance is not available for Tier 3 renewable energy procurement.

### Connection to Ongoing Building Performance

- LEED O+M EA credit Energy Performance: Investments in renewable energy throughout the building life cycle can help reduce building greenhouse gas emissions and improve the building's energy performance score, increase market demand for renewables, and support the growth and financial feasibility of new renewable energy projects.

# EA Credit: Enhanced Refrigerant Management

This credit applies to

- BD+C: New Construction (1 point)
- BD+C: Core & Shell (1 point)
- BD+C: Schools (1 point)
- BD+C: Retail (1 point)
- BD+C: Data Centers (1 point)
- BD+C: Warehouses & Distribution Centers (1 point)
- BD+C: Hospitality (1 point)
- BD+C: Healthcare (1 point)

## INTENT

To eliminate ozone depletion and global warming potential, and support early compliance with the Montreal Protocol, including the Kigali Amendment, while minimizing direct contributions to climate change.

## REQUIREMENTS

NC, CS, SCHOOLS, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

**Option 1. No Refrigerants or Low-Impact Refrigerants (1 point)**
Do not use refrigerants, or use only refrigerants (naturally occurring or synthetic) that have an ozone depletion potential (ODP) of zero and a global warming potential (GWP) of less than 50.

OR

**Option 2. Calculation of Refrigerant Impact (1 point)**
Comply with ASHRAE Standard 15-2019: Safety Standard for Refrigeration Systems, or USGBC-approved equivalent, as applicable to the project scope.

Develop and implement a refrigerant management plan that addresses leak detection, system retrofit, and end of life disposal for all HVAC&R systems containing more than 0.5 pound (225 grams) of refrigerant.

Select refrigerants that are used in heating, ventilating, air-conditioning, and refrigeration (HVAC&R) equipment to minimize or eliminate the emission of compounds that contribute to ozone depletion and climate change. The combination of all new and existing base building and tenant HVAC&R equipment that serve the project must comply with the following formula:

| IP units | SI units |
|---|---|
| $LCGWP + LCODP \times 10^5 \leq 100$ | $LCGWP + LCODP \times 10^5 \leq 13$ |
| **Calculation definitions for LCGWP + LCODP x $10^5 \leq 100$ (IP units)** | **Calculation definitions for LCGWP + LCODP x $10^5 \leq 13$ (SI units)** |
| LCODP = [ODPr x (Lr x Life +Mr) x Rc]/Life | LCODP = [ODPr x (Lr x Life +Mr) x Rc]/Life |
| LCGWP = [GWPr x (Lr x Life +Mr) x Rc]/Life | LCGWP = [GWPr x (Lr x Life +Mr) x Rc]/Life |
| LCODP: Lifecycle Ozone Depletion Potential (lb CFC 11/Ton-Year) | LCODP: Lifecycle Ozone Depletion Potential (kg CFC 11/(kW/year)) |

| | |
|---|---|
| LCGWP: Lifecycle Direct Global Warming Potential ($lb\ CO_2$/Ton-Year) | LCGWP: Lifecycle Direct Global Warming Potential ($kg\ CO_2$/kW-year) |
| GWPr: Global Warming Potential of Refrigerant (0 to 12,000 lb $CO_2$/lbr) | GWPr: Global Warming Potential of Refrigerant (0 to 12,000 kg $CO_2$/kg r) |
| ODPr: Ozone Depletion Potential of Refrigerant (0 to 0.2 lb CFC 11/lbr) | ODPr: Ozone Depletion Potential of Refrigerant (0 to 0.2 kg CFC 11/kg r) |
| Lr: Refrigerant Leakage Rate (2.0%) | Lr: Refrigerant Leakage Rate (2.0%) |
| Mr: End-of-life Refrigerant Loss (10%) | Mr: End-of-life Refrigerant Loss (10%) |
| Rc: Refrigerant Charge (0.5 to 5.0 lbs. of refrigerant per ton of gross AHRI rated cooling capacity) | Rc: Refrigerant Charge (0.065 to 0.65 kg of refrigerant per kW of AHRI rated or Eurovent Certified cooling capacity) |
| Life: Equipment Life (10 years; default based on equipment type, unless otherwise demonstrated) | Life: Equipment Life (10 years; default based on equipment type, unless otherwise demonstrated) |

For multiple types of equipment, calculate a weighted average of all base building HVAC&R equipment, using the following formula:

| IP units | SI units |
|---|---|
| $$\frac{\left[ \sum \left( LCGWP + LCODP \times 10^5 \right) \times Qunit \right]}{Qtotal} \leq 100$$ | $$\frac{\left[ \sum \left( LCGWP + LCODP \times 10^5 \right) \times Qunit \right]}{Qtotal} \leq 13$$ |

| Calculation definitions for $[ \sum (LCGWP + LCODP \times 10^5) \times Qunit ] / Qtotal \leq 100$ (IP units) | Calculation definitions for $[ \sum (LCGWP + LCODP \times 10^5) \times Qunit ] / Qtotal \leq 13$ (SI units) |
|---|---|
| Qunit = Gross AHRI rated cooling capacity of an individual HVAC or refrigeration unit (Tons) | Qunit = Eurovent Certified cooling capacity of an individual HVAC or refrigeration unit (kW) |
| Qtotal = Total gross AHRI rated cooling capacity of all HVAC or refrigeration | Qtotal = Total Eurovent Certified cooling capacity of all HVAC or refrigeration (kW) |

### Retail NC

Meet Option 1 or 2 for all HVAC systems.

Stores with commercial refrigeration systems must comply with the following.

- Use only non-ozone-depleting refrigerants.
- Select equipment with an average HFC refrigerant charge of no more than 1.75 pounds of refrigerant per 1,000 Btu/h (2.72 kg of refrigerant per kW) total evaporator cooling load.

- Demonstrate a predicted store-wide annual refrigerant emissions rate of no more than 15%. Conduct leak testing using the procedures in GreenChill's best practices guideline for leak tightness at installation.

Alternatively, stores with commercial refrigeration systems may provide proof of attainment of EPA GreenChill's silver-level store certification for newly constructed stores.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following edits and additions:

### Behind the Intent

While the Montreal Protocol provided for the phase-out of CFC and HCFC refrigerants due to their ozone depletion potential, it led the industry shift toward the usage of hydrofluorocarbons (HFCs), which are potent greenhouse gases. In the Kigali Amendment to the Montreal Protocol, adopted in 2016, 197 countries committed to cut the production and consumption of HFCs by more than 80 percent over the next 30 years.

Alternatives to HFCs have been developed to provide lower-GWP refrigerant options, although the availability of low-GWP refrigerants varies between applications. The transition to lower-GWP refrigerant options requires an increased focus on safety, as many “next generation” refrigerants can pose flammability and/or toxicity risks if not properly managed. ASHRAE Standard 15-2019: Safety Standard for Refrigeration Systems provides essential guidance to manufacturers, design engineers and operators who need to stay current with new air conditioning and refrigerating requirements. The selection of refrigerants and their operating systems should be based on a holistic analysis of multiple criteria, including safety, environmental impacts, energy efficiency and cost.

In addition to protecting human health, effective refrigerant management during processes of design, manufacturing, operation, systems servicing, and end of life helps to reduce global emissions. The majority of refrigerant emissions happen at end of life, so the effective disposal of refrigerants currently in circulation (including CFCs, HCFCs and HFCs) is essential. A robust refrigerant management plan provides a framework for building owners and operators to properly manage these chemicals and minimize direct contributions to climate change.

### Step-by-Step

#### Step 1. Document compliance with ASHRAE Standard 15-2019

Review ASHRAE Standard 15-2019: Safety Standard for Refrigeration Systems. The standard establishes procedures for the safe design, construction, installation and operation of refrigerant systems. Note that Standard 15 must be used with ASHRAE Standard 34-2019 Designation and Safety Classification of Refrigerants, which describes a shorthand way of naming refrigerants and assigns safety classifications based on toxicity and flammability data.

Ensure that all refrigeration equipment installed in the project comply with ASHRAE Standard 15-2019 requirements for restrictions on refrigerant use (section 7), installation restrictions (section 8), design and construction of equipment and systems (section 9), operation and testing (section 10) and general requirements (section 11), as applicable to the project scope.

#### Step 2. Develop and implement refrigerant management plan

Develop and implement a refrigerant management plan. The plan must include a complete inventory of all refrigerants used in the project and address refrigerant leak detection, system retrofit, and proper end of life disposal for all HVAC&R systems containing more than 0.5 pound (225 gram) of refrigerant.

The plan must identify the individuals responsible for the care and maintenance of refrigerant systems, regular leak detection and monitoring, record-keeping and training of personnel necessary to execute the plan.

All contractors or service technicians performing work on any HVAC&R systems shall have access to the refrigerant management plan and, upon completion of the work, provide documentation that confirms continued compliance with the plan.

### Step 3. Calculate refrigerant impact of proposed systems

Refer to the LEED v4 reference guide.

### Step 4. Incorporate design criteria into project plans and specifications

Refer to the LEED v4 reference guide.

## Further Explanation

### Referenced Standards

- ASHRAE Standard 15-2019: Safety Standard for Refrigeration Systems

### Required Documentation

Refer to the LEED v4 Reference Guide content, plus the following additions for Option 2:

- Confirmation that project HVAC&R systems comply with ASHRAE Standard 15
- Refrigerant management plan

### Connection to Ongoing Building Performance

- LEED O+M EA credit Enhanced Refrigerant Management: Effective refrigerant selection and management, especially at the point of disposal, is a critical strategy for addressing climate change and minimizing the release of building-related emissions into the atmosphere. Additionally, careful consideration of refrigerants used in HVAC&R equipment can improve performance and reduce operating costs throughout the building life cycle.

# MR Prerequisite: Storage and Collection of Recyclables

This prerequisite applies to

- BD+C: New Construction
- BD+C: Core & Shell
- BD+C: Schools
- BD+C: Retail
- BD+C: Data Centers
- BD+C: Warehouses & Distribution Centers
- BD+C: Hospitality
- BD+C: Healthcare

## INTENT

To reduce the disproportionate burden of landfills and incinerators that is generated by building occupants' waste hauled to and disposed of in landfills and incinerators through reduction, reuse and recycling service and education, and to conserve natural resources for future generations.

## REQUIREMENTS

NC, CS, SCHOOLS, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY NC, HEALTHCARE, RETAIL

Provide dedicated areas accessible to waste haulers and building occupants for the collection and storage of recyclable materials for the entire building. Collection and storage areas may be separate locations. Recyclable materials must include mixed paper, corrugated cardboard, glass, plastics, and metals. Take appropriate measures for the safe collection, storage, and disposal of two of the following: batteries, mercury-containing lamps, and electronic waste.

## GUIDANCE

There are no substantive changes to the prerequisite requirements; refer to the LEED v4 reference guide

### Beta Update

Retail projects should now follow guidance for New Construction. Retail-specific requirements are no longer applicable.

**Further Explanation**

**Connection to Ongoing Performance**

- LEED O+M MR prerequisite Waste Performance: This prerequisite is a strategy that can help achieve the MR prerequisite: Waste Performance in the v4.1 O+M rating system.

# MR Prerequisite: PBT Source Reduction – Mercury

This prerequisite applies to

- BD+C: Healthcare

## INTENT

To reduce mercury-containing products and devices and mercury release through product substitution, capture, and recycling.

## REQUIREMENTS

<u>Healthcare</u>

As part of the project's recycling collection system, identify the following:

- types of mercury-containing products and devices to be collected;
- criteria governing how they are to be handled by a recycling program; and
- disposal methods for captured mercury.

Applicable mercury-containing products and devices include, but are not limited to, lamps (such as linear and circular fluorescents, integrally ballasted and nonintegrally ballasted compact fluorescents and HIDs) and dental wastes (such as scrap amalgam, chair side traps, and separator wastes).

In facilities delivering dental care, specify and install amalgam separation devices that meet or exceed the ISO-11143 standard.

Comply with the mercury elimination requirements outlined below, from the 2010 FGI Guidelines for Design and Construction of Health Care Facilities, Section A1.3- 4b, Mercury Elimination.

- 4.2.1.1. New construction: healthcare facilities may not use mercury-containing equipment, including thermostats, switching devices, and other building system sources. Lamps are excluded.
- 4.2.1.2. Renovation: healthcare facilities must develop a plan to phase out mercury-containing products and upgrade current mercury-containing lamps to high-efficiency, low-mercury, or mercury-free lamp technology.

Do not specify or install preheat, T-9, T-10, or T-12 fluorescents or mercury vapor high-intensity discharge (HID) lamps in the project. Do not specify probe-start metal halide HID lamps in any interior spaces.

Specify and install illuminated exit signs that do not contain mercury and use less than 5 watts of electricity.

Fluorescent and high-pressure sodium lamps must meet the criteria in Table 1.

**Table 1. Maximum mercury content of lamps**

| *Lamp* | *Maximum content* |
|---|---|
| T-8 fluorescent, eight-foot | 10 mg mercury |
| T-8 fluorescent, four-foot | 3.5 mg mercury |
| T-8 fluorescent, U-bent | 6 mg mercury |
| T-5 fluorescent, linear | 2.5 mg mercury |
| T-5 fluorescent, circular | 9 mg mercury |
| Compact fluorescent, nonintegral ballast | 3.5 mg mercury |
| Compact fluorescent, integral ballast | 3.5 mg mercury, ENERGY STAR qualified |
| High-pressure sodium, up to 400 watts | 10 mg mercury |

| | |
|---|---|
| High-pressure sodium, above 400 watts | 32 mg mercury |

mg = milligram

## GUIDANCE

There are no substantive changes to the prerequisite requirements; refer to the LEED v4 reference guide, with the following addition:

### Further Explanation

Connection to Ongoing Performance

- LEED O+M MR credit Purchasing: This credit is a strategy that can help achieve the MR credit: Purchasing in O+M v4.1 rating system.

# MR Credit: Building Life-Cycle Impact Reduction

This credit applies to

- BD+C: New Construction (1-5 points)
- BD+C: Core & Shell (1-5 points)
- BD+C: Schools (1-5 points)
- BD+C: Retail (1-5 points)
- BD+C: Data Centers (1-5 points)
- BD+C: Warehouses & Distribution Centers (1-5 points)
- BD+C: Hospitality (1-5 points)
- BD+C: Healthcare (1-5 points)

## INTENT

To encourage adaptive reuse and optimize the environmental performance of products and materials.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL NC, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY NC, HEALTHCARE

Demonstrate reduced environmental effects during initial project decision-making by reusing existing building resources or demonstrating a reduction in materials use through life-cycle assessment.

Achieve one or more of the following options below for a maximum of 5 points.

Option 1. Building and Material Reuse (1-5 points)

Maintain the existing building structure, envelope, and interior nonstructural elements. Reused or salvaged materials from off site that are incorporated into the building can also contribute to the credit calculations. However, reuse materials contributing toward this credit may not contribute toward MR Credit Material Disclosure and Optimization – Sourcing of Raw Materials.

Historic, abandoned, or blighted buildings: Portions of buildings deemed structurally unsound or hazardous can be excluded from the credit calculations.

Path 1 and 2 reward projects that reuse structural and/or nonstructural elements based on the project area. Path 1 and 2 can be combined for points.

**Path 1: Maintain Existing Structural Elements: Walls, Floors, Roofs, and Envelope (1-5 points):**

Maintain the existing building structure (including floor and roof decking) and envelope (the exterior skin and framing, excluding window assemblies and nonstructural roofing materials). Calculate reuse of the existing project area according to Table 1.

Table 1. Path 1 Points for reuse of existing building structural elements

| *Percent of existing walls, floors and roof reuse by project area* | *Points BD+C* |
|---|---|
| *15%* | *1* |
| 30% | 2 |
| 45% | 3 |
| 60% | 4 |
| 75% | 5 |

AND/OR

Path 2: Maintain Interior Nonstructural Elements (1 point)

Use existing interior nonstructural elements (e.g. interior walls, doors, floor coverings and ceiling systems) for at least 30% of the entire completed building, including additions.

AND/OR

Option 2. Whole-Building Life-Cycle Assessment (1-4 points)

For new construction (buildings or portions of buildings), conduct a cradle-to-grave life-cycle assessment of the project's structure and enclosure and select one or more of the following paths below to earn up to 4 points:

Path 1: Conduct a life cycle assessment of the project's structure and enclosure (1 point).

Path 2: Conduct a life cycle assessment of the project's structure and enclosure that demonstrates a minimum of 5% reduction, compared with a baseline building in at least three of the six impact categories listed below, one of which must be global warming potential (2 points).

Path 3: Conduct a life cycle assessment of the project's structure and enclosure that demonstrates a minimum of 10% reduction, compared with a baseline building, in at least three of the six impact categories listed below, one of which must be global warming potential (3 points).

Path 4: Meet requirements of Path 3 and incorporate reuse and/or salvage materials into the project's structure and enclosure for the proposed design. Demonstrate reductions compared with a baseline building of at least 20% reduction for global warming potential and demonstrate at least 10% reduction in two additional impact categories listed below (4 points).

For Paths 2, 3 and 4 listed above, no impact category assessed as part of the life-cycle assessment may increase by more than 5% compared with the baseline building. Include a narrative of how the life cycle assessment was conducted and if applicable for paths 2, 3 and 4 what changes were made to proposed buildings in order to achieve the related impact reductions.

The baseline and proposed buildings must be of comparable size, function, orientation, and operating energy performance as defined in EA Prerequisite Minimum Energy Performance. The service life of the baseline and proposed buildings must be the same and at least 60 years to fully account for maintenance and replacement. Baseline assumptions must be based on standard design and material selection for the project location and building type. Use the same life-cycle assessment software tools and data sets to evaluate both the baseline building and the proposed building, and report all listed impact categories. Data sets must be compliant with ISO 14044.

Select at least three of the following impact categories for reduction:

- global warming potential (greenhouse gases), in kg $CO_2e$;
- depletion of the stratospheric ozone layer, in kg CFC-11e;
- acidification of land and water sources, in moles H+ or kg $SO_2e$;
- eutrophication, in kg nitrogen eq or kg phosphate eq;
- formation of tropospheric ozone, in kg NOx, kg O3 eq, or kg ethene; and
- depletion of nonrenewable energy resources, in MJ using CML / depletion of fossil fuels in TRACI.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

### Behind the Intent

#### Beta Update

Updates in v4.1 include a greater focus on reducing embodied carbon of building structures and enclosures. Changes to this credit are intended to incentivize reuse of existing buildings and components, as well as make building reuse calculations simpler. Further, if buildings or building elements cannot be re-used significantly, changes to the lifecycle analysis option of the credit encourage projects to conduct whole building life cycle assessment as an integral design component for many more buildings.

Former LEED v4 credit Option 1 (Historic Building reuse) and Option 2 (Renovation of Abandoned and Blighted Building) have been combined into Option 1 for v4.1. The former Credit Option 3 (Building and Material Reuse) now is replaced with a consolidated option 1 and includes two pathways for calculating building reuse. These changes consolidate the calculation methodology for all types of reuse and restore the LEED v2009 credit pathways (MR c1.1: Building reuse – maintain existing walls, floors and roofs; and MR c1.2: Building reuse – maintain interior nonstructural elements) that provided simpler, more prescriptive calculations. Projects that have experienced difficulty in selecting and demonstrating a combination of structural and non-structural reuse in v4 now have the option of selecting either one or both types of re-use (structural and/or non-structural interior) depending on project scope.

Credit Option 2 (formerly Option 4), Whole Building Life Cycle Assessment, is now available to projects that pursue building reuse strategies that also wish to conduct an WBLCA for the project. The total points available cannot exceed 5 points, though projects can earn one Exemplary Performance point if they achieve reuse and/or WBLCA points from Option 1 and 2 and exceed 5 points in combination.

Credit Option 2 now has an entry pathway that rewards the effort to conduct a whole building life-cycle assessment without having to demonstrate specific impact reductions. Further, an incremental second point is now possible for showing 5% reductions compared to a baseline for three impact categories including global warming potential (GWP). The third point in this option remains unchanged to the v4 WBLCA credit requirements (10% reductions compared to the baseline in three impact categories including GWP). Finally, to greater reward embodied carbon reductions through reuse, project teams can now earn up to four points in Credit Option 4 by incorporating building element reuse and/or salvaged materials into a project’s structure and enclosure and perform a life cycle assessment that shows at least a 20% reduction in global warming potential and at least 10% reduction in two other impact categories.

### Step-by-Step Guidance

Refer to LEED v4 reference guide with the following additions and modifications.

Option 1: Building and Material Reuse

New general guidance for v4.1 applicable to Paths 1 and 2:

Identify non-structural and structural elements of the existing space (e.g. walls, floors, roofs, doors, floor coverings, ceiling systems, etc.) that can be retained separately and in combination to select best pathway/approach for re-use (Path 1 or Path 2). Include elements reused onsite and/or salvaged from offsite as part of the reuse calculations.

Projects that incorporate part of an existing building but do not meet the requirements for this credit may apply the reused portion toward the achievement of MR Credit Sourcing of Raw Materials. To apply the reused portion for the Sourcing of Raw Material credit, determine the cost of each material. This cost will be the actual cost paid or, if the material came from on-site, the replacement value. The replacement value can be determined by pricing a comparable material in the local market; exclude labor and shipping. If a project team receives a discount from a vendor, the replacement value should reflect the discounted price as opposed to the list value. When the actual cost paid for the reused or salvaged material is below the cost of an equivalent new item, use the higher value (actual cost) cost of the new equivalent item in the calculations. When the cost to reclaim an item found on-site is less than the cost of an equivalent new item, use the cost of the new item (or replacement cost).

Option 2: Whole Building Life Cycle Assessment

Collect information needed to perform life cycle assessment of structure and enclosure of the building.

Follow standard process associated with performing a typical whole building life cycle assessment. In general this can be broken down into: 1) Define goal and scope of assessment, 2) Collect information about materials and scenarios, 3) Perform calculations for impacts using reliable LCA assessment tools, 4) Understand and interpret results, and 5) Document process and produce detailed assessment reports.

Ensure that the scope of the analysis is a cradle-to-grave assessment which includes environmental impacts associated with the life-cycle stages for the building structure and enclosure. Follow the LEED v4 reference guide for minimum requirements for LCA related to products, functional equivalence, service life and system boundary under Step 1 with the following clarifications:

- The system boundary of the analysis must include a cradle to grave scope (modules A-D). However, some gaps in sub-modules may exist due to the materials or dataset chosen and design optimizations attempted for the project. Gaps in sub-modules are allowed so long as the system boundary in total encompasses a cradle-to-grave assessment. The required modules for a compliant whole building life-cycle analysis include:
  - Product stage: include modules A1-A3.
  - Construction process: include at least module A4.
  - Use Stage: Include at least one module from B1-B5 (structural materials without expected impacts from use, maintenance, repair or replacement over the building life are allowed to be excluded).
  - End of life stage: Include at least one module from C1-C4.
- If the project site boundary includes detached ancillary structures, such as parking structures or outbuildings, those structures must be included in the WBLCA calculations.
- For projects demonstrating impact reductions compared to a baseline: The LCA software or tool used for the baseline and proposed design must be the same, with the same modules and impact categories evaluated.
- Note that LCA software or tools must have ISO-14044-compliant data sets and conform to ISO 21931-2017 and/or EN 15978:2011 and their data must meet the requirements of ISO 21930-2017 and EN 15804. Typically, the software tool providers will document they meet these criteria in the LCA output report.

*Additional Guidance for Whole Building LCA Tool Providers:*

The system boundary of a whole building LCA must include modules A-D as defined in ISO 21930 and EN 15804. LCA tools must have ISO-14044-compliant data sets and conform to ISO 21931-2017 and/or EN 15978:2011. Further, the underlying data must meet the requirements of ISO 21930-2017 and EN 15804.

- If LCI data is not available for certain products, LCA tools can incorporate product EPD data into their ISO 14044 compliant LCI datasets as long as:
  - The EPD has not expired.
  - The EPD scenarios are representative of contemporary technologies and/or practice, and are relevant to the project location.
  - The EPD data reports all indicators and system boundary information required by WBLCA tools.
  - The EPD or LCA clearly indicates which product (manufacturer and product name) or geographical region it reflects in compared to industrywide results of a material available in the tool.

**Further Explanation**
Calculations

Option 1: Building and Material Reuse
The v4 calculation of formerly credit Option 3. Building and Material Reuse in LEED v4 reference guide has been changed. Steps 1 and 3 have been removed. Step 2 (Reuse off-site materials) remains in effect.

The LEED v4 Building and Material Reuse concept and calculation for "surface area and layers of reuse" is no longer utilized. Instead, project teams will calculate reuse as follows below for Path 1 and Path 2.

<u>Path 1 Calculations: Maintain Existing Structural Elements: Walls, Floors, Roofs and Envelope</u>

The reuse calculation is based on the surface areas of major existing structural and envelope elements per equation 3. Structural support elements such as columns and beams are considered part of the larger surfaces they support, so they are not quantified separately.

Prepare a spreadsheet listing all envelope and structural elements within the existing building prior to construction or renovation. Quantify each item, listing the square footage of both the existing area and the retained area. Determine the percentage of existing elements that are retained by dividing the square footage of the total retained materials area by the square footage of the total existing materials area. Include any salvaged or reused materials that were sourced off-site and integrated into the project as part of the reused area in the calculations.

Take measurements as if preparing a bid for construction of a building. For structural floors and roof decking, calculate the square footage of each component. For existing exterior walls and existing walls adjoining other buildings or additions, calculate the square footage of the exterior wall only and subtract the area of exterior windows and exterior doors from both the existing and the reused area tallies. For interior structural walls (e.g., shear walls), calculate the square footage of one side of the existing wall element. Table 1 provides an example of the calculations for Path 1.

Table 1. Sample Building Structure and Envelope Reuse Calculation for Path 1.

| Structure/Envelope Element | Existing Area (sf) | Reused Area (sf) | Percentage Reused (%) |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Foundation/slab on Grade | 11,520 | 11,520 | 100.0% |
| 2nd floor Deck | 11,520 | 10,000 | 86.8% |
| 1st floor interior structural Walls | 240 | 240 | 100.0% |
| 2nd floor interior structural Walls | 136 | 136 | 100.0% |
| Roof Deck | 11,520 | 11,520 | 100.0% |
| South Exterior Wall (excl. windows) | 8,235 | 8,235 | 100.0% |
| East Exterior Wall (excl. windows) | 6,535 | 6,535 | 100.0% |
| West Exterior Wall (excl. windows) | 6,535 | 5,820 | 89.1% |
| *Off-site salvage - brick façade for north exterior wall (excl. windows)* | 8,235 | *5,500* | 66.8% |
| *Off-site salvage - structural beams for new stairwell* | 650 | *650* | 100.0% |
| **total** | **65,126** | **60,156** | **92.4%** |

Exclude the following items from this calculation: nonstructural roofing material, window assemblies, structural and envelope materials that are deemed structurally unsound, hazardous materials, and materials that pose a contamination risk to building occupants.

Equation 3. Percentage of existing building reuse – maintain existing structural elements:

Existing building reuse = $\frac{area\ reused\ on-site+area\ reused\ from\ off-site}{existing\ building\ area}$ x 100

Path 2 Calculations: Maintain Interior Nonstructural Elements

This pathway focuses on reuse of interior, nonstructural elements and compares the retained and reused elements with the total completed area of interior elements. It is not necessary to calculate the total area of existing interior nonstructural elements prior to demolition. Include any salvaged or reused materials that were sourced off-site and integrated into the project as part of the reused area in the calculations.

Take measurements as if preparing a bid for flooring, ceiling, or painting:

- Finished ceilings and flooring areas (tile, carpeting, etc.). Use square footage or square meters to determine area.
- Interior nonstructural walls. Determine the finished area between floor and ceiling and count both sides.
- Exterior structural and party walls. If the interior finishes (e.g., drywall and plaster) have been reused, count only one side.
- Interior doors. Count surface area once.
- Interior casework. Calculate the visible surface area of the assembly.

Include items that have been saved but may have been relocated, such as full-height demountable walls and doors that were rehung. Also include reused items purchased or sourced off-site from other buildings or projects, such as from salvage yards or donations.

Fixed items, such as nonstructural walls and doors, are included in this credit and count toward the percentage of reuse when they perform the same function (e.g., doors reused as doors). If materials are used for another purpose (e.g., doors made into tables), they can count toward the achievement of MR Credit: Sourcing of Raw Materials, but they cannot count toward both credits.

Table 2 illustrates a spreadsheet for determining credit compliance. The total area of all new and existing building materials (following construction) is determined. The total area of only the existing and reused components is then entered. The sum of the existing materials is then divided by the sum of the total building materials to obtain the overall percentage of retained components. Since the overall percentage of reused nonstructural interior materials exceeds 30% of the total area of all nonstructural interior building materials, the project earns 1 point.

Table 2. Sample Interior Nonstructural Element Reuse Calculation for Path 2.

| Interior Non-Structural Element | Total Area* (sf) | Existing/ Reused (sf) | Percentage Reused (%) |
|---|---|---|---|
| Gypsum Board Wall Partitions – full Height | 5,400 | 2,500 | 46.3% |
| Gypsum Board Wall Partitions – Partial Height | 650 | 650 | 100.0% |
| Carpeting | 15,000 | 0 | 0.0% |
| Resilient flooring | 350 | 350 | 100.0% |
| Ceramic tile | 150 | 150 | 100.0% |
| Suspended ceiling systems | 10,400 | 6,500 | 62.5% |
| Gypsum Board ceilings | 350 | 350 | 100.0% |
| Interior Doors (Wood) | 525 | 420 | 80.0% |
| Interior Windows / sidelights | 56 | 56 | 100.0% |
| *Offsite salvage: interior Doors (Metal)* | 86 | *86* | 100.0% |
| *Offsite salvage: interior casework / cabinetry* | 235 | *235* | 100.0% |
| **totals** | **33,202** | **11,297** | **34.0%** |
| *note: the total area calculation includes both new and existing/reused materials. | | | |

Determine the percentage of existing elements that are retained by dividing the total area of all retained interior nonstructural elements by the total area of interior nonstructural elements following Equation 4.

Equation 4: Percentage of existing building reuse – maintain interior nonstructural elements:

$$\text{Interior nonstructural reuse} = \frac{(area\ of\ retained\ interior\ nonstructural\ elements + area\ of\ elements\ reused\ from\ offsite)}{total\ area\ of\ interior\ nonstructural\ elements} \times 100$$

Projects that incorporate part of an existing building for reuse but do not meet the requirements for Path 2 may apply the reused portion toward the achievement of MR Credit Construction and Demolition Waste Management. To do so, determine an approximate weight or volume for existing building elements and count them as waste diversion in the credit calculations.

### Option 2 (Formerly Option 4): Whole Building Life Cycle Assessment

Refer to Option 4 in the LEED v4 reference guide with the following modifications and additions:

This option now has four thresholds outlined in four pathways. To achieve one point, the project must conduct a compliant lifecycle assessment of the project's structure and enclosure. Include structural materials from any detached or ancillary buildings in the WBLCA. To earn additional points, the proposed building must demonstrate a reduction in global warming potential and in two of five other impact categories when compared to a baseline building and include a narrative to explain the changes being made to proposed buildings in order to achieve the impact reductions (see credit requirements).

Developing an appropriate baseline building is necessary for a compliant WBLCA to show reductions in global warming potential and other impacts. Product and material environmental characteristics in the baseline building must reflect standard design practices and typical material selection choices for the project location and building type. For instance, assuming zero-percent recycled content in some metal products or concrete mixes does not reflect typical practice in North America. Project teams should look to common project types in the region and review industry resources in order to develop accurate baselines for claimed impact reductions. In documenting the credit, project teams will need to include a description of why the baseline structure and enclosure systems represent typical construction for the project, location, and building type.

Within Option 2, choose Path 1 (whole building life cycle analysis of the project) and/or Path 2, 3 or 4 (comparative whole-building life cycle analysis) as outlined in credit requirements. Note that for Path 1, project teams must complete a standard Whole Building Life Cycle Assessment (WBLCA) of the proposed design and report the impact categories in a WBLCA report, however there are no thresholds for reductions necessary to earn this point.

For Path 2, 3 and 4 as mentioned above, project teams must conduct a comparative WBLCA analysis and include a narrative summarizing differences between baseline and proposed building that contribute to the differences in LCA results. Points can be achieved as follows:

- 2 points – demonstrated impact reduction of at least 5% in Global Warming Potential and at least 2 other impact categories.
- 3 points – demonstrated impact reduction of at least 10% in Global Warming Potential and at least 2 other impact categories.
- 4 points – demonstrated impact reduction of 20% in Global Warming Potential and at least 10% in at least 2 other impact categories. This option must also incorporate reuse and/or salvaged materials as a part of the proposed structure or enclosure design. Strategies that offset significant amounts of embodied GWP include reuse of foundations, concrete structures, metal systems, and other high-impact structural materials. Reuse elements may be from on-site or off-site, and should be modeled following guidelines for small scale reuse (see Further Explanation, Small Scale Reuse in LEED v4), these guidelines should also be used for large scale reuse incorporation in Path 4 for LEED v4.1.

### Life-cycle impact measures or indicators
Refer to LEED v4 reference guide with the following additions:

Reporting of impact category results: Report impacts in units of "per square foot" or "per square meter", rounded to the nearest $10^{-4}$ for all six impact categories.

### Required Documentation
Documentation requirements for former Option 1 (historic building reuse) and Option 2 (renovation of abandoned or blighted building) are now included under the restructured Option 1: Building and Material Reuse.

Documentation requirement for Option 1, Building and Material Reuse:

- Path 1: Structural and nonstructural reused elements table and calculations

- Path 2: Interior nonstructural reused elements table and calculations

Documentation requirement for Option 2, Whole Building LCA:

- WBLCA report for structure and enclosure of building

Documentation requirement for Option 2, Whole Building LCA Path 2, 3 and 4:

- WBLCA report that includes description of LCA assumptions, scope and analysis process for baseline building and proposed building, life cycle impact assessment summary showing outputs of proposed building with percent change from baseline building for all impact categories, and a narrative indicating which path was pursued and how reductions were achieved.

### Exemplary Performance

- Option 1: Path 1: Reuse 90% of the building
- Option 2: Achieve Path 4 and show 40% reduction in GWP.
- Achieve more than 5 points from a combination of Option 1 and Option 2.

### Connection to Ongoing Performance

- LEED O+M MR prerequisite Waste Performance: The concept above is a collection of strategies that can help achieve MR prerequisite Waste Performance in the O+M v4.1 rating system.

# MR Credit: Environmental Product Declarations

This credit applies to

- BD+C: New Construction (1-2 points)
- BD+C: Core & Shell (1-2 points)
- BD+C: Schools (1-2 points)
- BD+C: Retail (1-2 points)
- BD+C: Data Centers (1-2 points)
- BD+C: Warehouses & Distribution Centers (1-2 points)
- BD+C: Hospitality (1-2 points)
- BD+C: Healthcare (1-2 points)

## INTENT

To encourage the use of products and materials for which life-cycle information is available and that have environmentally, economically, and socially preferable life-cycle impacts. To reward project teams for selecting products from manufacturers who have verified improved environmental life-cycle impacts.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Achieve one or more of the options below, for a maximum of 2 points.

**Option 1. Environmental Product Declaration (EPD) (1 point)**

Use at least 20 different permanently installed products sourced from at least five different manufacturers that meet one of the disclosure criteria below. (10 different permanently installed products from three different manufacturers for CS and Warehouses & Distribution Centers).

- Life-cycle assessment and environmental product declarations.
  - Products with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that have at least a cradle to gate scope are valued as one whole product for the purposes of credit achievement calculation.
  - Product-specific Type III EPD -- Internally Reviewed. Products with an internally critically reviewed LCA in accordance with ISO 14071. Products with product-specific internal EPDs which conform to ISO 14025, and EN 15804 or ISO 21930 and have at least a cradle to gate scope are valued as one whole product for the purposes of credit achievement calculation.
  - Industry-wide Type III EPD -- Products with third-party certification (Type III), including external verification, in which the manufacturer is explicitly recognized as a participant by the program operator. Products with industry-wide EPDs, which conform to ISO 14025, and EN 15804 or ISO 21930 and have at least a cradle to gate scope are valued as one whole product for the purposes of credit achievement calculation.
- Environmental Product Declarations which conform to ISO 14025 and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
  - Product-specific Type III EPD -- Products with third-party certification (Type III), including external verification and external critical review are valued as 1.5 products for the purposes of credit achievement calculation.

Option 2. Embodied Carbon/LCA Optimization (1 point)
Use products that have a compliant embodied carbon optimization report or action plan separate from the LCA or EPD.  Use at least 5 permanently installed products sourced from at least three different manufacturers. Products are valued according to the table below.

| Report type | Reference Document(s) for the Optimization Report | Report Verification | Valuation |
|---|---|---|---|
| Embodied Carbon/LCA Action Plan | Product-specific LCA or product-specific Type III EPD | Prepared by the manufacturer and signed by company executive | ½ product |
| Reductions in Embodied Carbon:<br><10% reduction in GWP relative to baseline | Baseline: Product-specific LCA, Product-specific Type III EPD, or Industry-wide Type III EPD<br>Optimized: Product-specific LCA or product-specific Type III EPD | Comparative analysis is verified by an independent party | 1 product |
| Reductions in Embodied Carbon:<br>10%+ reduction in GWP relative to baseline | | | 1.5 products |
| Reductions in Embodied Carbon:<br>20%+ reduction in GWP and 5%+ reduction in two additional impact categories, relative to baseline | Baseline: Product-specific LCA or Product-specific Type III EPD<br>Optimized: Product-specific LCA or product-specific Type III EPD | | 2 products |

Note: Reference documents for the optimization reports must be compliant with EPD Credit Option 1.

Impact categories:

- global warming potential (greenhouse gases), in $CO_2e$;
- depletion of the stratospheric ozone layer, in kg CFC-11e;
- acidification of land and water sources, in moles H+ or kg $SO_2e$;
- eutrophication, in kg nitrogen equivalent or kg phosphate equivalent;
- formation of tropospheric ozone, in kg $NO_x$, kg O3 eq, or kg ethene; and
- depletion of nonrenewable energy resources, in MJ using CML  / depletion of fossil fuels in TRACI.

For credit achievement calculation, products sourced (extracted, manufactured, purchased) within 100 miles (160 km) of the project site are valued at twice their base contributing  number of products, up to a maximum of 2 products.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

The prevalence of EPDs has grown significantly since LEED v4 was introduced in 2012. While uptake of Option 1 continues to increase in many regions, a significant number of product categories lack PCRs and many manufacturers do not have accompanying EPDs. Furthermore, Option 2 has been difficult to achieve due to the significant effort to investigate supply chains and the time it takes to reformulate products and develop comparable EPDs. Therefore, changes were made in v4.1 to simplify the selection of products with life cycle assessment data and increase the ability to select optimized products in LEED.

For Option 1 of the EPD credit, partial weightings for life cycle assessment reporting formats have been removed to simplify project team selection and review of life cycle impact disclosures. All compliant product-specific LCAs and EPDs are now worth one whole product, with one exception: third party certified type III EPDs with external verification of the LCA are valued more (1.5 products) to reward highest quality EPDs. In addition, the number of products threshold for credit achievement has been reduced for BD&C - Core and Shell and Warehouse and Distribution Center projects because of their reduced project scopes. In all cases, the Exemplary Performance option for Option 1 has been updated to reflect these changes.

For Option 2, new pathways are intended to reward initial first steps, leadership in life cycle impact reductions, and optimized products that have lowered embodied carbon and other impacts. The cost threshold has been removed to allow simpler achievement criteria. Option 2 now only has a number of products-based threshold: procure 5 products from at least three different manufacturers. Manufacturers that do not have comparable lifecycle data will find an entry-level pathway in Option 2 that rewards "action plans" for those who demonstrate initiative towards reducing life cycle impacts.

Finally, the limitation previously set on contribution of structure and enclosure materials towards total percent by cost of eligible products has been removed.

**Step-by-Step Guidance**
Select which option(s) to pursue. Option 1 and 2 are now based on number of products only, and some products may contribute to both Options 1 and 2. Option 1 rewards the selection of products having product-specific declarations, industry wide EPDs, or product specific type III EPDs. Products must be sourced from multiple manufacturers as indicated in credit requirements.

Option 1: Environmental Product Declarations

<u>Step 1: Specify and select compliant products</u>
Follow LEED v4 reference guide for how to start specifying products with available life cycle assessments or environmental product declarations. Note that if a single EPD covers multiple formulations or product types but reports only combined impact results, that EPD can only count as 1 product.

<u>Step 3: Count compliant products and materials and compile documentation</u>

Follow LEED v4 guidance keeping in mind that products with product-specific LCAs or EPDs meeting more than one criterion are now all equally weighted at the same valuation factor of 1 product. However, Type III EPDs that include external verification of the EPD declaration and external verification of the underlying LCA data are valued as 1.5 products. A Type III EPD is considered externally verified if the person conducting the third-party verification of the underlying LCA data is independent and outside of the organization (as per ISO 14025 and EN 15804 or ISO 21930) in which the EPD is developed.

Also, note that the requirement for EPDs applies to the final unit of purchase—that is, entire product assemblies, not individual components. For example, a window shade that is only sold with attached metal hardware and mounting system cannot separately count the fabric, metal housing, or fasteners as individual EPDs. Or, a metal stud wall system that can only be installed with the appropriate clips and fastening system are considered one product because the system only functions as a whole.

Option 2: Embodied Carbon/LCA Optimization

<u>Step 3: Calculate compliance</u>

Option 1: With the data collected in a tracking tool or the calculator provided by USGBC, use Equation 1 (see *Further Explanation, Calculations*) to calculate the total number of products that comply with Option 1 requirements. This equation calculates compliance based on the number of products, not their cost. Product-specific LCAs and various types of compliant EPDs are valued at 1 product, with the exception of third-party externally verified EPDs that are valued at 1.5 products for credit achievement purposes.

Option 2: The cost-based pathway is no longer available. Choose products that sum to at least 5 products from 3 or more manufacturers that meet at least one of the requirements listed in Option 2. Track products using the credit calculator or an offline tool and calculate the number of products based on attributes and multipliers. Note: in v4.1 there is no limit/cap on structure and enclosure materials towards contributing to the value of compliant building products.

**Further Explanation**

Calculations

Refer to LEED v4 reference guide with the following modifications to the equations – Equation 1 for Option 1 and Equations 2 and 3 for Option 2 (note that calculations for LEED v4 Equation 3 for alternative structure and enclosure limit are no longer applicable to this v4.1 credit).

<u>Equation 1: Total number of products with environmental product declarations (Option 1)</u>

Total # of products = {# of products with product specific declarations/industry specific declarations/internally verified type III EPDs* X 1} + {# of Type III EPDs with external verification and external critical review X 1.5}

<u>Equation 2: Percentage of cost for materials with Embodied Carbon/LCA Optimization Reports (Option 2)</u>

The cost-based pathway is no longer used for this credit. See Equation 3 below.

<u>Equation 3: Total number of products with Embodied Carbon/LCA Optimization Reports (Option 2)</u>

Total # of products = {# of products with action plans X 0.5 X location valuation factor} + {# of products with any Third-Party verified impact reductions in GWP impact category X 1 X location valuation factor}+{# of products with Third-Party verified impact reductions with a minimum of 10% reduction in GWP impact category x 1.5 X location valuation factor} +{# of products with Third-Party verified impact reductions with a minimum of 20% reduction in GWP impact category and a minimum of 5% reduction in 2 other impact categories X 2 X location valuation factor}

Where,

- Location valuation factor = multiplier for the extraction, manufacture, and purchase location (see *MR Overview, Location Valuation Factor*).

  *Note: no single product may contribute more than 2X value.*

### Option 1: Additional Guidance for Type III EPDs for Manufacturers and Program Operators

Manufacturers and Program Operators: Third party certified (Type III) EPDs have been split into two categories for LEED v4.1: those with internal critical review, and those with external review and verification. LEED v4.1 introduces a new ISO standard to help guide best practices in critical review by referencing ISO 14071 which provides guidelines for conducting a critical review of any type of LCA study and the competencies required for the review. Any Type III EPD (whether internally or externally reviewed) must follow the guidelines of ISO 14071 for reviewer and panelist qualifications and reporting consistency.

Externally critically reviewed and externally verified type III EPDs now are rewarded a multiplier of 1.5 "products" for credit calculation purposes. An EPD is considered externally verified if a person conducting the third-party verification is independent and outside of the organization (as per ISO 14025 and EN 15804 or ISO 21930) in which the EPD is developed.

### Documentation of Product-Specific LCA Reports: Summary Table

Manufacturers and Program Operators: Product-specific declarations are defined for this credit as declarations that are based on a life-cycle assessment of a product but not constituting a full EPD (for EPD documentation requirements, see *Documentation of EPDs: Summary Table*). In addition to the documentation outlined in the LEED v4 Reference Guide, product-specific LCA declarations published after July 1, 2021 must include a cover sheet or summary table with the following information at a minimum:

- All requirements outlined in LEED v4 reference guide for this section
- The name/credentials of person(s) conducting the life cycle assessment
- The type of LCA software used to conduct the assessment;
- Date of assessment with period of validity or expiration date of life cycle assessment
- Contact information of the declaration holder or producer (typically the manufacturer)
- Unique document ID number of the report
- Product type
- Product name(s) and/or product line(s) covered by the report
- Product description
- Indication of impact categories measured
- Standards met
- Independent review entity's name and statement
- Reference PCR
- The name/credentials of person(s) conducting the life cycle assessment
- URL link to the publicly available version of the document.

### Documentation of EPDs: Summary Table

Manufacturers and Program Operators: In addition to the documentation outlined under *Required Documentation* in the LEED v4 Reference Guide, all EPDs published after July 1, 2021 must include a separate cover sheet or summary table. The summary table must include:

- All requirements outlined in LEED v4 reference guide for this section
- The name/credentials of person(s) conducting the life cycle assessment
- The type of LCA software used to conduct the assessment;
- Date of assessment with period of validity or expiration date of life cycle assessment,
- A reference to the valid PCR
- Names of global regions covered under the EPD
- URL link to the publicly available version of the document.
- Unique document ID number of the report
- Product type
- Product name(s) and/or product line(s) covered by the report
- Expiration date for the report

**Option 2 Embodied Carbon/LCA Optimization Report Guidance - Action Plans** Compliant Embodied Carbon/LCA Action Plans are standalone documents provided by manufacturers and valued at ½ product for credit calculation purposes. Action plans are created after a manufacturer has conducted a life-cycle assessment of the product or product type, obtained results for the product in any of the life-cycle impact reporting formats per EPD Option 1, and has generated a publicly available narrative and action plan describing life-cycle assessment analysis with results.

Guidance for Manufacturers and Program Operators Creating Embodied Carbon/LCA Action Plan Reports:

A compliant Action Plan is developed by a manufacturer and based upon analysis from a product-specific LCA or product-specific type III EPD that uses EN 15804 or ISO 21930. The action plan must use the specified PCR functional unit for the LCA or EPD document. Action plans cannot be based on industry-wide LCA data or industry-wide EPDs and can be valid for no more than four years. Note: industry averages derived from a source other than an industry-wide EPD are not acceptable. Manufacturers using an industry-wide EPD must have been part of the industry-wide EPD in order to use it for optimization purposes.

The action plan must be publicly available and include strategies and analysis communicating how a manufacturer plans to mitigate or reduce life cycle impacts over time with special consideration of GWP reductions. The Action Plan does not have to be third party verified but at a minimum must be prepared by an individual with experience conducting product-specific LCAs. The Action Plan must be signed by an executive of the manufacturing company.

Action Plans must be a standalone document that includes the following information:

- Unique document ID number of the report
- Product type
- Product name(s) and/or product line(s) covered by the report
- Expiration date for the report
- Description of the LCA conducted including the dataset, software or platform used by manufacturer to complete the analysis.
- Provide a link to a summary of the underlying LCA data or EPD document.
- A table or otherwise summary of the largest life cycle impacts of their products throughout the product life cycle, which includes GWP impact result reporting at a minimum.
- Date of creation of the action plan as well as date of expiration (a maximum of four years for the plan).
- A written narrative describing immediate actions that will be pursued to reduce the overall life cycle impacts of the product within the four-year timeframe.
    - Include a description of the impact areas targeted for reduction in the action plan. The narrative shall describe how GWP is (or is not) targeted for reduction, including a numeric impact reduction target. Impact reductions must be shown as negative values and impact increases shown as positive values.
    - The narrative shall describe actions that will be pursued to reduce life cycle impacts of the product(s) within the four-year timeframe.
    - Include proposed changes in formulation or manufacturing processes that are planned as part of impact reduction strategy.
    - Include specific dates and a timeline for completion of all the steps described in the Action Plan. Only changes that are under the control of the manufacturer are valid for Action Plans.
        - Examples of optimization strategies under the control of the manufacturer include: expected changes from sourcing more local materials or suppliers to reduce shipping impacts, reduction in energy impacts from product manufacturing, an anticipation that the product will be designed to use less energy in the use phase or end of life phase, or installation of renewable energy for onsite generation at the manufacturing plant.
        - Examples of non-compliant changes are reductions that occurred without manufacturer action. For example, regulatory changes that result in lower impacts, energy grid emissions factor updates for the region, or LCA software

updates that result in lower impacts due to dataset changes rather than product optimizations.

- The reference LCA or EPD must meet all the requirements of the life cycle assessment reporting formats per Option 1 credit requirements and documentation requirements of product specific declarations or EPDs.

A sample of a compliant Embodied Carbon/LCA Action Plan is found in the *Resources* section of the online LEED credit library for this credit.

### Option 2 Embodied Carbon/LCA Optimization Report Guidance

Project Team Members, Program Operators and Manufacturers: Compliant Embodied Carbon / LCA Optimization Reports are valued as follows for credit calculation purposes:

- Verified comparison documents that show any percent impact reduction in GWP via LCA or EPD compared with LCA or EPD (product-specific or industry-wide EPD if the manufacturer is recognized as a participant by the program operator), value at 1 product.
- Verified comparison documents that show 10% or more impact reduction in GWP via current LCA or EPD compared with previous LCA or EPD (product-specific or industry-wide EPD if the manufacturer is recognized as a participant by the program operator), value at 1.5 products.
    - Note: if using industry-wide EPDs or a product-specific LCA as the basecase for showing life cycle impact reductions in embodied carbon, the maximum value is 1.5 products.
- Verified comparison documents that show 20% or more impact reduction in GWP and at least 5% reduction in two additional impact categories via current product specific externally verified Type III EPD compared with a previous externally verified Type III EPD of same product based on same PCR, value at 2 products.
    - Since a 2X product multiplier is an exemplary level, only products that show improvement from a past product-specific Type III EPD to a newer product-specific Type III EPD can achieve the 2 products multiplier.

<u>Guidance for Manufacturers and Program Operators Creating Embodied Carbon/LCA Optimization Reports:</u>

To be eligible for showing reductions in life cycle impacts or embodied carbon for a product, a manufacturer must have previously conducted a product-specific LCA, product-specific Type III EPD, or participated in a published industry-wide Type III EPD in accordance with EPD Credit Option 1 Requirements. Then, the manufacturer has conducted a second life cycle assessment or published a second industry wide or product specific EPD in accordance to EPD Credit Option 1 Requirements for the same product type or product after making improvements towards impact reductions. Finally, the manufacturer has conducted a comparative analysis of the results between the two life cycle assessments per comparability guidelines in ISO 14025, section 6.7.2 or EN 21930, section 5.5. The comparison must be from two products following the same Product Category Rule of the same product function or product type. Industry averages derived from a source other than an industry-wide EPD are not acceptable. Manufacturers using an industry-wide EPD must have been part of the industry-wide EPD in order to use it for optimization purposes. Note that these requirements are for conducting a comparative analysis towards impact reductions and must not be used to make comparative assertions towards environmental claims for the product or product type.

The comparative analysis must show impact reduction in the global warming potential (GWP) impact category and must include a narrative describing how reductions in impacts were achieved. The published comparisons must be third-party verified. The comparative analysis and Embodied Carbon/LCA Optimization report can be developed by the same organization that conducted the newer product-specific LCA or Type III EPD, but must be reviewed by an independent practitioner with experience in LCA.

The Embodied Carbon Optimization/LCA report must be a standalone document that includes the following information:

- Unique document ID number of the report
- Product type
- Product name(s) and/or product line(s) covered by the report
- Expiration date for the report
- Summary life-cycle impact category results from the baseline document (product-specific LCA, industry-wide Type III EPD, or product-specific Type III EPD). Results must be shown by module and impact category.
- Provide a link to the public version of the baseline document. Include the validation period and expiration date for the baseline document. The baseline document (LCA or EPD) cannot have expired more than 5 years before the newer LCA or EPD used for comparison was published.
- Summary life-cycle impact category results from the most current document (product-specific LCA or product-specific Type III EPD). Results must be shown by module and impact category. Provide a link to the public version of the current document. Include the validation period and expiration date for the newer document.
- LCA software details, LCA practitioner details and program operator details involved in development of both life cycle assessments.
- Expiration date of the comparative analysis (valid up to four years from when the second life-cycle assessment was conducted. The expiration date on the Optimization report should match the expiration date for the newest LCA or EPD document).
- The comparative analysis must show impact reduction in the global warming potential (GWP) impact category and include a narrative describing how reductions in impacts were achieved. Impact reductions must be shown as negative values and impact increases shown as positive values.
- Narrative explanation of the deliberate decisions taken to reduce life-cycle impacts of the product type or product.
- Only changes that are under the control of the manufacturer are valid for Optimization reports (i.e. "additional"):
    - Examples are expected changes from sourcing more local materials or suppliers to reduce shipping impacts, reduction in energy usage to manufacture the product within the manufacturing phase, an anticipation that the product will be designed to use less energy in the use phase, installation of renewable energy for onsite generation at the manufacturing plant, etc.
    - Examples of non-compliant changes are reductions that occurred without manufacturer action. For example, regulatory changes that result in lower impacts, energy grid emissions factor updates for the region, or LCA software updates that result in lower impacts due to the dataset rather than actual product optimizations.

<u>Manufacturers and Program Operators: Third-Party Verification Program Requirements for Life Cycle Impact Reporting, Comparisons and Narrative:</u>

- The third-party verification and certification program must conduct their operations in compliance with ISO 17065 or have been certified to ISO 17065.
- The verifier will confirm that the output document was conducted in compliance with the requirements as listed above.
- The third-party verifier of the life cycle comparisons and narratives must be different from the individual that created the LCA.
- The verifier must be qualified to conduct verification of life-cycle assessment reports, comparisons and narrative.
- The verifier must receive regular training on the verification process and updates to the program regularly to ensure consistency of verification.
- The program must have a database of publicly available third-party verified products to meet these requirements as listed above.

- The program must have a written third-party verification process and procedure that is updated regularly with a process to implement updates and changes to verifiers of the program that is publicly available.

Notes on Calculations:

- No single product may contribute more than 2X value.
- All product reports must be valid at the time the product was purchased for the project.

### Required Documentation

Follow LEED v4 reference guide documentation requirements with the following modifications for Option 2:

- Option 1: use the LEED v4.1 MR building product calculator. For products that have been verified for LEED by GBCI, include “Verified for LEED Documentation” ID numbers, or copies of EPD/LCA reports and compliant summary documents in LEED Online for products contributing toward credit.
- Option 2: use the LEED v4.1 MR building product calculator. For products that have been verified for LEED by GBCI, include “Verified for LEED Documentation” ID numbers for products selected in the calculator, or copies of action plans and optimization reports in LEED Online for products contributing toward credit.

### Exemplary Performance

Option 1: Purchase at least 40 qualifying permanently installed building products from ten different manufacturers that meet the credit criteria (Purchase at least 20 products from five different manufacturers for Core and Shell and Warehouse & Distribution Centers).

Option 2: Purchase at least 10 compliant products from five different manufacturers of permanently installed building products that meet the credit criteria.

### Connection to Ongoing Performance

- LEED O+M MR prerequisite Waste Performance, MR prerequisite Purchasing Policy, and MR credit Purchasing: A similar credit having some of the above requirements for existing buildings is required for the O+M v4.1 rating system and is a strategy that can help achieve MR prerequisite Waste Performance, MR prerequisite Purchasing Policy, and MR credit Purchasing.

# MR Credit: Sourcing of Raw Materials

This credit applies to

- BD+C: New Construction (1-2 points)
- BD+C: Core & Shell (1-2 points)
- BD+C: Schools (1-2 points)
- BD+C: Retail (1-2 points)
- BD+C: Data Centers (1-2 points)
- BD+C: Warehouses & Distribution Centers (1-2 points)
- BD+C: Hospitality (1-2 points)
- BD+C: Healthcare (1-2 points)

## INTENT

To encourage the use of products and materials for which life cycle information is available and that have environmentally, economically, and socially preferable life cycle impacts. To reward project teams for selecting products verified to have been extracted or sourced in a responsible manner.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL NC, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY NC, HEALTHCARE

### Responsible Sourcing of Raw Materials (1-2 points)

Use products sourced from at least three different manufacturers that meet at least one of the responsible sourcing and extraction criteria below for at least 15%, by cost, of the total value of permanently installed building products in the project (1 point).

Use products sourced from at least five different manufacturers that meet at least one of the responsible sourcing and extraction criteria below for at least 30%, by cost, of the total value of permanently installed building products in the project (2 points).

- *Extended producer responsibility.* Products purchased from a manufacturer (producer) that participates in an extended producer responsibility program or is directly responsible for extended producer responsibility. Products meeting extended producer responsibility criteria are valued at 50% of their cost for the purposes of credit achievement calculation.

- *Bio-based materials.* Bio-based products and materials other than wood must be tested using ASTM Test Method D6866 or equivalent method ISO 16620-2, or be certified to the USDA BioPreferred Voluntary Labeling Initiative that includes verification via ASTM 6866 testing. Exclude hide products, such as leather and other animal skin material.

    - Bio-based products that meet the criteria above: value at 50% of cost multiplied by the biobased content of the product for the purposes of credit achievement calculation.

- *Wood products.* Wood products must be certified by the Forest Stewardship Council or USGBC-approved equivalent. Products meeting wood products criteria are valued at 100% of their cost for the purposes of credit achievement calculation.

- *Materials reuse.* Reuse includes salvaged, refurbished, or reused products. Products meeting materials reuse criteria are valued at 200% of their cost for the purposes of credit achievement calculation.

- *Recycled content.* Products meeting recycled content criteria are valued at 100% of their cost for the purposes of credit achievement calculation.

- Recycled content is the sum of postconsumer recycled content plus one-half the preconsumer recycled content, based on weight.
- The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

For credit achievement calculation, products sourced (extracted, manufactured and purchased) within 100 miles (160 km) of the project site are valued at twice their base contributing cost, up to a maximum of 200% of cost.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

Option 1 of this credit in LEED v4 was intended to focus on improving the knowledge gaps and encourage best practices in raw materials sourcing and extraction. However, lack of specific enough Corporate Social Responsibility (CSR) reports have made achievement of this credit challenging. The intent of this credit option is still a priority and USGBC plans to move Option 1: Raw Material Source and Extraction Reporting to the Pilot Credit Library where it can be refined and updated.

By removing Option 1, Option 2 is now worth two points in version 4.1, and the title has changed to “Responsible Sourcing of Raw Materials**.”** Minor updates have been made to the credit criterion to better reward embodied carbon, renewable bio-based materials, and foster circular economies through recycling and reuse. Finally, the limitation on structure and enclosure materials has been removed. These changes are intended to increase uptake of these important material attributes and continue our efforts to refine best practices in materials extraction and sourcing.

**Step-by-Step Guidance**

For v4.1, projects no longer have to choose between the raw material source reporting option (previously Option 1) and optimized sourcing option (previously Option 2), hence projects should follow LEED v4 reference guide exclusively for leadership extraction practices (henceforth referred to as responsible sourcing of raw materials) and choose between the two new thresholds of 15% by cost (for 1 point) or 30% by cost (for 2 points) for the sourced products.

**Further Explanation**

Calculations

Equation 1 and Equation 3 (for alternative structure and enclosure limit) in the Reference Guide are no longer applicable to this credit. Instead, use Equation 2: Percentage of responsibly sourced products for applicable product cost, criterion valuation factor and location valuation factor with the following modifications in criterion valuation factor of different sourcing attributes:

Product cost = cost of product contributing toward credit.

Criterial valuation factor = multiplier assigned to each sourcing criterion:

- Bio-based products meeting basic criteria, value 0.5, by cost; bio-based products meeting Sustainable Agriculture Standard, value 1.0 by cost.
- Wood products certified to FSC standards, value 1.0 by cost (no change).
- Reused materials, value 2.0 by cost. Calculate cost according to the MR Credit Building Lifecycle Impact reduction, Option 3.
- Recycled content:
  - Postconsumer recycled materials, value 1.0 by cost (no change)

    - Pre-consumer recycled materials, value 0.5 by cost (no change)
    - Recycled content is the sum of postconsumer recycled content plus one-half the pre-consumer recycled content, based on weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.
- Location valuation factor: multiplier for extraction, manufacture and purchase location is 200% (no change)
- Extended Producer Responsibility is valued at 50%; valuation factor is 0.5 (no change)

Extended Producer Responsibility (EPR)

Follow LEED v4 reference guide with the following additional specifications for the two basic types of EPR programs:

- EPR claims must be made in accordance to ISO 14021.
- The manufacturer and/or programs have provided documentation showing participation in any of the following EPR platforms to contribute to LEED:
    - Manufacturer Based Programs:
        - A narrative from the manufacturer describing the nature of the program, where the materials can be collected, and where the materials go upon collection.
        - A state recognized program.
    - Third-party program:
        - A narrative from a manufacturer or third-party entity that includes language on how the third-party is directly responsible for the take back of materials. Within this narrative includes:
            - Collection facility locations.
            - Description of how materials are processed.
            - Fate of materials after they are processed.

Documentation for wood and bio-based products:

- Products with bio-based claims must be legally harvested by exporting and receiving country.
- Manufacturers/Programs must provide documentation on the specific product that includes the type of bio-based raw material used within the product. In addition, products must have either of the following:
    - Confirmation the ASTM D6866 test method was conducted which validates the percent by weight of bio-based material within the product.
    - Product has been certified to the USDA BioPreferred Program and includes the Voluntary Labeling verification of bio-based content via ASTM 6866 or ISO 16620-2 testing.

About the BioPreferred Voluntary Labeling initiative:

> Some products listed on the United States Department of Agriculture's BioPreferred Program Catalog include a voluntary labeling logo that indicates the biobased content of the product has been verified per ASTM D6886 testing. www.biopreferred.gov/BioPreferred

Calculating bio-based material contributions

- Calculate bio-based content using this formula:
    - 50% * percent by weight of bio-based material in total product * Cost of Material

Recycled Content: Follow LEED v4 reference guide with the following additional specifications:

Calculating recycled content contributions:

- Calculate product recycled content using this formula:
    - [% Pre Consumer * 50%] + [% Post Consumer * 100%] * Cost of Material

Notes on Calculations:

- No single product may contribute more than 200% of cost.
- All product reports must be valid at the time the product was purchased for the project.

### Required Documentation

Follow LEED v4 reference guide documentation requirements with the following modifications:

- Documentation requirements for Option 1 are no longer applicable.
- Instead, submit the LEED v4.1 MR building product calculator and documentation of product claims for credit requirements for either 15% by cost or 30% by cost threshold.
- For products that have been verified for LEED by GBCI, include ID numbers in the building product calculator. Additional documentation is not necessary to be included to LEED Online.

### Exemplary Performance

Purchase at least 45%, by cost, of the total value of permanently installed building products that meet the credit criteria.

### Connection to Ongoing Performance

- LEED O+M MR prerequisite Waste Performance, MR prerequisite Purchasing Policy, and MR credit Purchasing: A similar credit having some of the above requirements for existing buildings is required for the O&M v4.1 rating system and is a strategy that can help achieve MR prerequisite Waste Performance, MR prerequisite Purchasing Policy, and MR credit Purchasing.

# MR Credit: Material Ingredients

This credit applies to

- BD+C: New Construction (1-2 points)
- BD+C: Core & Shell (1-2 points)
- BD+C: Schools (1-2 points)
- BD+C: Retail (1-2 points)
- BD+C: Data Centers (1-2 points)
- BD+C: Warehouses & Distribution Centers (1-2 points)
- BD+C: Hospitality (1-2 points)
- BD+C: Healthcare (1-2 points)

## INTENT

To encourage the use of products and materials for which life-cycle information is available and that have environmentally, economically, and socially preferable life-cycle impacts. To reward project teams for selecting products for which the chemical ingredients in the product are inventoried using an accepted methodology and for selecting products verified to minimize the use and generation of harmful substances. To reward raw material manufacturers who produce products verified to have improved life-cycle impacts.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL NC, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY NC, HEALTHCARE

### Option 1. Material Ingredient Reporting (1 point)

Use at least 20 different permanently installed products from at least five different manufacturers that use any of the following programs to demonstrate the chemical inventory of the product to at least 0.1% (1,000 ppm). (10 different permanently installed products from at least three different manufacturers for CS and Warehouses & Distribution Centers)

- *ANSI/BIFMA e3 Furniture Sustainability Standard*. The documentation from the assessor or scorecard from BIFMA must demonstrate the product earned 4, 5, 7, or 8 points under 7.5.1.1 Chemical Assessment in e3-2019 (Pathway 1), 3 points under 7.5.2.2 Advanced Level in e3-2019 (Pathway 2), or at least 3 points under 7.5.1.3 Advanced Level in e3-2014.
    - For e3-2019: If product achieved 3 points under 7.5.1.1 in e3-2019 using the GHS classification sub-path, then the product meets this requirement. Manufacturer to provide additional backup documentation to show which sub-path was used in Pathway 1 (7.5.1) in this instance.
- *Cradle to Cradle.* Product has Material Health Certificate or is Cradle to Cradle Certified™ under standard version 3 or later with a Material Health achievement level at the Bronze level or higher.
- *Declare*. The Declare product label must meet the following requirements:
    - Declare labels designated as Red List Free, LBC Red List Free, or Declared.
    - Declare labels designated as LBC Red List Approved or LBC Compliant that demonstrate content inventory to 0.1% (1,000 ppm).
- *Facts – NSF/ANSI 336*: Sustainability Assessment for Commercial Furnishings Fabric at any certification level.
- *Global Green TAG*. Product Health Declaration (PHD) labels issued after January 1, 2020.
- *Health Product Declaration.* The end use product has a published and complete Health Product Declaration with full disclosure of known hazards in compliance with the Health Product Declaration Open Standard.
- *Living Product Challenge*. The included Declare product label must demonstrate content inventory to 0.1% (1,000 ppm).

- *Manufacturer Inventory*. The manufacturer has published complete content inventory for the product following these guidelines:
  - A publicly available inventory of all ingredients identified by name and Chemical Abstract Service Registration Number (CASRN) and/or European Community Number (EC Number).
  - Materials defined as trade secret or intellectual property may withhold the name and/or CASRN/EC Number but must disclose ingredient/chemical role, amount and hazard score/class using either:
    - Greenscreen List Translator (LT) score and/or Full GreenScreen Benchmark (BM)
    - The Globally Harmonized System of Classification and Labeling of Chemicals rev.6 (2015) (GHS)
      - The hazard screen must be applied to each trade secret ingredient and the inventory lists the hazard category for each of the health hazards included in Part 3 of GHS (e.g. "GHS Category 2 Carcinogen").
- *Product Lens Certification*

Any compliant reports above with third-party verification that includes the verification of content inventory are worth 1.5 products for credit achievement calculations.

AND/OR

Option 2: Material Ingredient Optimization (1 point)
Use products that have a compliant material ingredient report or action plan. Use at least 5 permanently installed products sourced from at least three different manufacturers. Products are valued according to the table below.

| Report Type & Criteria | Product Documentation | Report Verification | Valuation |
| --- | --- | --- | --- |
| Material Ingredient Screening and Optimization Action Plan | Action Plan based on publicly available material inventory to at least 1,000ppm. | Prepared by the manufacturer and signed by company executive | ½ product |
| Advanced Inventory & Assessment:<br>Inventory to at least 0.01% by weight (100 ppm) and no GreenScreen LT-1 hazards or GHS Category 1 hazards are present.<br>Or<br>Inventory to at least 0.01% by weight (100ppm) and at least 75% by weight of product is assessed using GreenScreen. The remaining 25% by weight of product has been inventoried and the GreenScreen assessment is publicly available. | *Cradle to Cradle Certified* or *Material Health Certificate* at Bronze level or higher.<br>*Declare* labels designated as *Red List Free* or *LBC Red List Free.*<br>*Green Seal*. Products certified under the Standard for Paints, Coatings, Stains and Sealers (GS-11, Edition 4.0) that do not include GHS Reproductive toxins (categories 1 and 2).<br>*Health Product Declaration* that meet optimization and verification criteria.<br>*Living Product Challenge* certified products that include a Red List Free or LBC Red List Free *Declare* label.<br>*Manufacturer Inventory* that meet optimization and verification criteria. | Third-party verified | 1 product |
| Material Ingredient Optimization:<br>Inventory to at least 0.01% by weight (100 ppm) and at least 95% by weight of product is assessed using GreenScreen. No BM-1 hazards are present. The remaining 5% not assessed has been inventoried and screened using GreenScreen List Translator and no GreenScreen LT-1 hazards are present. | *Cradle to Cradle Certified* or *Material Health Certificate* at Silver level or higher.<br>*Health Product Declaration* that meet optimization and verification criteria.<br>*Living Product Challenge* certified products that achieve Imperative 09: Transparent Material Health.<br>*Manufacturer Inventory* that meet optimization and verification criteria. | | 1.5 products |
| International Alternative Compliance Path:<br>*Available to projects located outside of the US* | *REACH Optimization*: Material Inventory to 100ppm with no substances found on the Authorization List – Annex XIV, the Restriction list – Annex XVII and the SVHC candidate list.<br>*Global Green TAG* PHD report. | REACH report prepared by the manufacturer<br>PHD Report verified by *Global Green TAG* | 1 product |

For credit achievement calculation, products sourced (extracted, manufactured, purchased) within 100 miles (160 km) of the project site are valued at twice their base contributing number of products), up to a maximum of 2 products.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

Changes were made in v4.1 to reduce barriers for achievement while maintaining the overall approach to the Materials Ingredients credit:

- Option 1 maintains the threshold of 20 products for most BD+C project types but now will allow project teams to meet the credit via 10 products instead of 20 for less material intensive BD+C-C&S and BD+C-warehouse projects. Products with Option 1 compliant reporting methodologies or labels with third-party verification of content inventory will be worth 1.5 products.
- The cost-based threshold for Option 2 has been removed to simplify credit achievement.
- A restructuring of Option 2 rewards manufacturers at multiple steps along the path towards product material ingredient optimization. The new format provides a stepwise approach towards leadership for materials ingredient screening, assessment and optimization.
- Option 3: Product Manufacturer Supply Chain Optimization has been removed from the rating system and pilot credit requirements as well as guidance moved to the Pilot Credit Library where it will be refined for possible incorporation back into the rating system in the future.
- The limitation previously set on structure and enclosure materials for cost calculation has been removed.

**Step-by-Step Guidance**

Follow LEED v4 reference guide with the following modifications:

Option 2 Material ingredient optimization requires the selection of at least 5 products to meet at least one of the paths listed in the credit requirement. Option 3 requirements and guidance are no longer applicable.

Option 1. Material Ingredient Reporting

Step 2. Specify and select compliant products

Specify at least 20 products, from at least five different manufacturers for BD&C projects (with the exception of BD&C- Core and Shell and Warehouse projects, for these project types only 10 products from three different manufacturers need to be specified).

Option 2. Material Ingredient Optimization

Step 3: Calculate number of compliant products

Equation 2 (formerly for product supply chain optimization) is no longer applicable. Therefore, determine the total number of compliant products using the new Equation 2 below. LEED v4 Equation 3 for alternative structure and enclosure percentage limit is no longer applicable.

**Further Explanation**

Refer to LEED v4 reference guide with the following modifications (Note that LEED v4 Equations 2 (supply chain optimization) and 3 (Alternative structure and enclosure limit) are no longer applicable for use in the newer credit, and Equation 2 for v4.1 Material Ingredients credit refers to newer product number metric for Option 2.

Calculations

Use the new Equation 2 below for Option 2 Material Ingredient Optimization (also see *Further Explanation, Material Ingredient Optimization)*

Equation 2: Total number of products (Option 2)

Total # of products = {# of products with Action Plans X 0.5 X location valuation factor} + {# of products with materials meeting the requirements in section Advanced Inventory and Assessment X 1 X location valuation factor}+{# of products with materials meeting the requirements in section Material Optimization x 1.5 X location valuation factor}

Where,

- Location valuation factor = multiplier for the extraction, manufacture, and purchase location (see *MR Overview, Location Valuation Factor*).

  *Note: no single product may contribute more than 2X the product valuation.*

**Option 1: Material Ingredient Reporting – Additional Guidance for Manufacturers**

Manufacturers: Refer to LEED v4 reference guide for this section with the following modifications and additions:

Cradle to Cradle (C2C) Certified and C2C Material Health Certificate

Refer to LEED v4 reference guide for this section with the following modifications:

The credit requirements for v4.1 are aligned with the latest version of the C2C standard v3 and v3.1. C2C v2.1.1 is no longer applicable.

The C2C Material Health Certificate uses material health assessment methodology of the C2C certified product standard to encourage awareness of chemicals in products and supply chains and contribute more specifically towards safer chemicals/greener chemistry within the C2C program. C2C Material Health Certificate can be obtained individually or as part of the C2C program and the requirements for both are identical. Both C2C Certified and C2C Material Health assessment are third-party verified claims that count as 1.5 products for the purpose of LEED v4.1 credits.

Declare and Living Product Challenge labels

Declare and Living Product Challenge labels are issued by the International Living Future Institute (ILFI) and generated via ILFI's Declare portal website or other tools. While third-party verification of Declare labels is not required in LEED, Declare labels that are content verified by a valid third party process are valued at 1.5 products for credit achievement calculations.

There are three kinds of Declare labels:

- "Red List Free," also known as "LBC Red List Free"
- "LBC Compliant," also known as "LBC Red List Approved"
- "Declared"

Products that receive the status of "Red List Free" or "LBC Red List Free" are 100% disclosed down to 100ppm level and do not contain any Red List chemicals. Products that receive the status of "Declared" are also 100% disclosed down to 100ppm level, but may contain one or more Red List ingredients that are not covered by an existing LBC temporary exception. All building products carrying "LBC Red List Free," "Red List Free," and "Declared" status meet LEED v4.1 requirements for disclosure. However, some products that receive the status of "LBC Compliant" or "LBC Red List Approved" may rely on one or more exceptions allowed in the program that may not satisfy the requirements for LEED credit achievement purposes. For example, some products that utilize Temporary Exception I10-E4 may withhold some proprietary ingredient information of up to 1% of product ingredients (therefore not meeting the LEED disclosure threshold), while some other LBC compliant products may use that exemption to exclude or withhold less than 0.1% of product ingredients information (and therefore meet the requirements of the LEED credit). Product specifiers must closely review the labels to ensure they meet the LEED requirement. The Declare product directory has a filter for LEED v4 compliance. https://living-future.org/declare/

The *Living Product Challenge*, version 1.1 or version 2.0, includes a verified "Red List Free" or "LBC Compliant" Declare label as part of certification. Therefore, *"LBC Compliant"* labels may be able to withhold more than 1,000ppm due to temporary exceptions allowed in LBC Complaint labels, making their disclosure potential identical to those found in Option 1. However, any product meeting the Living Product Challenge must have 100% of the content inventory reviewed by an assessor to 100ppm and screened against the Red List and GreenScreen List Translator. For a product to achieve the Transparent Material Health Imperative within the Living Product Challenge, an assessor must assess a minimum of 95% of the product content. The remaining 5% must be screened against the Green Screen List Translator and the ILFI Red List. Therefore, any Living Product Challenge that achieves the Transparent Material Health imperative meets the Optimization thresholds for Option 2 of the credit.

Global GreenTag

Global GreenTag provides a variety of product certifications in North America and over 70 countries worldwide. Global Green Tag's Product Health Declaration (PhD) label provides disclosure of contents, provides an evaluation of material ingredients, includes a list of banned ingredients, and provides evaluation of potential exposure and risks over the lifecycle stages of a product. PhD labels published after January 1, 2020 have a disclosure reporting format that is compliant with credit Option 1. Compliant PhD labels are worth 100% by cost, or 1 product, under Option 1.

Products that utilize ingredients found on the REACH Authorization, Restriction, and Candidate lists are not eligible for PhD certification, therefore PhDs are deemed to comply with the credit Option 2, International Alternative Compliance Path – REACH Optimization. PhDs are applicable for all projects outside the US where the REACH Optimization pathway is eligible on LEED projects. PhD reports are worth 100% by cost, or 1 product, under Option 2.

Green Seal

As a multi-attribute standard, Green Seal's paints and coatings standard includes criteria for material health optimization in addition to criteria for efficacy, sustainable packaging, and labeling. It also includes stringent limits for VOC content and emissions that meet LEED v4.1 IEQ credit: Low-Emitting Materials requirements.

GreenSeal standard for Paints, Coating, Stains, and Sealers (GS-11, Edition 4.0) has been approved for Material Ingredients - Option 2. Certified products that meet LEEDv4.1 optimization criteria [i.e. they do not include GHS Reproductive toxins (categories 1 and 2)] are eligible to be counted as 1 product. The GS-11 standard establishes environmental, health, and performance requirements for certain architectural coatings that are intended to be applied on-site, and for stains, finishes, and sealers.

Find compliant products at: https://certified.greenseal.org/directory

Health Product Declaration Open Standard

Follow LEED v4 reference guide for this section with the following modifications and additions:

HPDs can now be generated via the HPD online builder available on the HPDC website. While third-party verification of HPDs is not required in LEED, HPDs that are content verified by a valid third party process are valued at 1.5 products. The third party verification status of HPDs can be confirmed on the summary page of a published HPD.

Qualifying HPDs developed under the Open Standard version 2.0, 2.1, 2.2 or subsequent versions of the standard are eligible for documenting credit achievement if the HPD is still valid at the time that the product is purchased and used on a project. Version 1.0 HPDs are currently expired in the marketplace and will not contribute to this LEED v4.1 credit unless compliant products were purchased during the time the HPD was valid.

<u>Manufacturer Inventory</u>

Follow LEED v4 reference guide for this section with following modifications:

If the specific ingredient cannot be disclosed for proprietary reasons, the manufacturer may withhold the name and CASRN or EC number but still provide ingredient role/function in product, amount as a percent of total product content (or ppm), and hazard score/class using Green Screen (GS) List Translator, GS Benchmark, or Globally Harmonized System (GHS) for Classification and Labeling of Chemicals v2015. Report hazard levels and hazard endpoints that result in scoring the ingredient as Benchmark 1 using full Green Screen. It is not necessary to report hazards associated with higher Benchmark levels or LT-UNK (Unknown) using GS List Translator.

- For reporting of proprietary ingredients in a manufacturer inventory via GHS pathway (Global Harmonized System of Classification and Labeling of Chemicals Category rev. 6 or higher)
  - The hazard screen must be applied to each trade secret ingredient and the inventory lists the hazard category for each of the health hazard included in Part 3 of GHS (e.g. “GHS Category 2 Carcinogen”).
  - Identify in the inventory all hazard classes for which a classification cannot be made because there is insufficient data for a particular endpoint (data gaps):
    - For a product manufacturer, this is like GS-LT UNK per the GreenScreen LT pathway.
    - A GHS compliant manufacturer inventory will specify either a category hazard for the substance or state there is insufficient data for the particular endpoint in a statement “insufficient data” next to the chemical.

In addition to the requirements above, compliant manufacturer inventories must follow the most recent version of the HPDC Open Standard for reporting, ingredient categorization, disclosure thresholds, displaying content ranges, hazards, and other special conditions.

### Option 2: Material Ingredient Optimization Additional Guidance

Manufacturers: Refer to LEED v4 reference guide for this section with the following modifications and additions:

Under the newly structured Option 2, several different pathways can be used as starting points or frameworks for documenting substitution of problematic substances such as the screening and optimization action plan, manufacturer inventory, HPD (material transparency initiative from HPDC), Declare (product transparency label from ILFI), Green Screen (a program of Clean Production Action), Cradle to Cradle Certified and the European Union’s REACH program (for international projects only).

Option 2 goes beyond Option 1’s reporting requirement and encourages the use of products that have extensive screening and inventory of their ingredients as well as thorough assessment for potential health impacts and optimization of the ingredient chemistry. In order to achieve these goals, Option 2 has been restructured into three main compliance pathways: Material Ingredient Screening and

Optimization Action Plan (valued at 50% by cost or 0.5 product), Advanced Inventory and Assessment (valued at 100% by cost or 1 product) and finally, Material Ingredient Optimization (valued at 150% by cost or 1.5 products).

### Additional GreenScreen related guidance for Option 2 with GreenScreen Benchmark 1 for manufacturers and suppliers

Refer to LEED v4 reference guide for this section with the following modifications:

Under Option 2 in LEED v4 previously, the two levels of compliance—GS List Translator and GS full assessment—were weighted at 100% of cost and 150% of cost, respectively. The newer requirements for Option 2 in LEED v4.1 (Advanced Inventory and Assessment and Material Ingredient Optimization) place a more deliberate focus on the concept of ingredient assessment beyond screening, now explicitly reward GS Benchmark assessments for 75% by weight of product (valued at 1 product) or for 95% by weight of product (valued at 1.5 product) and require the remaining percentage by weight product in both cases to be screened using GS List Translator.

In general, GreenScreen Benchmarks are defined for single chemicals and well-defined mixtures of ingredients, such as metal alloys. However, complex materials and those with unknown or variable composition are less suitable for being assigned a single GreenScreen Benchmark. Examples of such materials include wood, stone, sand, aggregate, and mixed recycled content materials. Building products using significant amounts of these materials may face challenges in screening against GreenScreen Benchmarks for these ingredients while seeking to satisfy the LEED credit requirements. The product certifications and declaration programs recognized in LEED for this credit have requirements for accommodating complex or variable composition materials. Where no such guidance exists, such as for the Manufacturer Inventory pathway, manufacturers shall use the HPDC Open Standard guidelines for Special Conditions when inventorying, screening and assessing these materials and substances in product reports and declarations.

### Additional Guidance - Material Ingredient Screening and Optimization Action Plan (new for v4.1)

Project Teams: Compliant Material Ingredient Screening and Optimization Action Plans are standalone documents provided by manufacturers and are valued at ½ product for credit calculation purposes. Action plans are created after a manufacturer has inventoried their product to 1000 ppm and have provided a publicly available inventory and detailed action plan for how the product plans to mitigate hazard flagged ingredients.

<u>Guidance for Manufacturers Creating Material Ingredient Screening & Optimization Action Plan Reports</u>:

A compliant Action Plan is developed by a manufacturer and based upon analysis from conducting a product inventory of ingredients.  The manufacturer has inventoried the product to at least 1,000 ppm and has conducted a screening or assessment to determine ingredient hazard scores/classes within each product via any of the material ingredient reporting formats in credit Option 1.  For the Acton Plan, the manufacturer has identified specific opportunities for improvement and has provided a detailed action plan to mitigate or reduce known hazards following the principles of green chemistry. The action plan is a publicly available report and must be product-specific (not company, manufacturer or brand), and include the required information below.

A compliant Action Plan is a standalone document that includes these elements:

- Unique document ID number of the report
- Product type
- Product name(s) and/or product line(s) covered by the report
- Date of creation of the action plan
- Expiration date for the report (a maximum of 5 years from the date of creation)

- Description of the inventory conducted including the dataset, software, and screening or assessment platform used by the manufacturer to complete the ingredient screening and analysis.
- Provide a link to the underlying publicly available inventory meeting the requirements of Option 1, if not available in the action plan report.
- A description of specific green chemistry principles targeted for implementation in the action plan. Include proposed changes in formulation or manufacturing processes that are planned as part of green chemistry optimization strategy.
- A table or otherwise summary of the specific green chemistry principles targeted for implementation in the action plan, including specific dates and a timeline for completion of all the steps described in the action plan.
- Contact information of the organizational representative responsible for implementation and success of the proposed action plan.
- Include a written narrative describing the analysis of product ingredients and the action plan steps identified to address specific improvement areas. Specifically, the action plan narrative must include a descriptions of immediate and long-term actions that will be pursued to reduce hazards within the product and which principle(s) of green chemistry are being adopted by the organization (per ingredient) to make the changes within the 5 year timeframe.
    - Examples of optimization strategies in an action plan include: identifying planned manufacturing or formulation changes; planned alternatives assessment; proposed changes in manufacturing processes; and describing how those changes are expected to achieve the end goal of safer chemistry for the product.
    - The principles of green chemistry are those created by Paul Anastas and John Warner, www.warnerbabcock.com/green-chemistry/the-12-principles
- An action plan complete with all the requirements stated above earns 0.5 product valuation.

A sample of a compliant Material Ingredient Action Plan is found in the Resources section of the online LEED credit library.

Additional Guidance - Advanced Inventory and Assessment Pathway (new for v4.1)

Project Team Members and Manufacturers: Compliant Advanced Inventory and Assessment reports are third-party verified standalone documents provided by manufacturers and are valued as 1 product for credit calculation purposes. The end use product has demonstrated a product inventory and assessment of ingredients using any of the following programs:

The following product certifications and reports are eligible:

- *Cradle to Cradle*: Product has Material Health Certificate or is Cradle to Cradle Certified™ under standard version 3 or later with a Material Health achievement level at the Bronze level or higher, value at 100% by Cost or 1 Product.
- *Declare*: Product has a Declare label that is third-party verified and "Red List Free" or "LBC Red List Free."
- *Green Seal.* Products certified under the Standard for Paints, Coatings, Stains and Sealers (GS-11, Edition 4.0) that meet LEEDv4.1 Material Ingredients Credit: Option 2 – Material Ingredient Optimization criteria [i.e. they do not include GHS Reproductive toxins (categories 1 and 2)]. Qualifying products will include the following language on their certificates and in their Green Seal-certified product directory listings to indicate compliance with LEED v4.1 criteria:

    - "Eligible for LEEDv4.1 Material Ingredients Credit: Option 2 – Material Ingredient Optimization"

- *Health Product Declaration*: The product has demonstrated a chemical inventory to at least 0.01% by weight (100 ppm) with no GreenScreen LT-1 hazards or GHS Category 1 hazards. The HPD must be third party verified.
- *Health Product Declaration*: The product has demonstrated a chemical inventory to at least 0.01% by weight (100ppm) and at least 75% by weight of product is assessed using GreenScreen Benchmark assessment and/or is inventoried using applicable HPDC Special Conditions reporting requirements. The remaining 25% by weight of product has been

inventoried. The GreenScreen assessment must be publicly available. The HPD must be third-party verified.

- *Living Product Challenge*. Living Product Challenge certified products that include a "Red List Free" or "LBC Red List Free" Declare label.
- *Manufacturer Inventory*: The product has demonstrated a chemical inventory to at least 0.01% by weight (100 ppm) with no GreenScreen LT-1 hazards or GHS Category 1 hazards. The manufacturer inventory must be third party verified.
- *Manufacturer Inventory*: The product has demonstrated a chemical inventory to at least 0.01% by weight (100ppm) and at least 75% by weight of product is assessed using GreenScreen Benchmark assessment. The remaining 25% by weight of product has been inventoried. The GreenScreen assessment must be publicly available. The manufacturer inventory must be third-party verified.

Guidance for Manufacturers pursuing the Advanced Inventory and Assessment Pathway

To be eligible for showing an advanced inventory and assessment, a manufacturer has conducted a compliant inventory and/or assessment and published a document that satisfies the criteria below. All of the reports must be verified by an approved third-party verifier/assessor meeting the third-party verification requirements in section *"Third-Party Verification Program Requirements for Material Ingredient Reporting and Optimization."*

- Cradle to Cradle Bronze Certification or Material Health Certificate at a Bronze level
    - Product has Material Health Certificate or is Cradle to Cradle Certified™ under standard version 3 or later with a Material Health achievement level at the Bronze level. Cradle to Cradle product certificates meet the third-party verification criteria.
- Declare: Third-party verified "Red List Free" or "LBC Red List Free" Declare labels or Living Product Challenge labels.
    - The Declare label must indicate third-party verification.

Health Product Declaration or Manufacturer Inventory (with no GreenScreen List Translator-1 hazards):

- The product must demonstrate a chemical inventory to at least 0.01% by weight (100 ppm) with no GreenScreen LT-1 hazard scores or GHS Category 1 hazards.
- Since this pathway is an intermediate step towards full optimization and places greater emphasis on advanced inventory and assessment rather than major substitution or elimination of chemicals, GS scores of List Translator- probable carcinogens (LT-P1) and List Translator- Unknown (LT-UNK) are allowed to be reported as is for the ingredients and do not need to be resolved further by the manufacturer in order for this document to be compliant with LEED v4.1 requirements.
- Products utilizing the GHS pathway must display no Category 1 hazards for each ingredient down to 100 ppm levels. If there is no endpoint for a chemical, the manufacturer will need to display "no hazard endpoint" in their manufacturer inventory disclosure document. This reporting must be different from reporting of a data gap, if there is insufficient data available for a particular endpoint, the manufacturer will need to report "Insufficient data" for the particular endpoint of that ingredient/chemical.
- Chemicals with form specific hazards or special conditions must follow the special conditions guidelines in manufacturer inventory/HPDs, these must be available on HPDC website.
- The HPD or Manufacturer Inventory must be third party verified by an approved third-party verifier/assessor via either HPDC or Clean Production Action and meet the third-party verification requirements as specified above.
- In addition to the requirements above, compliant manufacturer inventories must follow the most recent version of the HPDC Open Standard for reporting, ingredient categorization, disclosure thresholds, displaying content ranges, hazards, and other special conditions.

- Health Product Declaration or Manufacturer Inventory (with 75% by weight of product assessed):

- At least 75% by weight of the product to 100ppm level for ingredients must be assessed using the GreenScreen Benchmark methodology.
- Since this pathway is an intermediate step towards full optimization and places greater emphasis on advanced inventory and assessment rather than major substitution or elimination of chemicals, the document must show that 75% by weight of the chemistry within the overall product has been assessed using a full GreenScreen Benchmark Assessment methodology. For the remaining 25% by weight of the product, GreenScreen List Translator scores of ingredients (i.e. preliminary GS List Translator screening) associated with their chemistry has been conducted.
- GreenScreen assessment reviews must be conducted via an approved GreenScreen Profiler and the Health Product Declaration or Manufacturer Inventory must be third-party verified by an approved verifier that meets the third-party verification requirements as stated above.
- Any GreenScreen assessments that resolve unknown and/or probable hazard scores must be made available to the public or the industry, either online in a free directory or through subscription to a common industry database.
- In addition to the requirements above, compliant manufacturer inventories must follow the most recent version of the HPDC Open Standard for reporting, ingredient categorization, disclosure thresholds, displaying content ranges, hazards, and other special conditions.

All compliant reports must also include:

- Product name(s) and/or product line(s) covered by the report
- Unique document ID number of the report
- Expiration date for the report

### Additional Guidance – Material Ingredient Optimization Pathway (new for v4.1)

Project Team Members and Manufacturers: Compliant Material Ingredient Optimization reports are third-party verified standalone documents provided by manufacturers and valued at 1.5 products for credit calculation purposes. The end use product has demonstrated a product inventory and assessment of ingredients using any of the following programs:

- *Cradle to Cradle*. Product is Cradle to Cradle v3 (or later) certified with Material Health category score of Silver or higher, or a Cradle to Cradle certified Material Health Certificate at Silver level or higher.
- Health Product Declaration: The product has demonstrated a chemical inventory to at least 0.01% by weight (100ppm) and at least 95% by weight of product is assessed using GreenScreen Benchmark assessment and/or is inventoried using applicable HPDC Special Conditions reporting requirements. No Benchmark 1 hazards (BM-1) are present in the end use product. The remaining 5% by weight of product not assessed has been inventoried and screened using GreenScreen List Translator and no GreenScreen LT-1 hazards are present in the end use product. The documents must be third party verified.
- *Living Product Challenge*. Products certified to the Living Product Challenge which includes achievement of Imperative 09: Transparent Material Health.
- Manufacturer Inventory: The product has demonstrated a chemical inventory to at least 0.01% by weight (100ppm) and at least 95% by weight of product is assessed using GreenScreen Benchmark assessment. No Benchmark 1 hazards (BM-1) are present in the end use product. The remaining 5% by weight of product not assessed has been inventoried and screened using GreenScreen List Translator and no GreenScreen LT-1 hazards are present in the end use product. The documents must be third party verified.

Guidance for Manufacturers pursuing the Material Ingredient Optimization Pathway

To be eligible for showing a Material Ingredient Optimization, a manufacturer has conducted a compliant inventory and/or assessment and published a document that satisfies the criteria below. All of the reports must be verified by an approved third-party verifier/assessor meeting the third-party verification requirements in section *"Third-Party Verification Program Requirements for Material Ingredient Reporting and Optimization."*

- Cradle to Cradle Silver or higher Certification or Material Health Certificate at a Silver level
    - Product has Material Health Certificate or is Cradle to Cradle Certified™ under standard version 3 or later with a Material Health achievement level at the Silver level.
- Health Product Declaration or Manufacturer Inventory (with 95% by weight of product assessed)
    - At least 95% by weight of the product to the 100ppm level for constituents must be assessed using the GreenScreen Benchmark methodology.
    - Since this pathway requires full optimization in the form of major substitution or elimination of most hazardous chemicals in the product, the document will display that at least 95% by weight of the chemistry within the overall product has been assessed against full GreenScreen Benchmark Assessment methodology (with no BM-1 hazards in end use products) as opposed to just List Translator score hazards (LT-1, LT-P1, LT-UNK). The remaining 5% by weight of product not assessed has been inventoried and screened using GreenScreen List Translator and no GreenScreen LT-1 hazards are present in the end use product.
    - GreenScreen assessments must be conducted via an approved GreenScreen Profiler and the Health Product Declaration or Manufacturer Inventory must be third-party verified.
- In addition to the requirements above, compliant manufacturer inventories must follow the most recent version of the HPDC Open Standard for reporting, ingredient categorization, disclosure thresholds, displaying content ranges, hazards, and other special conditions. Living Product Challenge.
    - Products certified to the Living Product Challenge which includes achievement of Imperative 09: Transparent Material Health.

All compliant reports must also include:

- Product name(s) and/or product line(s) covered by the report
- Unique document ID number of the report
- Expiration date for the report

### International Tips – Material Ingredient Optimization (Option 2)

Project Team Members and Manufacturers: Follow the LEED v4 Reference Guide for projects using the REACH Optimization ACP with the following additional guidance.

The following programs and documents are eligible for the international ACP. Products are valued at 1 product.

- *REACH Optimization*.
    - End use products and materials have fully inventoried chemical ingredients and each substance has been screened against the Authorization List – Annex XIV, the Restriction list – Annex XVII and the SVHC candidate lists:
        - *Restriction List*: https://echa.europa.eu/substances-restricted-under-reach
        - *Authorization list*: https://echa.europa.eu/authorisation-list
        - *SVHC Candidate list*: https://echa.europa.eu/candidate-list-table
    - Products must not contain any intentionally added ingredients found on the REACH Restricted and Authorization lists. Any ingredients in the product found on the Candidate list are not included at concentrations above 100ppm.
- *Global Green Tag.* Product has a certified Product Health Declaration (PhD) report.

Guidance for Manufacturers Providing Documentation for the International ACP:

REACH Optimization: Manufacturers shall provide documentation that confirms a product has had a full ingredient inventory of all intentionally added substances found in the end use product and that a REACH assessment has been conducted. The REACH compliance documentation shall state that no intentionally added ingredients are present in the product that are listed on the REACH Restriction and Authorization lists. Further, the manufacturer documentation shall verify that any ingredients found on the REACH Candidate list are not present in concentrations above 100ppm.

Acceptable documentation:

- Transparency report: Standalone transparency report that provides a complete inventory and shows compliance with the *REACH International ACP* credit requirements. Documentation must include a unique document ID number for the report, list the product type, product name(s) and/or product line(s) covered by the report, date of creation of the report, and expiration date for the report (a maximum of 5 years from the date of creation).

OR

- Manufacturer Attestation: Standalone letter from the product manufacturer declaring that the product meets the *REACH International ACP* credit requirements. No inventory is necessary. This letter must include a signature from someone at the company knowledgeable of product formulations and include their name, job title, and date of signature. The letter must also include the product type, product name(s) and/or product line(s) covered by the attestation letter. Manufacturer letters shall expire when product formulations change, or 3 years from the date of letter signature.

Global Green Tag: Manufacturers have a certified Global Green Tag Product Health Declaration (PHD) and the document is available publicly.

All compliant reports must also include:

- Product name(s) and/or product line(s) covered by the report
- Product type and product description
- Unique document ID number of the report
- Expiration date for the report

### Third-Party Verification Program Requirements for Material Ingredient Reporting and Optimization

- Qualifying third-party verification and certification programs should conduct their operations in compliance with ISO 17065 or have been certified to ISO 17065.
- The verifier will confirm that the output document was conducted in compliance with the requirements of the LEED credit.
- The verification process must cover an additional step of verifying the reliability of content inventory of the product as well as verifying product compliance to required thresholds in LEED.
- The third-party verifier of the material ingredient documents must be independent from the individual that created the documents.
- The verifier must be qualified to conduct verification of material ingredient documents.
- The material ingredient reporting program must provide training for the verifier on the verification process and updates to the program regularly to ensure consistency of verification.
- The program must have a database of publicly available third-party verified products that meet the applicable LEED credit requirements.
- The program must have a written third-party verification process and procedure that is updated regularly with a process to implement updates and changes to verifiers of the program that is publicly available.

### Required Documentation

Follow LEED v4 reference guide documentation requirements with the following modifications:

- Option 1: use the LEED v4.1 MR building product calculator. For products that have been verified for LEED by GBCI, include “Verified for LEED Documentation” ID numbers, or submit copies of product inventory documents in LEED Online for products contributing toward credit.
- Option 2: use the LEED v4.1 MR building product calculator. For products that have been verified for LEED by GBCI, include “Verified for LEED Documentation” ID numbers for products selected in the calculator, or copies of action plans and optimization reports in LEED Online for products contributing toward credit.
- Option 3: Documentation requirements no longer applicable.

Note: All product reports must be valid at the time the product was purchased for the project.

### Exemplary Performance

Option 1: Purchase at least 40 qualifying permanently installed building products from ten different manufacturers that meet the credit criteria (Source at least 20 products from five different manufacturers for CS and Warehouse & Distribution Centers).

Option 2: Purchase at least 10 qualifying products from five different manufacturers of permanently installed building products that meet the credit criteria.

### Connection to Ongoing Performance

- LEED O+M MR credit Purchasing: products meeting the above requirements can help achieve the MR credit Purchasing .

# MR Credit: PBT Source Reduction – Mercury

This credit applies to

- BD+C: Healthcare (1 point)

## INTENT

To reduce the release of persistent, bioaccumulative, and toxic (PBTs) chemicals associated with the life cycle of building materials.

## REQUIREMENTS

HEALTHCARE

Specify and install fluorescent lamps with both low mercury content (MR Prerequisite PBT Source Reduction—Mercury) and long lamp life, as listed in Table 1.

Table 1. Criteria for rated life of low-mercury lamps

| *Lamp* | Maximum content | *Lamp life (hrs)* |
|---|---|---|
| T-8 fluorescent, eight-foot | 10 mg mercury | Standard output - 24,000 rated hours on instant start ballasts (3-hour starts)<br>High output – 18,000 rated hours on instant start ballasts or program start ballasts (3-hour starts) |
| T-8 fluorescent, four-foot | 3.5 mg mercury | Both standard and high output - 30,000 rated hours on instant start ballasts, or 36,000 rated hours on program start ballasts (3 hour starts) |
| T-8 fluorescent, two-foot and three-foot | 3.5 mg mercury | 24,000 rated hours on instant start ballasts or program start ballasts (3-hour starts) |
| T-8 fluorescent, U-bent | 6 mg mercury | 18,000 rated hours on instant start ballasts, or 24,000 rated hours on program start ballasts (3-hour starts) |
| T-5 fluorescent, linear | 2.5 mg mercury | Both standard and high-output - 25,000 rated hours on program start ballasts |
| T-5 fluorescent, circular | 9 mg mercury | Both standard and high-output – 25,000 rated hours on program start ballasts |
| Compact fluorescent, nonintegral ballast | 3.5 mg mercury | 12,000 rated hours |
| Compact florescent, integral ballast, bare bulb | 3.5 mg mercury, ENERGY STAR qualified | Bare bulb - 10,000 rated hours<br>Covered models such as globes, reflectors, A-19s – 8,000 hours |
| High-pressure sodium, up to 400 watts | 10 mg mercury | Use noncycling type or replace with LED lamps or induction lamps |
| High-pressure sodium, above 400 watts | 32 mg mercury | Use noncycling type or replace with LED lamps or induction lamps |

Do not specify or install circular fluorescent lamps or probe start metal halide lamps.

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following addition:

**Further Explanation**

Connection to Ongoing Performance

- LEED O+M MR credit Purchasing: This credit is a strategy that can help achieve the MR credit Purchasing in O+M v4.1 rating system.

# MR Credit: PBT Source Reduction – Lead, Cadmium, and Copper

This credit applies to

- BD+C: Healthcare (1-2 points)

## INTENT

To reduce the release of persistent, bioaccumulative, and toxic (PBT) chemicals associated with the life cycle of building materials.

## REQUIREMENTS

<u>HEALTHCARE</u>

Specify substitutes for materials manufactured with lead and cadmium, as follows.

Lead

- For water intended for human consumption, specify and use solder and flux to connect plumbing pipe on site that meets the California AB1953 standard, which specifies that solder not contain more than 0.2% lead, and flux not more than a weighted average of 0.25% lead for wetted surfaces. The “lead free” label as defined by the Safe Drinking Water Act (SDWA)) does not provide adequate screening for the purposes of this credit because the SDWA defines “lead free” as solders and flux containing 0.2% lead or less.
- For water intended for human consumption, specify and use pipes, pipe fittings, plumbing fittings, and faucets that meet the California law AB1953 of a weighted average lead content of the wetted surface area of not more than 0.25% lead.
- Specify and use lead-free roofing and flashing.
- Specify and use electrical wire and cable with lead content less than 300 parts per million.
- Specify no use of interior or exterior paints containing lead.
- For renovation projects, ensure the removal and appropriate disposal of disconnected wires with lead stabilizers, consistent with the 2002 National Electric Code requirements.

Lead used for radiation shielding and copper used for MRI shielding are exempt.

Cadmium

- Specify no use of interior or exterior paints containing intentionally added cadmium.

Copper

- For copper pipe applications, reduce or eliminate joint-related sources of copper corrosion:
    - use mechanically crimped copper joint systems; or
    - specify that all solder joints comply with ASTM B828 2002, and specify and use ASTM B813 2010 for flux.

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following addition:

**Further Explanation**

Connection to Ongoing Performance

- LEED O+M MR credit Purchasing: This credit is a strategy that can help achieve the MR credit Purchasing in O+M v4.1 rating system.

# MR Credit: Furniture and Medical Furnishings

This credit applies to

- BD+C: Healthcare (1-2 points)

## INTENT

To enhance the environmental and human health performance attributes associated with freestanding furniture and medical furnishings.

## REQUIREMENTS

<u>HEALTHCARE</u>

Use at least 30% (1 point) or 40% (2 points), by cost, of all freestanding furniture and medical furnishings (e.g., mattresses, foams, panel fabrics, cubicle curtains, window coverings, other textiles) that meet the criteria in one of the following three options.

Include built-in casework and built-in millwork in the base building calculations, even if manufactured off site. The dollar value of any individual product may be included in the total qualifying value if the product meets the criteria.

### Option 1. Minimal Chemical Content

All components that constitute at least 5%, by weight, of a furniture or medical furnishing assembly, including textiles, finishes, and dyes, must contain less than 100 parts per million (ppm) of at least four of the five following chemical groups:

- urea formaldehyde;
- heavy metals, including mercury, cadmium, lead, and antimony;
- hexavalent chromium in plated finishes consistent with the European Union Directive on the Restriction of the Use of Certain Hazardous Substances (EU RoHS);
- stain and nonstick treatments derived from perfluorinated compounds (PFCs), including perfluorooctanoic acid (PFOA); and
- added antimicrobial treatments.

AND/OR

### Option 2. Testing and Modeling of Chemical Content

All components of a furniture or medical furnishing assembly, including textiles, finishes, and dyes, must contain less than 100 parts per million (ppm) of at least two of the five chemicals or materials listed in Option 1.

New furniture or medical furnishing assemblies must be in accordance with ANSI/BIFMA Standard Method M7.1–2011. Comply with ANSI/BIFMA e3-2019 Furniture Sustainability Standard, Sections 7.6.1 and 7.6.2, using either the concentration modeling approach or the emissions factor approach. Model the test results using the open plan, private office, or seating scenario in ANSI/BIFMA M7.1, as appropriate. USGBC-approved equivalent testing methodologies and contaminant thresholds are also acceptable. Documentation submitted for furniture must indicate the modeling scenario used to determine compliance.

Salvaged and reused furniture more than one year old at the time of use is considered compliant, provided it meets the requirements for any site-applied paints, coatings, adhesives, and sealants.

AND/OR

### Option 3: Building Product Disclosure and Optimization

Use products that meet at least one of the criteria below. Each product can receive credit for each criterion met. The scope of any environmental product declaration (EPD) must be at least cradle to gate.

- Life-cycle assessment and environmental product declarations.
    - Products with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that have at least a cradle to gate scope are valued as one whole product for the purposes of credit achievement calculation.
    - Product-specific Type III EPD -- Internally Reviewed. Products with an internally critically reviewed LCA in accordance with ISO 14071. Products with product-specific internal EPDs which conform to ISO 14025, and EN 15804 or ISO 21930 and have at least a cradle to gate scope are valued as one whole product for the purposes of credit achievement calculation.
    - Industry-wide Type III EPD -- Products with third-party certification (Type III), including external verification, in which the manufacturer is explicitly recognized as a participant by the program operator. Products with industry-wide EPDs, which conform to ISO 14025, and EN 15804 or ISO 21930 and have at least a cradle to gate scope are valued as one whole product for the purposes of credit achievement calculation.
- Environmental Product Declarations which conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
    - Product-specific Type III EPD -- Products with third-party certification (Type III), including external verification and external critical review are valued as 1.5 products for the purposes of credit achievement calculation.
- *Extended producer responsibility.* Products purchased from a manufacturer (producer) that participates in an extended producer responsibility program or is directly responsible for extended producer responsibility. Products meeting extended producer responsibility criteria are valued at 50% of their cost for the purposes of credit achievement calculation.
- *Bio-based materials.* Bio-based products and materials other than wood must be tested using ASTM Test Method D6866 or equivalent method ISO 16620-2, or be certified to the USDA BioPreferred Voluntary Labeling Initiative that includes verification via ASTM 6866 testing. Exclude hide products, such as leather and other animal skin material.
    - Bio-based products that meet the criteria above: value at 50% of cost multiplied by the biobased content of the product for the purposes of credit achievement calculation.
- *Wood products.* Wood products must be certified by the Forest Stewardship Council or USGBC-approved equivalent. Products meeting wood products criteria are valued at 100% of their cost for the purposes of credit achievement calculation.
- *Materials reuse.* Reuse includes salvaged, refurbished, or reused products. Products meeting materials reuse criteria are valued at 200% of their cost for the purposes of credit achievement calculation.
- *Recycled content.* Products meeting recycled content criteria are valued at 100% of their cost for the purposes of credit achievement calculation.
    - Recycled content is the sum of postconsumer recycled content plus one-half the preconsumer recycled content, based on weight.
    - The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

Products that meet the above criteria are valued according to source location (extraction, manufacture, and purchase point must be within the distances noted below):

For credit achievement calculation, products sourced (extracted, manufactured, purchased) within 100 miles (160 km) of the project site are valued at 200% of their base contributing cost.

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following additions:

**Further Explanation**

Option 3: Building Product Disclosure and Optimization

Please refer to the v4.1 beta guide section for MR credits Environmental Product Declarations and Sourcing of Raw Materials for guidance on implementation.

Connection to Ongoing Performance

- LEED O+M MR credit Purchasing: This credit is a strategy that can help achieve the MR credit Purchasing in O+M v4.1 rating system.

# MR Credit: Design for Flexibility

This credit applies to

- BD+C: Healthcare (1 point)

## INTENT

Conserve resources associated with the construction and management of buildings by designing for flexibility and ease of future adaptation and for the service life of components and assemblies.

## REQUIREMENTS

<u>HEALTHCARE</u>

Increase building flexibility and ease of adaptive use over the life of the structure by employing at least three of the following strategies.

- Use *interstitial space*. Design distribution zone utility systems and equipment including HVAC, plumbing, electrical, information technology, medical gases, and life safety systems to serve the occupied zones and have the capacity to control multiple zones in clinical spaces.
- Provide programmed soft space, such as administration or storage, equal to at least 5% of *departmental gross area* (DGA). Locate soft space adjacent to clinical departments that anticipate growth. Determine a strategy for future accommodation of displaced soft space.
- Provide shell space equal to at least 5% of DGA. Locate it such that it can be occupied without displacing occupied space.
- Identify horizontal expansion capacity for diagnostic and treatment or other clinical space equal to at least 30% of existing floor area (excluding inpatient units) without demolition of occupied space (other than at the connection point). Reconfiguration of additional existing occupied space that has been constructed with demountable partition systems is permitted.
- Design for future vertical expansion on at least 75% of the roof, ensuring that existing operations and service systems can continue at or near capacity during the expansion.
- Designate space for future above-grade parking structures equal to 50% of existing on-grade parking capacity, with direct access to the main hospital lobby or circulation. Vertical transportation pathways that lead directly to the main hospital lobby or circulation are acceptable.
- Use demountable partitions for 50% of applicable areas.
- Use movable or modular casework for at least 50% of casework and custom millwork. Base the calculation on the combined value of casework and millwork, as determined by the cost estimator or contractor.

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following addition:

**Further Explanation**

Connection to Ongoing Performance

- LEED O+M MR prerequisite Waste Performance: This credit is a strategy that can help achieve the MR prerequisite Waste Performance in O+M v4.1 rating system.

# MR Credit: Construction and Demolition Waste Management

This credit applies to

- BD+C: New Construction (1-2 points)
- BD+C: Core & Shell (1-2 points)
- BD+C: Schools (1-2 points)
- BD+C: Retail (1-2 points)
- BD+C: Data Centers (1-2 points)
- BD+C: Warehouses & Distribution Centers (1-2 points)
- BD+C: Hospitality (1-2 points)
- BD+C: Healthcare (1-2 points)

## INTENT

To reduce construction and demolition waste disposed of in landfills and incineration facilities through waste prevention and by reusing, recovering, and recycling materials, and conserving resources for future generations. To delay the need for new landfill facilities that are often located in frontline communities and create green jobs and materials markets for building construction services.

## REQUIREMENTS

NC, CS, Schools, Retail NC, Data Centers, Warehouses & Distribution Centers, Hospitality NC, Healthcare

Develop and implement a construction and demolition waste management plan and achieve points through waste prevention and/or diversion.

Waste Management Plan and Report:

All projects must develop and implement a construction and demolition waste management plan:

- Identify strategies to reduce the generation of waste during project design and construction.
- Establish waste diversion goals for the project by identifying the materials (both structural and nonstructural) targeted for diversion.
- Describe the diversion strategies planned for the project. Describe where materials will be taken including expected diversion rates for each material.

Provide a final waste management report detailing all waste generated, including disposal and diversion rates for the project. Calculations can be by weight or volume but must be consistent throughout. Exclude excavated soil and land-clearing debris from calculations. Include materials destined for alternative daily cover (ADC) in the calculations as waste (not diversion). Any materials sent to a comingled recycling facility for processing must take the facility average recycling rate and must include any ADC as waste (not diversion).

### Option 1. Diversion (1 point)

Follow the Waste Management Plan and divert at least 50% of the total construction and demolition materials from landfills and incineration facilities.

AND/OR

Option 2. Waste Prevention (2 points)

Follow the Waste Management Plan and prevent waste through reuse and source reduction design strategies. Salvage or recycle at least 50% of demolition debris and utilize waste minimizing design strategies and construction techniques for new construction elements. Track all demolition debris generated by the project from start of construction through project completion. Also track all new construction waste materials generated from start of construction through project completion to determine the project's total waste generation from new construction activities. Exclude hazardous materials and land-clearing debris from calculations.

Points are awarded as follows:

Divert at least 50% of all demolition waste, if any. Generate less than 10 lbs./ft2 (50 kg/m2) of waste materials from all new construction activities (2 points)

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

The requirement for diversion via multiple material streams in LEED has been removed. Project teams now have more flexible ways to prevent and divert waste in order to earn points. This new structure rewards the hierarchy of first reduce, reuse, and then recycle.

Additional updates clarify when waste-to-energy can count as diversion for international projects. The changes also incorporate and modify the popular *Pilot Credit 87 for Verified Construction & Demolition Recycling Rates* into the credit (via Exemplary Performance) and define the minimum requirements for a commingled facility certified recycling rate. Finally, the total waste generation pathway has been revised to favor project types that source reduce and generate less waste overall.

**Step-by-Step Guidance**

Refer to LEED v4 Construction and Waste Management Plan prerequisite reference guide with the following modifications:

All recycling facilities must be regulated by a local or state authority. Note that regulatory authorities often do not regulate recycling rates of facilities. To determine the mixed waste processing facility recycling rate (also known as "commingled" or "mixed materials" recycling rates), projects must use an average diversion rate for the facility that corresponds to the time materials were generated on the project and sent to the facility. The average recycling rate for the facility must exclude ADC.

Construction Waste Management Plan

Step 1: Develop and implement a Construction Waste Management Plan during the project design phase and prior to construction.

All projects must develop a Construction Waste Management Plan per the LEED v4 Reference guide with modifications made in the credit requirements. The Waste Management Plan should include goals for waste prevention, waste diversion, identification of recycling haulers and recycling facilities, and data collection and reporting procedures.

- Tracking: develop a method for tracking the amount of all waste and recyclable materials generated during demolition activities (if any), including demolition of existing buildings, other structures on the site, or components demolished as part of building renovation work.

Separately, keep track of waste and recyclable materials generated during new construction activities.

- Waste prevention: Include strategies targeted to reduce the total amount of waste generated during construction, renovation or demolition activities. Identify design strategies to dematerialize or otherwise prevent unused or waste materials. Deconstruct and salvage renovation materials for reuse to the greatest extent possible.
- Diversion: locate recyclers or organizations that provide recycling options for the materials targeted for diversion. Confirm each facility can accept the types of materials the project plans to send for recycling. Obtain a diversion rate for the facility/organization receiving materials, including ADC amounts for commingled recycling processors. Indicate if any commingled facilities have third party verification of recycling rates. Projects must take the facility average recycling rate and be reported in weight or volume (must be consistent). Volume to weight conversions are acceptable if conversion factors are developed by reputable local agency or organizations.
    - o If no local values are available, refer to the most recent EPA Volume-to-Weight Conversion Factors for Solid Waste: www.epa.gov/smm/volume-weight-conversion-factors-solid-waste

Indicate in the Construction Waste Management Plan whether or not the selected recycling facilities that process commingled (mixed) materials have third party verification of their recycling rates. These facilities support accurate reporting and nationally consistent metrics for recycling rates. See the *Exemplary Performance* section for minimum criteria for eligible third-party verified recycling rate programs.

Step 2 – Implement the Waste Management Plan: Follow the LEED v4 Reference Guide for step-by-step guidance (Step #1) in the Construction Waste Management Credit. Note that project-specific waste diversion percentages from waste sorting facilities are not allowed. Projects must use the facility's average recycling rate.

Step 3 – Calculate Diversion Rate: Follow the LEED v4 Reference Guide for step-by-step guidance (Step #2) in the Construction Waste Management Credit. Note that the number of material streams are no longer required to be tracked. Develop a method for tracking the amount of all demolition materials generated on the project (if any). Separately, keep track of waste materials generated during new construction activities.

Step 4 – Produce Waste Management Report: Follow the LEED v4 Reference Guide for step-by-step guidance (Step #3) in the Construction Waste Management Credit with modifications for the v4.1 changes herein.

Option 1: Diversion

After exploring source reduction and design strategies to prevent waste, determine strategies for on-site and off-site waste collection during construction and consider the infrastructure needed for implementation. Projects may use a combination of on-site separation and commingled collection to achieve the diversion goals, depending on what is appropriate for the project location, waste materials generated, and available facilities and haulers. Strategies for achieving high waste diversion include:

- Stage collection bins onsite to correspond with construction phases and contractor schedules. If one trade is onsite for a defined period that has a recyclable waste stream, consider having a single bin for that type of waste instead of—or in addition to—a commingled bin (examples include a bin for concrete recycling during demolition, or separate bins for drywall, wood framing, or roofing waste during those phases).

- Source separated materials taken to an individual recycler (such as a scrap metal recycler, sheetrock vendor, or biomass operator) will tend to have much higher diversion rates than a mixed-waste recycling processor.
- Donate surplus or salvaged materials.
- Participate in manufacturer take-back and recycling programs for removed products in salvageable condition, like ceiling tiles, furniture or flooring.
- Incineration of some C&D materials (other than wood) may be considered diversion for international projects only if reuse and recycling methods are not readily available in the project's location; this must be included in the Waste Management Plan. See *Further Explanation* for additional details on waste-to-energy.

Option 2: Waste Prevention:
Follow step-by-step instructions from the v4 Reference Guide with the following modifications:

Step 2: Calculate Total Waste Reduction

Projects can document waste prevention techniques undertaken on the project to earn 2 points. To calculate the project's total waste, include all materials generated from the project construction and demolition activities and sent offsite for recycling, diversion, landfill, incineration, or any other uses. Exclude hazardous materials, land-clearing debris, and on-site reused materials from the generation numbers. A narrative, provided in the LEED form, must describe strategies in design and construction that were implemented to reduce waste from being generated on the jobsite (See LEED v4 reference guide, *Further Explanation, Source Reduction* for more guidance on source reduction strategies).

Tracking: To calculate waste prevention, project teams must track the amount of waste generated during demolition work and—separately—during new construction activities. For projects with demolition activities, including demolition of existing buildings, other structures on the site, or components demolished as part of building renovation work, develop a method for tracking the amount of all waste generated from demolition. To be eligible for Option 2, the project must demonstrate that at least 50% of the demolition waste was diverted (note: ADC does not count as diversion). Separately, keep track of waste generated during new construction activities. The amount of new construction-phase waste will be used to quantify the amount of waste generated (per $ft^2$ or $m^2$) for Option 2 credit compliance.

Reducing waste by thoughtful design results in the reduction of waste on the jobsite. Stopping waste before it is created is always higher priority than managing waste after construction. Successful projects have implemented the following strategies to prevent construction and demolition waste in LEED:

- Reuse buildings or building components. Materials that are reused onsite are excluded from the waste generation calculations. Sending materials offsite to salvage, donation or recycling, such as through a documented manufacturer take-back program, does not count as waste prevention but can count towards project diversion.
- Source reduction strategies should be incorporated into the design of the project and outlined in the Waste Management Plan. These strategies include reusing existing materials and components, designing for modular construction sizes and techniques, specifying reduced packaging from vendors, designing for industry-standard measurements, eliminating unnecessary finishes, and off-site prefabrication of components or assemblies.
- Work with subcontractors and/or finish material suppliers to eliminate or minimize packaging waste and reduce overall materials rather than send them for disposal or recycling.

**Further Explanation**

Waste-to-Energy

Refer to LEED v4 reference guide with the following modifications:

The combustion of wood materials resulting from recycling processing (also known as "wood-derived fuel" or "biomass") is classified as an acceptable means of diversion for projects both in the US and internationally and is not considered waste-to-energy for LEED project diversion reporting purposes.

Forms of waste-to-energy (other than wood) are not widely utilized for construction and demolition waste management in the United States and it is not considered an acceptable means of diversion for projects within the US. For projects outside the US where waste-to-energy markets for construction and demolition materials may be more common, projects may be eligible to count waste-to-energy as diversion under the *Alternative Compliance Path for International Projects* (see *International Tips* section).

### International Tips

Alternative Compliance Path for International Projects: Waste-to-Energy

International projects that cannot meet diversion requirements via reuse and recycling methods may consider waste-to-energy as diversion if the European Commission Waste Framework Directive 2008/98/EC and Waste Incineration Directive 2000/76/EC are followed. Furthermore, waste-to-energy facilities must meet applicable European Committee for Standardization (CEN) EN 303 standards.

- EN 303-1—1999/A1—2003, Heating boilers with forced draught burners
- EN 303-2—1998/A1—2003, Heating boilers with forced draught burners
- EN 303-3—1998/AC—2006, Gas-fired central heating boilers
- EN 303-4—1999, Heating boilers with forced draught burners
- EN 303-5—2012, Heating boilers for solid fuels
- EN 303-6—2000, Heating boilers with forced draught burners
- EN 303-7—2006, Gas-fired central heating boilers equipped with a forced draught burner

Project teams pursuing this compliance option must demonstrate that reuse and recycling strategies were exhausted before sending material to waste-to-energy facilities.

### Required Documentation

- A compliant Construction and Demolition Waste Management Plan.
- A narrative for waste prevention/design strategies used on the project to achieve the waste threshold and calculation of total waste per area (if pursuing Waste Prevention points).
- MR construction and demolition waste management calculator that demonstrates total and diverted waste amounts and documentation of recycling rates for commingled facilities.
- International projects: justification narrative for use of WTE strategy for international teams and documentation of WTE facilities adhering to EN standards (if applicable)

### Exemplary Performance

Achieve Option 1 and Option 2.

OR

Divert 50% or more of all waste and utilize certified recycling facilities for all commingled waste.

### Certified Recycling Facilities

Qualified third-party organizations who certify facility average recycling rates include these minimum program requirements:

*Requirements for Certified Recycling Facilities:*

Projects must utilize a recycling facility that processes and recycles commingled (mixed) construction and demolition waste materials that has received independent third-party certification of their recycling rates. Qualified third-party organizations who certify facility average recycling rates include these minimum program requirements:

- The certification organization follows guidelines for environmental claims and third-party oversight, including ISO/IEC 17065:2012 and relevant portions of the ISO 14000 family of standards.
- The certification organization is an independent third party who continuously monitors "certified" facilities to ensure that the facilities are operating legally and meeting the minimum program requirements for facility certification and recycling rates.
- Certification organizations shall certify to a protocol that was developed on a consensus basis for recycling facility diversion rates that is not in a draft or pilot program.
- The methodology for calculating facility recycling rates must be:
    - Developed with construction and demolition recycling industry stakeholders and be specific to the construction and demolition recycling industry;
    - Must include a methodology that is applicable across broad regions (i.e. nationally); and,
    - A published and publicly available standard.
- Data submitted by the facilities to the certification organization in support of the recycling rate is audited. The audit includes, at a minimum: the evaluation of recyclable sales records, verification of facility sales into commodity markets, an assessment of downstream materials and how these materials are managed after they leave the site, monitoring off-site movement of materials, and a review of the facilities' customers weight tags information.
- Facilities submit data to the certification organization that supports the recycling rate, such as a mass balance recycling rate (tons in/tons out) for a twelve month period, or quarterly sorts completed and verified by an independent third party entity.
- Breakdown of materials (by type and by weight), including analysis of supporting data relating to amounts (in tons) and types of materials received and processed at the facility.
- At a minimum, the third-party certifying organization conducts an on-site visit of the Facility for the first year certification, with subsequent site visits occurring at least once every two (2) years, unless additional visits are deemed necessary by the certification organization. The site visit will examine:
    - How materials enter, are measured, deposited, processed/sorted and exit facility,
    - Conduct interviews with key personnel, and discuss how materials are managed after they leave the site
    - Confirm equipment types and capacity,
    - Observe and verify load/materials sorting and accuracy,
    - Verify use and accuracy of scales including calibration frequency.

- Diversion rates shall adhere to these requirements:

    - Measurements must be based on weight (not volume), using scales.
    - Diversion Rates must be available on a website and viewable by the general public.
    - Methodology for calculating diversion and recycling rates must be publicly available and applicable to national or country-level accounting standards for construction and demolition waste recycling facilities.

- Facility recycling data submitted to certification program will be analyzed for recycling rates using a mass balance formula or quarterly sorts completed and verified by an independent third party entity.
- Final recycling rate will include overall facility diversion rates with and without ADC/Beneficial Reuse, and will include separate recycling rates by material type as well as combined average including wood derived fuel/bio-fuel separate from other waste to energy or incineration end-markets.

Presently, the Recycling Certification Institute's Certification of Real Rates (CORR) protocol meets the above requirements. Find facilities at: www.recyclingcertification.org/certified-facilities

### Connection to Ongoing Performance

- LEED O+M MR prerequisite Waste Performance: A similar measure with modified requirements for existing buildings is required for the O+M v4.1 rating system and is a strategy that can help achieve the MR prerequisite: Waste Performance.

# EQ Prerequisite: Minimum Indoor Air Quality Performance

This prerequisite applies to

- BD+C: New Construction
- BD+C: Core & Shell
- BD+C: Schools
- BD+C: Retail
- BD+C: Data Centers
- BD+C: Warehouses & Distribution Centers
- BD+C: Hospitality
- BD+C: Healthcare

## INTENT

To contribute to the comfort and well-being of all building occupants by establishing minimum standards for indoor air quality (IAQ).

## REQUIREMENTS

NC, CS, Schools, Retail, Data Centers, Warehouses & Distribution Centers, Hospitality

Mechanically Ventilated Spaces

For mechanically ventilated spaces, meet the requirements of ASHRAE Standard 62.1–2016, Sections 4, 5, 6.2, 6.5, and 7, or a local equivalent, whichever is more stringent.

AND

Provide outdoor air monitors for all mechanical ventilation systems with outdoor air intake flow greater than 1000 cfm (472 L/s). The monitoring device must be capable of measuring the minimum outdoor air intake flow and be capable of measuring the design minimum outdoor air intake flow with an accuracy of +/–10%. An alarm must indicate when the outdoor airflow value varies by 15% or more from the setpoint.

Alternatively, for constant-volume systems that do not employ demand control ventilation, provide an indicator capable of confirming the intake damper is open to the position needed to maintain the design minimum outdoor airflow as determined during the system startup and balancing.

Naturally Ventilated Spaces

For naturally ventilated spaces, meet one of the following ventilation requirements.

- Option 1. ASHRAE prescriptive natural ventilation compliance path
  Meet the requirements of ASHRAE 62.1-2016 with addendum l, Sections 4, 6.4.1, 6.4.3, 6.4.4, and 6.5.

  OR

- Option 2. ASHRAE Engineered natural ventilation system compliance path
  Meet the requirements of ASHRAE 62.1-2016 with addendum l, Sections 4, 6.4.2, 6.4.3, 6.4.4 and 6.5

  OR

- **Option 3. Historic building using ASHRAE prescriptive natural ventilation path**
  This option is available to projects located in a building registered as a local or national historic building.

  Meet the requirements of ASHRAE 62.1-2016 with addendum l, Sections 4, 6.4.1.1-6.4.1.6, 6.4.3, 6.4.4, and 6.5.

AND

Comply with at least one of the following monitoring strategies.

- Provide a direct exhaust airflow measurement device capable of measuring the exhaust airflow. This device must measure the exhaust airflow with an accuracy of +/–10% of the design minimum exhaust airflow rate. An alarm must indicate when airflow values vary by 15% or more from the exhaust airflow setpoint. *This strategy is not allowed for projects using Natural Ventilation Option 3. Historic building*.
- Provide automatic indication devices on all natural ventilation openings intended to meet the minimum opening requirements. An alarm must indicate when any one of the openings is closed during occupied hours.
- Monitor carbon dioxide ($CO_2$) concentrations within each thermal zone. $CO_2$ monitors must be between 3 and 6 feet (900 and 1 800 millimeters) above the floor and within the thermal zone. $CO_2$ monitors must have an audible or visual indicator or alert the building automation system if the sensed $CO_2$ concentration exceeds the setpoint by more than 10%. Calculate appropriate $CO_2$ setpoints using the methods in ASHRAE 62.1–2016, Appendix D.

All Spaces
The indoor air quality procedure defined in ASHRAE Standard 62.1–2016, Section 6.3 may not be used to comply with this prerequisite.

<u>CS only</u>
Mechanical ventilation systems must be capable of meeting projected ventilation levels and monitoring based on the requirements of anticipated future tenants.

<u>Residential only</u>
In addition to the requirements above, if the project building contains residential units, each dwelling unit must meet all of the following requirements:

- Design and install a dwelling-unit mechanical ventilation system that complies with ASHRAE 62.2-2016, Sections 4, 6.7, and 6.8, or a local equivalent, whichever is more stringent. Supply and balanced mechanical ventilation systems must be designed and constructed to provide ventilation air directly from the outdoors. Mechanical ventilation systems are not required when the project meets the exception to Section 4.1.1 of ASHRAE 62.2-2016.
- Design and install local mechanical exhaust systems in each kitchen and bathroom (including half-baths) that comply with ASHRAE 62.2-2016, Sections 5 and 7 or local equivalent, whichever is more stringent. Exhaust air to the outdoors. Do not route exhaust ducts to terminate in attics or interstitial spaces. Recirculating range hoods or recirculating over-the-range microwaves do not satisfy the kitchen exhaust requirements. For exhaust hood systems capable of exhausting in excess of 400 cubic feet per minute (188 liters per second), provide makeup air at a rate approximately equal to the exhaust air rate. Makeup air systems must have a means of closure and be automatically controlled to start and operate simultaneously with the exhaust system. Use ENERGY STAR–labeled bathroom exhaust fans in all bathrooms (including half-baths) or performance equivalent for projects outside the U.S. A heat recovery ventilator (HRV) or energy recovery ventilator (ERV) may be used to exhaust single or multiple bathrooms if it has an efficacy level meeting the ENERGY STAR Technical Specifications for Residential Heat-Recovery Ventilators and Energy-Recovery Ventilators (H/ERVs) Version 2.0 as certified by the Home Ventilating Institute (HVI).
- Unvented combustion appliances (ovens and ranges excluded) are not allowed.

- Carbon monoxide (CO) monitor must be installed on each floor of each dwelling unit, hard-wired with a battery backup. CO monitors are required in all types of units, regardless of the type of equipment installed in the unit.
- Any indoor fireplaces and woodstoves must have solid glass enclosures or doors that seal when closed.
- Any indoor fireplaces and woodstoves that are not closed combustion or power-vented must pass a backdraft potential test to ensure that depressurization of the combustion appliance zone is less than 5 Pa.
- Space- and water-heating equipment that involves combustion must be designed and installed with closed combustion (i.e., sealed supply air and exhaust ducting) or with power-vented exhaust, or located in a detached utility building or open-air facility.

HEALTHCARE

Meet the requirements of ASHRAE Standard 170-2017, Sections 6-10, and meet the requirements above for monitoring for mechanical ventilation systems.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

The ASHRAE standards have been updated to newer versions:

- ASHRAE 62.1-2010-> ASHRAE 62.1-2016 (updated version)
- ASHRAE 170-2008 and FGI 2010 -> ASHRAE 170-2017 (updated version)

Option 2 is available for use through regional compliance pathways.

- EN 13779-2007 ->EN 16798-3:2017 (local applicability)

Monitoring requirements for smaller ventilation systems have been removed while revising requirements for larger systems per ASHRAE 189.1 and previous LEED interpretation. Specific criteria are introduced for constant-volume systems such as an indicator that confirms damper position to maintain design minimum outdoor airflow during system test and balance.

Credit language for natural ventilation pathway is revised to incorporate ASHRAE 62.1-2016 addendum l and to reflect better which specific sections from 62.1-2016 need to be met for naturally ventilated spaces, for engineered natural ventilation or for ventilation of projects registered as historic buildings (since existing historic buildings may be limited in their ability to alter the building envelope to include additional ventilation systems/adjust openings).

**Step-by-Step Guidance**

Refer to LEED v4 reference guide with the following modifications:

Step 1. Evaluate Outdoor Air Quality: For evaluation of outdoor air quality, follow the specific sections 4.5, 6.2, 6.5 and 7 per the latest version of ASHRAE 62.1-2016.

Steps 2-4. Refer to LEED v4 reference guide

Mechanically ventilated spaces (and Mixed-Mode spaces when a mechanical ventilation is active)

Steps 1. Refer to LEED v4 reference guide

Step 2-3. Refer to the LEED v4 reference guide. Note: The indoor air quality procedure (defined in ASHRAE Standard 62.1–2016, Section 6.3) may not be used to comply with this prerequisite. For projects interested in using this section must pursue the pilot credit Performance-based indoor air quality design and assessment.

Step 4. Meet Minimum Requirements: Meet minimum requirements of the newer versions of the standards as defined in rating system requirements, for example ASHRAE 62.1-2016, sections 4, 5, 6.2, 6.5 and 7.

For projects within U.S., indicate if project is in a non-attainment area for PM2.5 and ozone. Projects located outside the U.S. are considered to be in non-attainment area for PM2.5 and ozone (exceeding national standard or guideline, unless local government published outdoor air quality data indicates otherwise). For all of these projects, follow additional guidelines in ASHRAE 62.1- 2016, Section 6.2.1.2 and section 6.2.1.3 for exceedance of PM2.5 and ozone. Prior to occupancy, for PM2.5, confirm that prior to occupancy, air cleaning devices or filters with a minimum MERV of at least 11 or higher per ASHRAE 52.2 (or equivalent) are installed. Similarly, for ozone, confirm that prior to occupancy, air cleaning devices will be provided where the ozone levels exceed the NAAQS levels for projects within U.S. or exceed ozone national standard or guideline for projects located outside of the U.S.

Step 5. Implement Airflow Monitoring: Airflow monitoring requirements for mechanically ventilated spaces need to be met only for larger ventilation systems with airflow > 1000 cfm (472 L/s). For constant volume systems, at the time of system test and balance, install a monitoring device or indicator that confirms position of intake damper to maintain the design minimum outdoor airflow.

Naturally ventilated spaces (and mixed mode systems when mechanical ventilation is inactivated)

Steps 1-2. Refer to LEED v4 reference guide

Step 3. Perform Natural Ventilation Procedure: Determine the best of the three options provided to pursue for natural ventilation, depending on if the building is registered as an historic building or not and follow the requirements for either case. For non-historic buildings, exception to full natural ventilation requirements per ASHRAE 62.1-2016 is permitted under section 6.4 for engineered natural ventilation system.

Step 4. Refer to LEED v4 reference guide

Step 5. Implement Monitoring System: Direct exhaust airflow measurement device strategy is not allowed for projects registered as historic buildings.

**Further Explanation**

Required Documentation

Refer to LEED v4 reference guide with the following modifications.

- For Option 1, Option 2 and mixed mode, confirm that project meets minimum requirements of applicable sections of ASHRAE 62.1- 2016.
- For naturally ventilated and mixed mode ventilated projects, confirmation that projects meets requirements of the applicable sections in ASHRAE 62.1-2016.

*Healthcare documentation only:*

- Confirmation that project meets minimum requirements of ASHRAE 170-2017, Sections 6-10

Connection to Ongoing Performance

- LEED O+M EQ prerequisite Minimum Indoor Air Quality: Providing and maintaining proper minimum ventilation in existing buildings helps to establish minimum indoor air quality and is an important strategy to assessing how the building is performing for the occupants with regards to overall indoor environmental quality via the indoor environmental quality performance prerequisite.

# EQ Prerequisite: Environmental Tobacco Smoke Control

This prerequisite applies to

- BD+C: New Construction
- BD+C: Core & Shell
- BD+C: Schools
- BD+C: Retail
- BD+C: Data Centers
- BD+C: Warehouses & Distribution Centers
- BD+C: Hospitality
- BD+C: Healthcare

## INTENT

To prevent or minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to environmental tobacco smoke.

## REQUIREMENTS

NC, CS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

For this prerequisite smoking includes tobacco smoke, as well as smoke produced from the combustion of cannabis and controlled substances and the emissions produced by electronic smoking devices.

Prohibit smoking inside the building.

Prohibit smoking outside the building except in designated smoking areas located at least 25 feet (7.5 meters) (or the maximum extent allowable by local codes) from all entries, outdoor air intakes, and operable windows.

Communicate the no-smoking policy to occupants. Have in place provisions for enforcement or no-smoking signage.

Residential only

**Option 1. No Smoking**
Meet the requirements above.

OR

**Option 2. Compartmentalization of Smoking Areas**
Meet the requirements above for all areas inside and outside the building except dwelling units and private balconies.

Each dwelling unit where smoking is permitted must be compartmentalized to prevent excessive leakage between units:

- Weather-strip all exterior doors and operable windows in the residential units to minimize leakage from outdoors.
- Weather-strip all doors leading from residential units into common hallways.
- Minimize uncontrolled pathways for the transfer of smoke and other indoor air pollutants between residential units by sealing penetrations in the walls, ceilings, and floors and by sealing vertical chases (including utility chases, garbage chutes, mail drops, and elevator shafts) adjacent to the units.

- Demonstrate a maximum leakage of 0.30 cubic feet per minute per square foot (1.53 liters per second per square meter) at 50 Pa of enclosure (i.e., all surfaces enclosing the apartment, including exterior and party walls, floors, and ceilings). Renovation projects that retain their existing envelope must meet an allowable maximum leakage of 0.50 cfm50 per square foot (2.54 liters per second per square meter) of enclosure area.

SCHOOLS
Prohibit smoking on site.

Communicate the no-smoking policy to occupants. Have in place provisions for enforcement or no-smoking signage.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

Newer changes to this prerequisite include a revised formal definition of smoking that aligns with industry best practice and incorporates previous related LEED interpretations. In response to feedback from project teams with unique no-smoking enforcement methods, requirements for communicating a no-smoking policy have also been revised and projects can use other means of enforcement beyond signage, and signage location is no longer required to be within 10 feet of the building entrances.

The following language has been moved from the credit requirements to the reference guide: "Also prohibit smoking outside the property line in spaces used for business purposes."

**Step-by-Step Guidance**

Step 1. Determine Smoke-Free Locations:

Obtain information from the owner that smoking is prohibited inside the building. Residential projects may allow smoking in specific units, with specific requirements for ensuring that those units are adequately isolated (Refer to the *LEED v4 reference guide, Further Explanation, Project Type Variations).*

- Identify the location of building openings, including entries, outdoor air intakes, and operable windows.
- Emergency exits do not quality as building openings if the doors are alarmed, because alarmed doors will not be opened. Emergency exits without alarms qualify as building openings.

Step 2. Designate Locations of Exterior Smoking Areas:

Determine whether the project has or will have designated outdoor smoking areas. Locate any area designated for smoking at least 25 feet (7.5 meters) from smoke free areas, based on the information gathered in step 1. The 25-foot (7.5 meter) distance is a straight line calculation. Research local codes applicable to the building- the code regulations may or may not meet the 25 feet distance rule for exterior smoking. See the *LEED v4 reference guide, further explanation, code limitations and restrictions*.

- Consider design strategies that may encourage people to use the designated smoking area, such as covered seating
- Educate occupants on the smoking policy and encourage them to self-police. This is particularly important in retail situations.
- Ashtrays signal that smoking is allowed in a particular area. Be sure these are placed outside the 25-foot (7.5 meter) perimeter.

Step 3: Determine Locations of No Smoking Signage:

Communicate no smoking policy proactively to occupants at regular time periods. While the 10 feet of all building entrances rule for posting of signage/no smoking policy is no longer required, it is required to communicate the no smoking policy to occupants and have in place provisions for either enforcement of the no smoking policy or posting of no smoking signage near all the building entrances.

Tips for good signage include drawings, photos or signage with language communicating clearly interior and exterior no smoking policy, or explicit language such as ‘no smoking allowed within xx feet’ and ‘smoking is allowed in designated smoking areas only’ and indicate on signage what those areas are etc.

**Further Explanation**

Property Line Less Than 25 Feet (7.5 Meters) From the Building:

Projects with a property line less than 25 feet (7.5 meters) from the building must consider space usage when determining the outdoor smoking policy. Smoking must still be prohibited on sidewalks within 25 feet (7.5 meters) of openings. Building staff should be educated about this policy so they can direct smokers to designated smoking areas and away from entrances or windows. See Figure 1 in the LEED v4 reference guide.

Project Type Variations

Restaurant

Smoking must be prohibited outside the restaurant building in all areas except the designated outdoor smoking area. This prohibition must include all restaurant seating/café tables controlled by the project even if they lie outside of the property line (such as on a public sidewalk). See Figure 1 in the LEED v4 reference guide.

### Required Documentation

Follow LEED v4 reference guide documentation requirements with the following modifications:

- Description of project’ s no smoking policy, addressing the expanded smoking definition in entirety and including information on how policy is communicated to building occupants and enforced for all projects where smoking is prohibited as well as for residential projects where smoking is permitted.
- Scaled site plan or map showing the location of all designated outdoor smoking and no-smoking areas, location of property line, and site boundary and indicating 25 foot distance from building openings or alternatively a copy of the local code regulations (translated in English with relevant sections highlighted) that are being met for non-smoking on the project in lieu of 25 feet rule.
- Drawings, photos, or other evidence of signage with language communicating no-smoking policy or evidence of any other means of enforcement (for example, evidence of enforcement by security personnel, educational pamphlets regarding building smoking policy or via digital displays available in lobby area etc.)
- Narrative of code restrictions being used in lieu of 25 feet rule from building openings for no smoking policy.

### Connection to Ongoing Performance

- LEED O+M EQ prerequisite Environmental Tobacco Smoke Control: Strategies undertaken for minimizing exposure of building occupants to environmental tobacco smoke in a newly constructed building such as effective communication of the smoking policy for the building may help create precedence for prohibiting smoking in operations phase of the building and can contribute to better indoor environmental quality performance for the occupants during the operations phase.

# EQ Prerequisite: Minimum Acoustic Performance

This prerequisite applies to

- BD+C: Schools

## INTENT

To provide classrooms that facilitate teacher-to-student and student-to-student communication through effective acoustic design.

## REQUIREMENTS

<u>SCHOOLS</u>

### HVAC Background Noise

Achieve a maximum background noise level of 40 dBA from heating, ventilating, and air-conditioning (HVAC) systems in classrooms and other core learning spaces. Follow the recommended methodologies and best practices for mechanical system noise control in ANSI Standard S12.60–2010, Part 1, Acoustical Performance Criteria, Design Requirements and Guidelines for Schools or a local equivalent for projects outside the U.S.

### Exterior Noise

For high-noise sites (peak-hour Leq above 60 dBA during school hours), implement acoustic treatment and other measures to minimize noise intrusion from exterior sources and control sound transmission between classrooms and other core learning spaces. Projects at least one-half mile (800 meters) from any significant noise source (e.g., aircraft overflights, highways, trains, industry) are exempt.

### Reverberation Time

Design each of the classrooms and other core learning spaces to meet one of the following:

- The total surface area of acoustic wall panels, ceiling finishes, and other sound-absorbent finishes equals or exceeds the total ceiling area of the room (excluding lights, diffusers, and grilles). Materials must have an NRC of 0.70 or higher to be included in the calculation.
- The calculated or measured reverberation times comply with ANSI Standard S12.60-2010, Part 1.
- For spaces ≥ 20,000 Cubic Feet (566 Cubic Meters), the calculated or measured reverberation times comply with Table 1:

Table 1. Maximum reverberation time for large volume spaces

| Type of room | Mid-frequency Reverberation time (s) |
|---|---|
| Large lecture room (more than 50 people) | <=1.0 |
| Library | <=1.0 |
| Assembly hall, multi-purpose hall | 0.8 ~ 1.2 |
| Indoor sports hall, swimming pool | 1.5~2.0 |
| Gymnasium/activity studio | <=1.5 |
| Dance studio | <=1.2 |

*For details of the above reverberation time requirements, please refer to Building Bulletin 93 – Acoustic Design of Schools: Performance Standards published by the UK’s Department for Education in February 2015.

Note: the reverberation time is quoted in terms of the mid-frequency reverberation time, Tmf, which is the arithmetic average of the reverberation times in 500hz, 1 kHz, and 2kHz octave bands, or the arithmetic average of the reverberation times in the one-third octave bands from 400 Hz to 2.5 kHz.

Exceptions

Exceptions to the requirements because of a limited scope of work or to observe historic preservation requirements will be considered.

For spaces which involve complex sound calculations and/or special considerations, such as those for music rehearsal/performance, recording studio, drama studio, teaching space intended specifically for students with special hearing or communication needs, this Prerequisite shall not apply and engagement with an acoustician is critical to the acoustic design and performance of the space.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

The reverberation time requirements for large-volume spaces have been updated to replace the standard: NRC-CNRC Construction Technology Update No. 51 with a table developed by USGBC based on UK Department for Education performance standard Building Bulletin 93.

The ASHRAE and AHRI references for HVAC background noise have been removed to emphasize ANSI Standard S12.60-2010, Part 1, as the primary source for background noise in classrooms and other core learning spaces. Background noise levels can still be calculated or measured using the ASHRAE and AHRI references.

Exceptions for certain spaces are included to clarify the scope (and limitations) of this prerequisite.

**Step-by-Step Guidance**

Steps 1-9. Refer to the LEED v4 reference guide. Note that for step 4, it is still acceptable to verify background noise via calculations from the ASHRAE Handbook or AHRI standard, or measurements via ANSI Part 1 annex A1 or ASHRAE Handbook, or other equivalent method.

Step 9. Select reverberation time compliance option for each classroom and core learning space

In addition to the language in this step in the LEED v4 reference guide, add:

Option 3. Maximum reverberation time for large volume spaces

Confirm that the reverberation time for the space complies with Table 1 in the rating system using calculations or measurements. Retain calculations or measurement logs for credit documentation.

Step 10. Remove this step (covered above in step 9, option 3).

**Further Explanation**

Connection to Ongoing Performance

- LEED O+M EQ prerequisite Indoor Environmental Quality Performance: Strategies to minimize HVAC background noise, exterior noise and reverberation time for newly constructed schools can help contribute to better indoor environmental quality and overall occupant satisfaction during operations phase.

# EQ Credit: Enhanced Indoor Air Quality Strategies

This credit applies to

- BD+C: New Construction (1-2 points)
- BD+C: Core & Shell (1-2 points)
- BD+C: Schools (1-2 points)
- BD+C: Retail (1-2 points)
- BD+C: Data Centers (1-2 points)
- BD+C: Warehouses & Distribution Centers (1-2 points)
- BD+C: Hospitality (1-2 points)
- BD+C: Healthcare (1-2 points)

## INTENT

To promote occupants' comfort, well-being, and productivity by improving indoor air quality.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Comply with 3 strategies for 1 point or 6 strategies for 2 points

*Strategy 1. Entryway Systems*

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

Warehouses & Distribution Centers only

Entryway systems are not required at doors leading from the exterior to the loading dock or garage but must be installed between these spaces and adjacent office areas.

Healthcare only

In addition to the entryway system, provide pressurized entryway vestibules at high-volume building entrances.

*Strategy 2. Interior Cross-Contamination Prevention*

Sufficiently exhaust each space where hazardous gases or chemicals may be present or used (e.g., garages, housekeeping and laundry areas, copying and printing rooms), using the exhaust rates determined in EQ Prerequisite Minimum Indoor Air Quality Performance or a minimum of 0.50 cfm per square foot (2.54 l/s per square meter), to create negative pressure with respect to adjacent spaces when the doors to the room are closed. For each of these spaces, provide self-closing doors and deck-to-deck partitions or a hard-lid ceiling.

*Strategy 3. Filtration of Outdoor Air*

Each ventilation system that supplies outdoor air to occupied spaces must have particle filters or air-cleaning devices that meet one of the following filtration media requirements:

- minimum efficiency reporting value (MERV) of 13 or higher, in accordance with ASHRAE Standard 52.2–2017; or
- Equivalent filtration media class of $ePM_1$ 50% or higher, as defined by ISO 16890-2016, Particulate Air Filters for General Ventilation, Determination of the Filtration Performance.

Replace all air filtration media after completion of construction and before occupancy.

Data Centers only

The above filtration media requirements are required only for ventilation systems serving regularly occupied spaces.

*Strategy 4. Filtration of Recirculated Air*

Each ventilation system that supplies recirculated air to occupied spaces must have particle filters or air-cleaning devices that meet one of the following filtration media requirements:

- Minimum efficiency reporting value (MERV) of 13 or higher, in accordance with ASHRAE Standard 52.2–2017; or
- Equivalent filtration media class of $ePM_1$ 50% or higher, as defined by ISO 16890-2016, Particulate Air Filters for General Ventilation, Determination of the Filtration Performance.

Replace all air filtration media after completion of construction and before occupancy.

Data Centers only

The above filtration media requirements are required only for ventilation systems serving regularly occupied spaces.

*Strategy 5. Increased Ventilation 15 Percent*

Increase breathing zone outdoor air ventilation rates to 95% of all occupied spaces by at least 15% above the minimum rates as determined in EQ Prerequisite Minimum Indoor Air Quality Performance.

*Strategy 6. Increased Ventilation 30 Percent*

Increase breathing zone outdoor air ventilation rates to 95% of all occupied spaces by at least 30% above the minimum rates as determined in EQ Prerequisite Minimum Indoor Air Quality Performance.

*Strategy 7. Operable Windows*

75% of the regularly occupied spaces have operable windows that provide access to outdoor air. The windows must meet the opening size and location requirements of ASHRAE 62.1-2016 with addendum l, section 6.4.1.2.

*Strategy 8. Engineered Natural Ventilation*

Achieve Option 2. ASHRAE Engineered natural ventilation system compliance path under EQ prerequisite. Minimum Indoor Air Quality Performance.

*Strategy 9. Carbon Dioxide Monitoring*

Monitor $CO_2$ concentrations within all densely occupied spaces. $CO_2$ monitors must be between 3 and 6 feet (900 and 1 800 millimeters) above the floor. $CO_2$ monitors must have an audible or visual indicator or alert the building automation system if the sensed $CO_2$ concentration exceeds the setpoint by more than 10%. Calculate appropriate $CO_2$ setpoints using methods in ASHRAE 62.1–2016, Appendix D.

*Strategy 10. Additional Source Control and Monitoring*

For spaces where air contaminants are likely, evaluate potential sources of additional air contaminants besides $CO_2$. Develop and implement a materials-handling plan to reduce the likelihood of contaminant release. Install monitoring systems with sensors designed to detect the specific contaminants. An alarm must indicate any unusual or unsafe conditions.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

The credit has been restructured to a list of 10 strategies. New strategies are included for (1) filtration of recirculated air, (2) increased ventilation at 15% above prerequisite levels, and (3) operable windows.

Referenced standards for Strategy 3. Filtration of outdoor air and Strategy 9. Carbon dioxide monitoring have been updated to recent versions as follows:

- ASHRAE 52.2-2010 → ASHRAE 52.2-2017
- EN 779-2002 → ISO 16890-2016 ASHRAE 62.1-2010 → ASHRAE 62.1-2016

The strategies for natural ventilation and mixed mode ventilation have been updated to align with EQ prerequisite Minimum indoor air quality performance to encouraging natural ventilation design beyond prescriptive values as defined in ASHRAE 62.1-2016 addendum L as *naturally ventilated engineered systems*.

The strategy for Exterior Contamination Prevention has been removed from this credit but may be pursued as an innovation credit.

**Step-by-Step Guidance**

Follow LEED v4 reference guide with the following modifications:

Step 1. Select strategies

Determine which strategies the project will pursue.

If pursuing strategy 1. Entryway Systems

Refer to LEED v4 reference guide, Option 1. Enhanced IAQ Strategies, Entryway systems

If pursuing strategy 2. Interior Cross-Contamination Prevention

Refer to LEED v4 reference guide, Option 1. Interior Cross-Contamination Prevention and use ASHRAE 62.1-2016, Table 5.5.1 that lists minimum separation distances for air intakes.

If pursuing strategy 3. Filtration of Outdoor Air

Follow LEED v4 guidance for specifying outdoor air filtration media meeting credit requirements for minimum efficiency reporting value (MERV) ratings per ASHRAE standard or equivalent filtration media class of ePM1 50% or higher per ISO 16890- 2016, Particulate Air Filters for General Ventilation, Determination of the Filtration Performance instead of EN 779-2002- Class F7 filters or higher.

If pursuing strategy 4. Filtration of Recirculated Air

Identify all HVAC equipment that supplies recirculated air to occupied spaces and specify filtration media that meet the credit requirements for minimum efficiency reporting value (MERV) ratings or equivalent filtration media class.

### If pursuing strategy 5. Increased Ventilation 15 Percent

Follow the EQ Prerequisite Minimum Indoor Air Quality Performance prerequisite's steps for mechanical ventilation systems to determine the amount of outdoor air that must be supplied by each ventilation system. To meet the credit requirements, the system must deliver 15% more outdoor air to 95 percent of the occupied spaces at all times the space is occupied. For multiple-zone recirculating systems, this will likely increase the required outdoor air intake for the system by more than 15%.

### If pursuing strategy 6. Increased Ventilation 30 Percent

Follow the EQ Prerequisite Minimum Indoor Air Quality Performance prerequisite's steps for mechanical ventilation systems to determine the amount of outdoor air that must be supplied by each ventilation system. To meet the credit requirements, the system must deliver 30% more outdoor air to 95 percent of the occupied spaces at all times the space is occupied. For multiple-zone recirculating systems, this will likely increase the required outdoor air intake for the system by more than 30%.

### If pursuing strategy 7. Operable Windows

Identify all regularly occupied spaces and collect the following information for each space:

- Location of openings (on one side, two opposite sides, or two adjacent sides),
- Size of the opening (openable area).

Review section 6.4.1.2 in ASHRAE 62.1-2015 addendum I for window size and location requirements and compare the results with the design. Revise if necessary, to ensure that all regularly occupied spaces meet the requirements.

### If pursuing strategy 8. Engineered Natural Ventilation

This strategy is met if the project complies with natural ventilation Option 2 under the EQ Prerequisite Minimum Indoor Air Quality Performance.

### If pursuing strategy 9. Carbon Dioxide Monitoring

Refer to LEED v4 reference guide, Option 2. Additional Enhanced IAQ Strategies, Carbon Dioxide CO2) monitoring section. Use ASHRAE 62.1-2016, Appendix C for determining CO2 concentration set-points.

Densely occupied spaces are defined as: an area with design occupant density of 25 people or more per 1,000 square feet (93 square meters).

### If pursuing strategy 10. Additional Source Control and Monitoring

Refer to LEED v4 reference guide, Option 2. Additional Enhanced IAQ Strategies, Additional Source Control and Monitoring

**Further Explanation**

### Exhaust Rates for Interior Cross Contamination Prevention

Follow LEED v4 reference guide for this section as well as ASHRAE 62.1-2016, Table 6-5 that lists minimum exhaust rates for spaces whose exhaust requirements exceed the 0.5 cfm per square foot rate.

### Required Documentation

Refer to LEED v4 Reference Guide content, with the following additions:

- Strategy 4. Mechanical schedules highlighting MERV or filtration media class for all units that supply return air
- Strategy 6. Increased ventilation: confirmation (calculations are documented under EQ Prerequisite Minimum Indoor Air Quality Performance)
- Strategy 7. Diagrams or description of location of operable windows and opening size calculations
- Strategy 8. Natural ventilation confirmation (calculations are documented under EQ Prerequisite Minimum Indoor Air Quality Performance)

### Exemplary Performance

Comply with 8 strategies.

### Connection to Ongoing Performance

- LEED O+M EQ prerequisite Indoor Environmental Quality Performance: Strategies undertaken for improving indoor air quality such as having permanent entryway systems, specific filtration requirements as well as monitoring of contaminants can contribute to better indoor environmental quality performance for the occupants during the operations phase.

# EQ Credit: Low-Emitting Materials

This credit applies to

- BD+C: New Construction (1-3 points)
- BD+C: Core & Shell (1-3 points)
- BD+C: Schools (1-3 points)
- BD+C: Retail (1-3 points)
- BD+C: Data Centers (1-3 points)
- BD+C: Warehouses & Distribution Centers (1-3 points)
- BD+C: Hospitality (1-3 points)
- BD+C: Healthcare (1-3 points)

## INTENT

To reduce concentrations of chemical contaminants that can damage air quality and the environment, and to protect the health, productivity, and comfort of installers and building occupants.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Use materials on the building interior that meet the low-emitting criteria below. Points are awarded according to Table 1:

| Table 1. Points for low-emitting materials | |
|---|---|
| 2 product categories | 1 point |
| 3 product categories | 2 points |
| 3 product categories at 90% threshold | 3 points |
| 4 product categories | 3 points |
| 4 product categories with at least 3 product categories at 90% threshold | 3 points + exemplary performance |
| 5 product categories | 3 points + exemplary performance |

### Paints and Coatings

At least 75% of all paints and coatings, **by volume or surface area**, meet the *VOC emissions evaluation* AND 100% meet the *VOC content evaluation*. To meet the 100% requirement for VOC content evaluation, a VOC budget may be used.

The paints and coatings product category includes all interior paints and coatings wet-applied on site, specialized finishes (dyes, sealers, hardeners and toppings for concrete floors), and plaster. Exclude foamed-in place and sprayed insulation (include in Insulation category).

### Adhesives and Sealants

At least 75% of all adhesives and sealants, **by volume or surface area**, meet the *VOC emissions evaluation* AND 100% meet the *VOC content evaluation*. To meet the 100% requirement for VOC content evaluation, a VOC budget may be used.

The adhesives and sealants product category includes all interior adhesives and sealants wet-applied on site.

### Flooring

At least 90% of all flooring, by cost or surface area, meets the *VOC emissions evaluation OR inherently nonemitting sources criteria, OR salvaged and reused materials criteria*.

The flooring product category includes all types of hard and soft surface flooring (carpet, ceramic, vinyl, rubber, engineered, solid wood, laminates), raised flooring, wall base, transition strips/stair nosing, grills, entryway systems, underlayments, and other floor coverings.

Exclude poured concrete, subflooring (include subflooring in the composite wood category, if applicable),and wet-applied products applied on the floor (include in paints and coatings category).

### Wall panels

At least 75% of all wall panels, by cost or surface area, meet the *VOC emissions evaluation, OR inherently nonemitting sources criteria, OR salvaged and reused materials criteria.*

The wall panels product category includes all finish wall treatments (wall coverings, wall paneling, wall tile), gypsum, curtain walls, retail slatwall, trim, interior and exterior doors, non-structural wall framing, interior and exterior windows, window film and treatments, countertops, laminate/veneer used for built-in cabinetry, non-structural sandwich panels, CMU.

Exclude cabinetry (include the composite wood components of built-in cabinetry in the composite wood category and free-standing cabinetry in the furniture category), and vertical structural elements (include structural wood panels or structural composite wood in the composite wood category, if applicable), bathroom accessories, and door hardware.

### Ceilings

At least 90% of all ceilings, **by cost or surface area**, meet the *VOC emissions evaluation, OR inherently nonemitting sources criteria, OR salvaged and reused materials criteria.*

The ceilings product category includes all ceiling panels, ceiling tile, surface ceiling structures such as gypsum or plaster, suspended systems (including canopies and clouds), and glazed skylights.

Exclude overhead structural elements (include structural elements in the composite wood category, if applicable).

### Insulation

At least 75% of all insulation, by cost or surface area, meets the *VOC emissions evaluation.*

The insulation product category includes all thermal and acoustic boards, batts, rolls, blankets, sound attenuation fire blankets, foamed-in place, loose-fill, blown, and sprayed insulation.

Exclude insulation for HVAC ducts and plumbing piping from the credit. Insulation for HVAC ducts may be included at the project team's discretion.

### Furniture

At least 75% of all furniture in the project scope of work, **by cost**, meets the *furniture emissions evaluation, OR inherently nonemitting sources criteria, OR salvaged and reused materials criteria.*

The furniture product category includes all seating, desks and tables, filing/storage, free-standing cabinetry, systems furniture, moveable/demountable partitions, bathroom/toilet partitions, shelving, lockers, specialty and custom fixtures and furniture, and furnishing items (such as area rugs, cubicle curtains, mattresses, and mirrors) purchased for the project.

Exclude office and bathroom accessories, art, recreational items, and planters from the credit.

### Composite Wood

At least 75% of all composite wood**, by cost or surface area**, meets the *Formaldehyde emissions evaluation OR salvaged and reused materials criteria.*

The composite wood product category includes all particleboard, medium density fiberboard (both medium density and thin), hardwood plywood with veneer, composite or combination core, and wood structural panels or structural wood products.

Exclude products covered in the flooring, ceiling, wall panels, or furniture categories from this category.

Low-emitting criteria

***Inherently nonemitting sources***

Product is an inherently nonemitting source of VOCs (stone, ceramic, powder-coated metals, plated or anodized metal, glass, concrete, clay brick, and unfinished or untreated solid wood) and has no binders, surface coatings, or sealants that include organic chemicals.

***Salvaged and reused materials***

Product is more than one year old at the time of use. If finishes are applied to the product on-site, the finishes must meet the *VOC emissions evaluation* AND *VOC content evaluation* requirements.

***VOC emissions evaluation***

Product has been tested according to California Department of Public Health (CDPH) Standard Method v1.2–2017 and complies with the VOC limits in Table 4-1 of the method. Additionally, the range of total VOCs after 14 days (336 hours) was measured as specified in the CDPH Standard Method v1.2 and is reported (TVOC ranges: 0.5 mg/$m^3$ or less, between 0.5 and 5 mg/$m^3$, or 5 mg/$m^3$ or more).

Laboratories that conduct the tests must be accredited under ISO/IEC 17025 for the test methods they use.  Products used in any setting other than schools and classrooms must be modeled to private office scenario. For schools projects, modeling to office and/or schools scenario is permitted.

The statement of product compliance must include the exposure scenario(s) used, the range of total VOCs, and must follow the product declaration guidelines in CDPH Standard Method v1.2-2017, Section 8. Manufacturer statements must also include a summary report from the laboratory that is less than three years old and the amount of wet-applied product applied in mass per surface area (if applicable). Organizations that certify manufacturers' claims must be accredited under ISO/IEC 17065.

***VOC content evaluation***

Product meets the VOC content limits outlined in one of the applicable standards and for projects in North America, methylene chloride and perchloroethylene may not be intentionally added.

Statement of product compliance must be made by the manufacturer or a USGBC-approved third-party. Any testing must follow the test method specified in the applicable regulation. If the applicable regulation requires subtraction of exempt compounds, any content of intentionally added exempt compounds larger than 1% weight by mass (total exempt compounds) must be disclosed.

- Paints and coatings:
  - California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings

- South Coast Air Quality Management District (SCAQMD) Rule 1113, amended February 5, 2016, effective date 1/1/19
- Adhesives and sealants:
  - SCAQMD Rule 1168, amended October 6, 2017

*Formaldehyde emissions evaluation*

Product meets one of the following:

- Certified as ultra-low-emitting formaldehyde (ULEF) product under EPA Toxic Substances Control Act, Formaldehyde Emission Standards for Composite Wood Products (TSCA, Title VI) (EPA TSCA Title VI) or California Air Resources Board (CARB) Airborne Toxic Control Measure (ATCM)
- Certified as no added formaldehyde resins (NAF) product under EPA TSCA Title VI or CARB ATCM
- Wood structural panel manufactured according to PS 1-09 or PS 2-10 (or one of the standards considered by CARB to be equivalent to PS 1 or PS 2) and labeled bond classification Exposure 1 or Exterior
- Structural wood product manufactured according to ASTM D 5456 (for structural composite lumber), ANSI A190.1 (for glued laminated timber), ASTM D 5055 (for I-joists), ANSI PRG 320 (for cross-laminated timber), or PS 20-15 (for finger-jointed lumber).

*Furniture emissions evaluation*

Product has been tested in accordance with ANSI/BIFMA Standard Method M7.1–2011 (R2016) and complies with ANSI/BIFMA e3-2014e or e3-2019e Furniture Sustainability Standard, Sections 7.6.1 (for half credit, by cost) OR 7.6.2 (for full credit, by cost), OR 7.6.2 AND 7.6.3 for one and a quarter credit, by cost. Laboratories that conduct the tests must be accredited under ISO/IEC 17025 for the test methods they use.

Seating products must be evaluated using the seating scenario. Classroom furniture must be evaluated using the standard school classroom scenario. Other products should be evaluated using the open plan or private office scenario, as appropriate. The open plan scenario is more stringent.

Statements of product compliance must include the exposure scenario(s). Organizations that certify manufacturers' claims must be accredited under ISO/IEC 17065.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

The compliance methodology for this credit is more straightforward but continues to promote holistic consideration of products installed in the building and their potential overall impact on indoor air quality

Option 2 Budget Calculation method has been removed completely to simplify the approach towards compliance requirements and core credit achievement is now based solely on meeting number of compliant product categories. Previously bundled product category of ceilings, walls and insulation available as separate product categories, updated definitions are added for all product categories and compliance criteria for most product categories can now be showed either via percent of cost or surface area for most product categories. The threshold ranges for compliance are adjusted to 75%-90% by cost or surface area. Some other changes are: i) including inherently non-emitting sources and salvaged/reused materials as part of compliance criteria rather than exceptions/exclusions to reward project teams more directly, (ii) clear allowance for using VOC budget approach for VOC content for wet-applied products, and iii) modifying existing standard references CDPH standard method v1.1-> CDPH standard method v1.2 (updated version).

Other standards further modified were as follows:

- SCAQMD Rule 1113, June 2011 → SCAQMD Rule 1113, February 2016 (updated version)
- SCAQMD Rule 1168, July 2005 → SCAQMD Rule 1168, October 2017 (updated version)
- ANSI/BIFMA M7.1-2011 → ANSI/BIFMA M7.1-2011 (R2016) (re-affirmed version)
- ANSI/BIFMA e3-2011 → ANSI/BIFMA e3-2014e (updated version) and ANSI/BIFMA e3-2019 (updated version) EPA TSCA Title VI and structural composite wood industry standards (new standard for formaldehyde emissions in composite wood)

Additionally, standards for projects outside of the U.S. are now available for use through regional compliance pathways (see International Tips section).

**Step-by-Step Guidance**

Step 1. Research products

Review project documents to identify all applicable products and specify them according to the low-emitting criteria appropriate for the product.

In most cases, turning to a third-party certification program is the easiest way to find and specify products.

- VOC emissions evaluation: See the list of certification programs that use CDPH Standard method v1.2 published by the California Department of Public Health at cdph.ca.gov. Green Seal GS-11 Edition 4.0 and Asthma & allergy friendly Certification Standard (ASP:04-01 Paint Indoor Decorative Wall, ASP: 05-01 Resilient Flooring, ASP:05-03 Textile Flooring, and ASP:19-01 Fiberglass Insulation) also use CDPH Standard method v1.2.

- VOC content evaluation: The following programs certify VOC content to CARB SCM, SCAQMD Rule 1113 and/or SCAQMD Rule 1168:
    - Asthma & allergy friendly Certification Standard (ASP:04-01 Paint Indoor Decorative Wall)
    - Certified Green by MAS
    - Green Seal GS-11 Edition 4.0
    - Indoor Advantage Gold – Building Materials by SCS
    - ClearChem by Berkeley Analytical (*self-declared claims*)

- Formaldehyde emissions evaluation:
    - See the list of third-party certifiers for TSCA Title VI and CARB ATCM published by the EPA at epa.gov.
    - Structural composite wood products with an APA trademark meet the requirement of being PS 1-09 or PS 2-10 and labeled bond classification Exposure 1 or Exterior.

- Furniture emissions evaluation: The following certifications and programs use ANSI/BIFMA e3 and are accredited under ISO/IEC 17065:
    - *Clean Air Silver by Intertek (for half credit)*
    - Clean Air Gold by Intertek
    - *GREENGUARD Certified by UL (for half credit)*
    - GREENGUARD Gold by UL
    - *Indoor Advantage-Furniture by SCS (for half credit)*
    - Indoor Advantage Gold- Furniture by SCS
    - Level by BIFMA
    - Certified Green by MAS
    - VOC Green by Benchmark International

For the VOC content evaluation, when determining the appropriate VOC limit, use the manufacturer's product classification rather than how the product was used on the project. For example, a defined roof coating is not a carpet adhesive simply because it was used this way on the project. If the product is classified as a roof coating under the stated regulation (such as SCAQMD), it must meet the appropriate VOC limit for roof coatings.

Follow the language in the rating system for each product category to identify materials to include. Some materials installed in the project are excluded from this credit entirely. For example, the following products are not applicable to the product categories, or they are considered exterior products: equipment related to fire suppression, HVAC, plumbing, electrical, conveying and communications systems, poured concrete, Structural insulated panels (SIPs), and water-resistive barriers (material installed on a substrate to prevent bulk water intrusion). For this credit, the following products should be considered within the building interior: the air barrier membrane itself, the vapor barrier/vapor retarder membrane (if used inside the air barrier), and non-structural prefabricated building envelope products that are in contact with the building interior such as sandwich panels,

### Step 2. Install compliant products

Make sure selected products are installed in the building. Any product substitutions should be carefully reviewed by the design team and contractor for compliance with credit requirements. At time of product purchase, collect documentation that confirms the product complies with the low-emitting criteria.

### Step 3. Calculate percentage compliance

For each product category being pursued, list out the material, cost/surface area/volume, and compliant criteria. Confirm the percentage compliant meets the threshold for the given product category.

For VOC content, note that the 100% compliance threshold may be met using a VOC budget approach. Refer to the LEED v4 reference guide Option 1. Step 1 for more information on this calculation.

For the Furniture product category, the contributing cost is dependent on the compliance criteria selected. Make sure the actual product cost AND contributing product cost are listed in the calculations.

**Further Explanation**

### Composite Wood

TSCA Title VI (Formaldehyde standards for Composite Wood Products Act): In 2016, EPA issued a final rule to implement the formaldehyde standards for composite wood products act that added Title VI to the Toxic Substances Control Act (TSCA). TSCA Title VI establishes formaldehyde emission standards identical to the California Air Resources Board (CARB) limits. As with CARB ATCM, the goal is to reduce exposure and adverse effects from formaldehyde emissions in composite wood. The rule affects formaldehyde emission standards applicable to hardwood plywood (with some exemptions for laminated products under hardwood plywood), medium density fiberboard and particleboard and finished goods containing these products that are manufactured and traded in the U.S. region., establishes a third party certification program for emission testing of these products and includes requirements for ULEF and NAF resins used in these products.

If the composite wood product has a finish or treatment applied off-site (including but not limited to: fire-retardant, paint, stain or other coating), the product may still be included in the composite wood category if the off-site applied finish or treatment complies with the VOC emissions evaluation. To document this situation, include the VOC emissions evaluation documentation as supporting documentation for the composite wood product.

Wet-applied products, applied to composite wood on-site, belong in the adhesives and sealants or paints and coatings category, as applicable.

### Documentation for Manufacturer Claims for VOC emissions evaluation

If compliance to CDPH or EN 16516 is being demonstrated through a manufacturer's claim, provide a test report or summary report with the following information:

| CDPH Standard Method v1.2-2017 |
|---|
| Declaration that the product has been tested according to CDPH Standard Method v1.2-2017 and complies with the VOC limits in Table 4-1 of the method; |
| TVOC results at 14 days measured as specified in CDPH Standard Method v1.2-2017; |
| Test date |
| The name of the laboratory that performed the evaluation and documentation (such as accreditation number or certificate with scope of accreditation) demonstrating the accreditation under ISO/IEC 17025 for the test method |
| The modeling scenario used (must be private office unless the product is installed in a classroom) |
| For wet-applied products, the amount of product applied in mass per surface area (during testing) |

| EN 16516:2017 with 2018 updates |
|---|
| Declaration that the product has been tested according to EN 16516:2017 with 2018 updates and complies with the German AgBB Testing and Evaluation Scheme (2018) thresholds. |
| Sum of R ratio results for VOCs with LCI values and summed individual VOC concentrations for VOCs without LCIs. |
| Declaration that formaldehyde limit of 10 μg/m3 after 28 days has been met |

| |
|---|
| TVOC value measured after 28 days and is < 1000 ug/m3 |
| Test date |
| The name of the laboratory that performed the evaluation and documentation (such as accreditation number or certificate with scope of accreditation) demonstrating the accreditation under ISO/IEC 17025 for the test method |

### Inherently Nonemitting Materials

Stone, ceramic, and porcelain tiles; powder-coated metals, plated or anodized metal, glass, clay brick, and solid wood are materials which, on their own, are considered inherently nonemitting without additional information.

For any other materials, a manufacturer chemical inventory of the product to at least 0.1% (1000 ppm) *(such as those used to document MRc Material Ingredients*) is required to confirm the product complies with the inherently nonemitting sources criteria.

- Consider the entire product and the fabrication. For example, a hollow metal door is made of other materials in addition to metal, a window is comprised of more than glass, and concrete often includes more than stone, gravel, sand, cement and water (e.g. additives like fly ash, plasticizers and hardeners).
- When an inherently nonemitting material is joined with binders/resins, other materials (ex. gaskets, core/internal components); has a surface coating, treatment, or adhesives/sealants, etc.) the resultant product is subject to the VOC emissions evaluation criteria.
- A wet-applied product with 0 g/L of VOC content is not considered inherently nonemitting.

### International standards

See *International tips* section below

### International Tips

Projects outside of the U.S. may want to consider these additional certifications and programs that have been identified to meet the low-emitting materials credit requirements. *Note: This list is not comprehensive. Additional programs may be used if they meet the applicable rating system requirements or regional compliance pathways.*

- VOC emissions evaluation: The following certifications and programs use EN 16516 and may be used to comply with the regional ACP for VOC emissions evaluation:
  - *Blue Angel (if formaldehyde limit of 10 micrograms per cubic meter after 28 days is also met)*
  - *Danish indoor climate label Emission Class 1*
  - *Eco-INSTITUT-Label (if formaldehyde limit of 10 micrograms per cubic meter after 28 days is also met)*
  - *EMICODE EC1 (if formaldehyde limit of 10 micrograms per cubic meter after 28 days is also met. EMICODE has formaldehyde limit of 50 $\mu g/m^3$ after 3 days)*
  - *EMICODE EC1$^{PLUS}$ (Additional information regarding the formaldehyde limit at 28 days is not required for products meeting EMICODE EC1plus)*
  - Finnish Emission Classification of Building Materials (M1)
  - GUT (for textile floorings)
  - Indoor Air Comfort Gold
  - *NaturePLUS (if formaldehyde limit of 10 micrograms per cubic meter after 28 days is also met.)*
  - *TÜV SÜD guidelines TM-07, TM-09, and TM-10 (if formaldehyde limit of 10 micrograms per cubic meter after 28 days is also met.)*

- VOC emissions evaluation: The following certification uses CDPH Standard Method v1.2-2017 and may be used by projects outside of the U.S. to comply with VOC emissions evaluation.
    - Taiwan Healthy Building Material Label
- VOC content evaluation: The following certifications and programs use European Decopaint Directive and TRGS 610 and may be used to comply with the regional ACP for VOC content evaluation:
    - Indoor Air Comfort Gold
    - EMICODE EC1 or EC1 Plus
- Furniture emissions evaluation
    - Finnish Emission Classification of Building Materials (M1)
    - TÜVRheinland Green Product Mark Furniture
- Formaldehyde emissions evaluation (for composite wood)
    - Blue Angel Composite Wood Panels
    - Byggvarubedömningen (BVB)
    - Finnish Emission Classification of Building Materials (M1)
    - French VOC Emissions Labeling Class A or A+
    - Indoor Air Comfort
    - Indoor Air Comfort Gold

### Required Documentation

- USGBC's Low-emitting materials calculator or equivalent documentation
- Documentation of low-emitting criteria met
    - Inherently nonemitting: chemical inventory of the product to at least 0.1% (1000 ppm) confirming product is made from inherently nonemitting materials (*not required if product is stone, ceramic, and porcelain tiles; powder-coated metals, plated or anodized metal, glass, clay brick, and solid wood)*
    - Salvaged and reused: applicable purchase order, finish plan, schedule, and/or specifications from contract documents
    - VOC emissions evaluation:
        - Third-party claim: product certificate from third party certifier with modeling scenario
        - Manufacturer claim (also called self-declared or first-party claims)
            - Laboratory test report or summary report from the manufacturer or the laboratory that includes the required information outlined in Further Explanation: Documentation for Manufacturer Claims for VOC emissions evaluation
    - VOC content: product certificate from third party certifier or manufacturer information documenting the VOC content in grams per liter (g/L) less water and federally exempt solvents.
    - Formaldehyde emissions: one of the following:
        - Product certificate from third-party certifier that states the certification period
        - Product information or manufacturer statement of conformity
        - Photograph of product's APA trademark stamp (for structural products)
        - The VOC emissions evaluation documentation for any finish or treatment applied off-site (if applicable).
    - Furniture emissions: product certificate from third-party certifier that includes the exposure scenario used. Also include the BIFMA LEVEL® scorecard (if the BIFMA Level® e3 Sections achieved are not included on the third party certificate).

### Exemplary Performance

Earn 5 product categories or earn 4 product categories and reach 90% threshold in at least three product categories.

### Connection to Ongoing Performance

- LEED O+M EQ prerequisite Indoor Environmental Quality Performance: Strategies to reduce chemical contaminant levels for improved air quality and human health such as using inherently non-emitting products and/or using products with low VOC content/emissions in newly constructed spaces can contribute to better indoor environmental quality during operations phase.

# EQ Credit: Construction Indoor Air Quality Management Plan

This credit applies to

- BD+C: New Construction (1 point)
- BD+C: Core & Shell (1 point)
- BD+C: Schools (1 point)
- BD+C: Retail (1 point)
- BD+C: Data Centers (1 point)
- BD+C: Warehouses & Distribution Centers (1 point)
- BD+C: Hospitality (1 point)
- BD+C: Healthcare (1 point)

## INTENT

To promote the well-being of construction workers and building occupants by minimizing indoor air quality problems associated with construction and renovation.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY

Develop and implement an indoor air quality (IAQ) management plan for the construction and preoccupancy phases of the building. The plan must address all of the following.

During construction, meet or exceed all applicable recommended control measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd edition, 2007, ANSI/SMACNA 008–2008, Chapter 3.

Protect absorptive materials stored on-site and installed from moisture damage.

Do not operate permanently installed air-handling equipment during construction unless filtration media with a minimum efficiency reporting value (MERV) of 8, as determined by ASHRAE 52.2–2017, with errata (or  media with $ISO_{coarse}$ 90% or higher, as defined by ISO 16890-2016, Particulate Air Filters for General Ventilation, Determination of the Filtration Performance ), are installed at each return air grille and return or transfer duct inlet opening such that there is no bypass around the filtration media. Immediately before occupancy, replace all filtration media with the final design filtration media, installed in accordance with the manufacturer's recommendations.

Prohibit the use of smoking inside the building and within 25 feet (7.5 meters) of the building openings during construction. Smoking includes tobacco smoke, as well as smoke produced from the combustion of cannabis and controlled substances and the emissions produced by electronic smoking devices.

HEALTHCARE

*Moisture.* Develop and implement a moisture control plan to protect stored on-site and installed absorptive materials from moisture damage. Immediately remove from site and properly dispose of any materials susceptible to microbial growth and replace with new, undamaged materials. Also include strategies for protecting the building from moisture intrusion and preventing occupants' exposure to mold spores.

*Particulates.* Do not operate permanently installed air-handling equipment during construction unless filtration media with a minimum efficiency reporting value (MERV) of 8, as determined by ASHRAE 52.2–2017, with errata (or media with $ISO_{coarse}$ 90% or higher, as defined by ISO 16890-2016, Particulate Air Filters for General Ventilation, Determination of the Filtration Performance ), are installed at each return air grille and return or transfer duct inlet opening such that there is no bypass around the filtration media. Immediately before occupancy, replace all filtration media with the final design filtration media, installed in accordance with the manufacturer's recommendations.

*VOCs.* Schedule construction procedures to minimize exposure of absorbent materials to VOC emissions. Complete painting and sealing before storing or installing "dry" materials, which may accumulate pollutants and release them over time. Store fuels, solvents, and other sources of VOCs separately from absorbent materials.

*Outdoor emissions.* For renovation projects involving waterproofing, repairing asphalt roofing, sealing parking lots, or other outdoor activities that generate high VOC emissions, develop a plan to manage fumes and avoid infiltration to occupied spaces. Comply with the procedures established by NIOSH, Asphalt Fume Exposures during the Application of Hot Asphalt to Roofs (Publication 2003–112).

*Tobacco.* Prohibit the use of tobacco products inside the building and within 25 feet (7.5 meters) of the building entrance during construction.

*Noise and vibration.* Develop a plan based on the British Standard (BS 5228) to reduce noise emissions and vibrations from construction equipment and other nonroad engines by specifying low-noise emission design or the lowest decibel level available that meets performance requirements in the British Standard. Construction crews must wear ear protection in areas where sound levels exceed 85 dB for extended periods.

*Infection control.* For renovations and additions adjacent to occupied facilities or phased occupancy in new construction, follow the FGI 2018 Guidelines for Design and Construction of Hospitals, Guidelines for Design and Construction of Outpatient Facilities, Guidelines for Design and Construction of Residential Health, Care, and Support Facilities and The Joint Commission Standards to establish an integrative infection control team comprising the owner, designer, and contractor to evaluate infection control risk and document the required precautions in a project-specific plan. Use the Guidelines for Environmental Infection Control in Health-Care Facilities, 2003, updated July 2019 to assess risk and to select mitigation procedures for construction activities.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

Changes for this credit include updates to recent versions of referenced ASHRAE, FGI and European standards or updates to reference more globally applicable standards. The changes made were to the following standards:

- ASHRAE 52.2-2010 → ASHRAE 52.2-2017 (updated version)
- EN 779-2002 → ISO 16890-2016 (global applicability)
- FGI 2010 → FGI 2018

Other clarifications were including a more extensive definition of smoking to cover related non-tobacco products and to extend the prohibition of smoking within 25 feet of all building openings during construction not just entrances.

**Step-by-Step Guidance**

Refer to LEED v4 reference guide with the following modifications:

Healthcare

Step 1. Evaluate infection control risk: Follow the newer 2018 FGI Guidelines for Design and Construction of Health Care facilities.

**Further Explanation**

International Tips

In countries where MERV ratings are not available, filtration class used must be $ISO_{coarse}$ 90% or higher per ISO 16890-2016, Particulate Air Filters for General Ventilation, Determination of the Filtration Performance instead of Class F5 per EN 779-2002.

Connection to Ongoing Performance

- LEED O+M EQ prerequisite Indoor Environmental Quality Performance: Strategies to promote well-being of construction workers and occupants during construction activities such as formulating and implementing an indoor air quality plan can contribute to better indoor environmental quality during operations phase.

# EQ Credit: Indoor Air Quality Assessment

This credit applies to

- BD+C: New Construction (1-2 points)
- BD+C: Schools (1-2 points)
- BD+C: Retail (1-2 points)
- BD+C: Data Centers (1-2 points)
- BD+C: Warehouses & Distribution Centers (1-2 points)
- BD+C: Hospitality (1-2 points)
- BD+C: Healthcare (1-2 points)

## INTENT

To establish better quality indoor air in the building after construction and during occupancy to protect human health, productivity, and wellbeing.

## REQUIREMENTS

NC, Schools, Retail, Data Centers, Warehouses & Distribution Centers, Hospitality, Healthcare

Select one of the following two options, to be implemented after construction ends and the building has been completely cleaned. All interior finishes, such as millwork, doors, paint, carpet, acoustic tiles, and movable furnishings (e.g., workstations, partitions), must be installed, and major VOC punch list items must be finished. The options cannot be combined.

Option 1. Flush-Out (1 point)

Path 1. Before Occupancy

Install new filtration media and perform a building flush-out by supplying a total air volume of 14,000 cubic feet of outdoor air per square foot (4 267 140 liters of outdoor air per square meter) of gross floor area while maintaining an internal temperature of at least 60°F (15°C) and no higher than 80°F (27°C) and relative humidity no higher than 60%.

OR

Path 2. During Occupancy

If occupancy is desired before the flush-out is completed, the space may be occupied only after delivery of a minimum of 3,500 cubic feet of outdoor air per square foot (1 066 260 liters of outdoor air per square meter) of gross floor area while maintaining an internal temperature of at least 60°F (15°C) and no higher than 80°F (27°C) and relative humidity no higher than 60%.

Once the space is occupied, it must be ventilated at a minimum rate of 0.30 cubic foot per minute (cfm) per square foot of outdoor air (1.5 liters per second per square meter of outside air) or the design minimum outdoor air rate determined in EQ Prerequisite Minimum Indoor Air Quality Performance, whichever is greater. During each day of the flush-out period, ventilation must begin at least three hours before occupancy and continue during occupancy. These conditions must be maintained until a total of 14,000 cubic feet per square foot of outdoor air (4 270 liters of outdoor air per square meter) has been delivered to the space.

OR

Option 2. Air Testing (1-2 points)

After construction ends and before occupancy, but under ventilation conditions typical for occupancy, conduct baseline IAQ testing in occupied spaces for the contaminants listed in Path 1. Particulate matter and inorganic gases (for 1 point) and/or Path 2. Volatile organic compounds (for 1 point). Retail projects may conduct the testing within 14 days of occupancy.

Path 1. Particulate Matter and Inorganic Gases (1 point)

Test for the particulate matter (PM) and inorganic gases listed in Table 1, using an allowed test method, and demonstrate the contaminants do not exceed the concentration limits listed in the table.

Table 1. Particulate Matter and inorganic gases

| Contaminant (CAS#) | Concentration Limit<br>(μg/m$^3$) | Allowed Test Methods |
|---|---|---|
| Carbon monoxide (CO) | 9 ppm; no more than 2 ppm above outdoor levels | ISO 4224<br>EPA Compendium Method IP-3<br>GB/T 18883-2002 for projects in China<br><br>Direct calibrated electrochemical instrument with accuracy of +/- 3% of reading and resolution of 0.1 ppm<br><br>NDIR CO Sensors with accuracy of 1% of 10 ppm full scale and display resolution of less than 0.1ppm |
| PM 10 | ISO 14644-1:2015, cleanroom class of 8 or lower<br><br>50 μg/m$^3$<br>Healthcare only: 20 μg/m$^3$ | Particulate monitoring device with accuracy greater of 5 micrograms/m3 or 20% of reading and resolution (5 min average data) +/- 5 μg/m$^3$ |
| PM 2.5 | 12 μg/m$^3$ or 35 μg/m$^3$** | |
| Ozone | 0.07 ppm | Monitoring device with accuracy greater of 5 ppb or 20% of reading and resolution (5 min average data) +/- 5 ppb<br><br>ISO 13964<br>ASTM D5149 -– 02<br>EPA designated methods for Ozone |

**Projects in areas with high ambient levels of PM2.5 (known EPA nonattainment areas for PM2.5, or local equivalent) must meet the 35 ug/m$^3$ limit, all other projects should meet the 12 ug/m$^3$ limit.

AND/OR

### Path 2. Volatile Organic Compounds (1 point)

Perform a screening test for Total Volatile Organic Compounds (TVOC). Use ISO 16000-6, EPA TO-17, or EPA TO-15 to collect and analyze the air sample. Calculate the TVOC value per EN 16516:2017, CDPH Standard Method v1.2 2017 section 3.9.4, or alternative calculation method as long as full method description is included in test report. If the TVOC levels exceed 500 μg/m$^3$, investigate for potential issues by comparing the individual VOC levels from the GC/MS results to associated cognizant authority health-based limits. Correct any identified issues and re-test if necessary.

Additionally, test for the individual volatile organic compounds listed in Table 2 using an allowed test method and demonstrate the contaminants do not exceed the concentration limits listed in the table. Laboratories that conduct the tests must be accredited under ISO/IEC 17025 for the test methods they use.

Exemplary performance is available for projects that test for the additional target volatile organic compounds specified in CDPH Standard Method v1.2-2017, Table 4-1 and do not exceed the full CREL levels for these compounds adopted by Cal/EPA OEHHA in effect on June 2016.

Table 2. Volatile organic compounds

| Contaminant (CAS#) | Concentration Limit ($\mu g/m^3$) | Allowed Test Methods |
| --- | --- | --- |
| Formaldehyde 50-00-0 | 20 $\mu g/m^3$ (16 ppb) | ISO 16000-3, 4;<br>EPA TO-11a,<br>EPA comp. IP-6A<br>ASTM D5197-16 |
| Acetaldehyde 75-07-0 | 140 $\mu g/m^3$ | |
| Benzene 71-43-2 | 3 $\mu g/m^3$ | ISO 16000-6<br>EPA IP-1,<br>EPA TO-17,<br>EPA TO-15<br>ISO 16017-1, 2;<br>ASTM D6196-15 |
| Hexane (n-) 110-54-3 | 7000 $\mu g/m^3$ | |
| Naphthalene 91-20-3 | 9 $\mu g/m^3$ | |
| Phenol 108-95-2 | 200 $\mu g/m^3$ | |
| Styrene 100-42-5 | 900 $\mu g/m^3$ | |
| Tetrachloroethylene 127-18-4 | 35 $\mu g/m^3$ | |
| Toluene 108-88-3 | 300 $\mu g/m^3$ | |
| Vinyl acetate 108-05-4 | 200 $\mu g/m^3$ | |
| Dichlorobenzene (1,4-) 106-46-7 | 800 $\mu g/m^3$ | |
| Xylenes-total 108-38-3, 95-47-6, and 106-42-3 | 700 $\mu g/m^3$ | |

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

While Option 1 for this credit remains unchanged, Option 2 for air testing has been modified significantly following market feedback to make the credit more flexible and achievable. Projects can now select the type of contaminants to be tested in form of organic or inorganic compounds (1 point each) or both (2 points) via split pathways for particulate matter (PM) and organic gases testing and/or volatile organic compound (VOC) testing.

A significant area of flexibility newly provided is allowance of monitoring instruments in addition to standard laboratory based test methods for meeting thresholds of particulate matter and inorganic gases (Path 1). Further, a new indoor cleanrooms testing standard ISO 14644-1: 2015 and the associated cleanroom class rating of 8 or lower measured via a monitoring device is now required for all indoor PM while separate U.S. EPA NAAQS thresholds for PM2.5 and PM10 as well as gravimetric test methods for particulate matter are no longer required to be met.

For Path 2 (VOC testing), the contaminant list has been revised to now consist of 12 VOCs (including formaldehyde) that need to be tested for and threshold met, however the credit no longer deems the TVOC limit to be a pass/fail criteria. For the revised credit, TVOC is intended to be used more as a screening metric to inform testing location as well as needs for a given project. However, projects will still need to report TVOC results and if exceeding a concentration level of 500 ug/m3, will need to investigate any potential sources of higher TVOC level and perform corrective actions as necessary.

**Step-by-Step Guidance**
Follow LEED v4 reference guide for step-by-step guidance.

**Further Explanation**
Exemplary Performance
Available for Option 2 (air testing). Projects need to test for all additional target VOCs specified in CDPH Standard Method v1.2- 2017, Table 4-1 and not exceed full CREL levels for these compounds (adopted by Cal/EPA OEHHA and in effect from June 2016).

Connection with Ongoing Building Performance

- LEED O+M EQ prerequisite Indoor Environmental Quality Performance: Strategies to establish enhanced indoor air quality such as performing air testing for contaminants and meeting contaminant threshold levels can directly contribute to better indoor environmental quality during operations phase.

# EQ Credit: Thermal Comfort

This credit applies to

- BD+C: New Construction (1 point)
- BD+C: Schools (1 point)
- BD+C: Retail (1 point)
- BD+C: Data Centers (1 point)
- BD+C: Warehouses & Distribution Centers (1 point)
- BD+C: Hospitality (1 point)
- BD+C: Healthcare (1 point)

## INTENT

To promote occupants' productivity, comfort, and well-being by providing quality thermal comfort.

## REQUIREMENTS

Meet the requirements for both thermal comfort design and thermal comfort control.

### Thermal Comfort Design

NC, SCHOOLS, RETAIL, DATA CENTERS, HOSPITALITY, HEALTHCARE

Design heating, ventilating, and air-conditioning (HVAC) systems and the building envelope to meet the requirements of ASHRAE Standard 55–2017, Thermal Comfort Conditions for Human Occupancy with errata or a local equivalent.

For natatoriums, demonstrate compliance with ASHRAE HVAC Applications Handbook, 2015 edition, Chapter 5, Places of Assembly, Typical Natatorium Design Conditions, with errata.

Data Centers only

Meet the above requirements for regularly occupied spaces.

WAREHOUSES & DISTRIBUTION CENTERS

Meet the above requirements for office portions of the building.

In regularly occupied areas of the building's bulk storage, sorting, and distribution areas, include one or more of the following design alternatives:

- radiant flooring;
- circulating fans;
- passive systems, such as nighttime air, heat venting, or wind flow;
- localized active cooling (refrigerant or evaporative-based systems) or heating systems; and
- localized, hard-wired fans that provide air movement for occupants' comfort.
- other equivalent thermal comfort strategy.

### Thermal Comfort Control

NC, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY

Provide individual thermal comfort controls for at least 50% of individual occupant spaces. Provide group thermal comfort controls for all shared multioccupant spaces.

Thermal comfort controls allow occupants, whether in individual spaces or shared multioccupant spaces, to adjust at least one of the following in their local environment: air temperature, radiant temperature, air speed, and humidity.

Hospitality only
Guest rooms are assumed to provide adequate thermal comfort controls and are therefore not included in the credit calculations.

Retail only
Meet the above requirements for at least 50% of the individual occupant spaces in office and administrative areas.

HEALTHCARE

Provide individual thermal comfort controls for every patient room and at least 50% of the remaining individual occupant spaces. Provide group thermal comfort controls for all shared multioccupant spaces.

Thermal comfort controls allow occupants, whether in individual spaces or shared multioccupant spaces, to adjust at least one of the following in their local environment: air temperature, radiant temperature, air speed, and humidity.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

The ASHRAE standards have been updated to the latest versions:

- ASHRAE 55-2010 → ASHRAE 55-2017 (updated version)
  - Major changes from 2010 include: clarifications to elevated air speed method, new requirement to calculate the change to thermal comfort resulting from direct solar radiation impacting occupants.
- ASHRAE Applications Handbook 2011 edition → ASHRAE Applications Handbook 2015 edition (updated version)

Option 2 is available for use through regional compliance pathways.

**Step-by-Step Guidance**

**Step 1. Select Analysis Method(s)**

Select the methodology from ASHRAE Standard 55-2017 that will be used for the thermal comfort analysis. Refer to the standard for restrictions with some of the methods. For example, section 5.3.1 is restricted to conditions without direct solar radiation.

Additional calculations or considerations required if direct-beam solar radiation falls on the occupant. Calculations are available in ASHRAE 55-2017 Normative Appendix C.

Tools such as the CBE Thermal Comfort Tool (https://comfort.cbe.berkeley.edu/) may be used to assist with the analysis. A new feature (SolarCal) is also available for the direct-beam solar radiation calculations.

Step 2. Design Project's Conditioning Systems

Design the project's conditioning systems to provide the acceptable comfort conditions identified in the analysis. Verify that all spaces at risk for discomfort, such as locations close to the entrances prone to drafts or west-facing walls that may retain heat, have been addressed.

ASHRAE 55–2017, Section 6.1, requires the design to be within the acceptable comfort range at all combinations of conditions that are expected to occur, including variations in internal loads and the exterior environment, and at both full- and partial-load conditions. Systems that cannot maintain comfort under all conditions (e.g., a constant-volume rooftop unit with a single compressor may have problems controlling humidity levels) do not meet the credit requirements.

**Further Explanation**

### Criteria for Occupant-Controlled Naturally Conditioned Spaces

The same set of requirements per LEED v4 reference guide for use of occupant controlled naturally conditioned spaces (or adaptive) method are applicable for the newer standards ASHRAE 55-2017 (Section 5.4) and ISO 17772-201 (Section H.2) as well.

### Examples

Example 1: Follow guidance per LEED v4 reference guide with the exception of referring to ASHRAE 55-2017, Table 5.2.2.B for garment insulation values and Graphic Comfort Zone Method per Section 5.3.1

Example 2: Follow guidance per LEED v4 reference guide with the exception of referring to ASHRAE 55-2017, Table 5.2.1.2 and related Appendix F as well as Analytical Comfort Zone Method per Section 5.3.2 that incorporates the computer model method.

Example 3: Follow guidance per LEED v4 reference guide with the exception of referring to ASHRAE 55-2017, Section 5.4, Method for Determining Acceptable Conditions in Naturally Conditioned Spaces and plotting the average monthly outdoor temperatures and design operative temperatures per Figure 5.4.2.

Example 4: Follow guidance per LEED v4 reference guide with the exception of referring to ISO 17772-2017, Section 6.2.2 and Figure H.1- Default Design Values for the Indoor Operative Temperature for Buildings without Mechanical Cooling for using the adaptive method.

### Project Type Variations

Refer to LEED v4 reference guide with the following modifications:

Use ASHRAE 55-2017, Appendix F for guidance on Gymnasiums, Fitness areas and other spaces with high metabolic rates

Natatoriums: Use ASHRAE HVAC Applications handbook, 2015 edition for typical natatorium design conditions guidance.

### Required Documentation

Refer to LEED v4 ref guide with the following modifications:

- For thermal comfort design compliance, supporting documentation verifying that the thermally conditioned spaces meet ASHRAE Standard 55-2017 for 80% acceptability. Examples include a psychometric chart, PMV/PPD calculations, CBE Thermal Comfort Tool results, a copy of ASHRAE Standard 55-2017 Figure I2, Figure I4, and/or Figure I5, or predicted worst case (both heating and cooling) indoor conditions for each month on a copy of ASHRAE Standard 55-2017 Figure 5.4.2.
- Explanation of how project complies with the direct solar radiation requirements in ASHRAE Standard 55-2017.
    - Screenshots of the local discomfort assessment and SolarCal windows from the CBE Thermal Comfort Tool are acceptable.

## Connection with Ongoing Building Performance

- LEED O+M EQ prerequisite Indoor Environmental Quality Performance: Strategies to promote occupant comfort and wellbeing by providing thermal comfort such as designing HVAC systems and building envelope per thermal comfort standards and providing individual thermal comfort controls in newly constructed occupant spaces can contribute to better indoor environmental quality and overall occupant satisfaction during operations phase.

# EQ Credit: Interior Lighting

This credit applies to

- BD+C: New Construction (1-2 points)
- BD+C: Schools (1-2 points)
- BD+C: Retail (1-2 points)
- BD+C: Data Centers (1-2 points)
- BD+C: Warehouses & Distribution Centers (1-2 points)
- BD+C: Hospitality (1-2 points)
- BD+C: Healthcare (1 point)

## INTENT

To promote occupants' productivity, comfort, and well-being by providing high-quality lighting.

## REQUIREMENTS

<u>NC, Schools, Data Centers, Warehouses & Distribution Centers, Hospitality</u>

Meet 1 strategy for 1 point. Meet 3 strategies total for 2 points.

1. Glare Control

For all regularly occupied spaces, meet one of the following requirements:

- Use light fixtures with a luminance of less than 7,000 candela per square meter (cd/m)$^2$ between 45 and 90 degrees from nadir.

OR

- Achieve a Unified Glare Rating (UGR) rating of <19 using software modelling calculations of the designed lighting.

Exceptions include wallwash fixtures properly aimed at walls, as specified by manufacturer's data, indirect uplighting fixtures, provided there is no view down into these uplights from a regularly occupied space above, and any other specific applications (i.e. adjustable fixtures).

2. Color Rendering

For all regularly occupied spaces meet one of the following requirements:

- Use light sources that have a Color Rendering Index (CRI) of at least 90.
- Use light sources that have a Color Fidelity Index greater than or equal to 78 and a gamut index between 97 and 110, determined in accordance with Illuminating Engineering Society (IES) TM-30.

3. Lighting Control

Provide dimmable or multilevel lighting for 90% of all regularly occupied spaces.

4. Surface Reflectivity

For at least 90% regularly occupied spaces, use interior finishes with a surface reflectance greater or equal to 80% for ceilings and 55% for walls. If included in the project scope, use furniture finishes with a surface reflectance greater or equal to 45% for work surfaces and 50% for movable partitions.

HEALTHCARE

Provide dimmable or multilevel lighting for 90% of all regularly occupied spaces in staff areas.

For at least 75% of patient sleeping rooms, provide lighting controls that are readily accessible from the patient's bed. In patient rooms with more than one patient, the controls must be individual lighting controls. Exceptions include in-patient critical care, pediatric, and psychiatric patient rooms.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

The interior lighting credit has been overhauled to prioritize strategies identified by industry lighting experts as most critical and impactful for new construction LEED projects.

Lighting quality strategies for lamp life, direct overhead lighting, and surface illuminance ratio have been removed.

The threshold for light fixture luminance has been decreased from 2,500 candela per square meter (cd/m2) to 7,000 cd/m2. An alternative metric Unified Glare Rating has been added as a new option.

The threshold for Color rendering index has been increased from CRI of 80 to CRI of 90. An alternative metric Color Fidelity Index has been added as a new option.

The previous option for lighting control has been simplified to a single requirement for dimmable or multilevel lighting in regularly occupied spaces. Projects no longer have to differentiate between individual and shared multi-occupant spaces. All lighting controls can be shared (individual lighting controls are not required).

The surface reflectance requirements have been combined, requirements for floors are removed and the thresholds have been decreased from 85% for ceilings and 60% for walls to 80% for ceilings and 55% for walls.

**Step-by-Step Guidance**

Step 1. Establish Lighting Needs

Work with the owner to understand occupant's lighting needs and desires.

- Document the types of tasks that will occur in each space and the tools or equipment that occupants use regularly, and determine appropriate light levels for tasks.
- Identify the level of control that occupants should have and the characteristics of the occupant population.
- Select measures that are appropriate for the project. Some options require attention during early design phases because achievement depends on luminaire selection and configuration and architectural surface specifications.

Step 2. For Projects Pursuing Glare Control

- For the light fixtures, review luminaire cutsheets, Illuminating Engineering Society photometric files, or other documentation to identify luminance between 45 degrees and 90 degrees from nadir and select products that meet the credit requirements.

- Alternatively, select fixtures so that the spaces meet the UGR rating requirements.
- Exceptions include wallwash fixtures properly aimed at walls, as specified by manufacturer's data, indirect uplighting fixtures, provided there is no view down into these uplights from a regularly occupied space above, and any other specific applications (i.e. adjustable fixtures).
- Exclude shipping and receiving, warehouse, and distribution centers where projects need to meet IES recommended foot-candles while maintaining clearance for forklifts and other tall equipment.

Step 3. For Projects Pursuing Color Rendering

Specify all light sources to meet the credit requirements for color rendering index or color fidelity index.

- Exceptions include lamps or fixtures specifically designed to provide colored lighting for effect, site lighting, and lamps or fixtures designed for some other special use.
- For the light sources, determine the CRI, not to be confused with correlated color temperature (CCT) which refers to the spectrum of warm to cool. A light source can have a high or low CRI regardless of CCT.

Step 4. For Projects Pursuing Lighting Control

Design lighting to meet the credit requirements for lighting control.

- Identify all regularly occupied spaces in the project.
- Design lighting controls for each of these spaces to meet the credit requirements.

Step 5. For Projects Pursuing Surface Reflectivity

Select or specify high-reflective finish materials. Before construction begins, review manufacturer's cutsheets to identify reflectance typically expressed as a fraction or percentage LR (light reflectance) or LRV (light reflectance value). If manufacturers' data do not include reflectance, measure the reflectance of product samples (before construction) or the installed product (post-construction) using the methodology described in IES Lighting Handbook, or use reflectance charts such as Lighting Guide 11, Surface Reflectance and Color.

For work surfaces and movable partitions compliance is limited to the opaque surfaces of the partition; transparent or partially transparent surfaces are excluded.

If each surface is unable to comply with the reflectance requirement a weighted average surface reflectance calculation can be performed.

Step 6. Confirm Compliance

Compile documentation that confirms compliance with the selected strategies.

**Further Explanation**

Required Documentation

- Table of regularly occupied spaces and associated lighting details
- Lighting details, including manufacturer and model, results of estimations, or in situ or laboratory photometric tests
- Surface Reflectivity:
    - List of ceiling and wall surfaces, work surfaces (if in project scopes), movable partitions (if in project scope), and their associated surface reflectance values

- Average surface reflectance calculations (if needed)

### Connection to Ongoing Performance

- LEED O+M EQ prerequisite Indoor Environmental Quality Performance: Strategies to promote occupant comfort and wellbeing by providing high quality lighting in form of designing for lighting controls as well as by providing enhanced lighting quality measures in newly constructed buildings can contribute to better indoor environmental quality and overall occupant satisfaction during operations phase.

# EQ Credit: Daylight

This credit applies to

- BD+C: New Construction (1-3 points)
- BD+C: Core & Shell (1-3 points)
- BD+C: Schools (1-3 points)
- BD+C: Retail (1-3 points)
- BD+C: Data Centers (1-3 points)
- BD+C: Warehouses & Distribution Centers (1-3 points)
- BD+C: Hospitality (1-3 points)
- BD+C: Healthcare (1-2 points)

## INTENT

To connect building occupants with the outdoors, reinforce circadian rhythms, and reduce the use of electrical lighting by introducing daylight into the space.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Provide manual or automatic (with manual override) glare-control devices for all regularly occupied spaces. For core and shell projects, glare-control devices are not required in the spaces to be fit-out by the tenant(s).

AND

Select one of the following three options.

**Option 1. Simulation: Spatial Daylight Autonomy and Annual Sunlight Exposure (1–3 points, 1-2 points Healthcare)**

Perform annual computer simulations for spatial daylight autonomy$_{300/50\%}$ (sDA$_{300/50\%}$), and annual sunlight exposure$_{1000,250}$ (ASE$_{1000,250}$) as defined in IES LM-83-12 for each regularly occupied space. Healthcare projects must use each regularly occupied space located in the perimeter area determined under EQ Credit Quality Views. Additionally, calculate the average sDA$_{300/50\%}$ value for the total regularly occupied floor area.

For any regularly occupied spaces with ASE$_{1000,250}$ greater than 10%, identify how the space is designed to address glare.

Points are awarded according to Table 1.

**Table 1. Points for Option 1**

| | *New Construction, Core and Shell, Schools, Retail, Data Centers, Warehouses and Distribution Centers, Hospitality* | Healthcare |
|---|---|---|
| The average sDA$_{300/50\%}$ value for the regularly occupied floor area is at least **40%** | 1 point | 1 point |
| The average sDA$_{300/50\%}$ value for the regularly occupied floor area is at least **55%** | 2 points | 2 points |

| | | |
|---|---|---|
| The average $sDA_{300/50\%}$ value for the regularly occupied floor area is at least **75%** | 3 points | Exemplary performance |
| Each regularly occupied space achieves $sDA_{300/50\%}$ value of at least **55%** | Exemplary performance *or 1 additional point if 2 points achieved above.* | Exemplary performance |

The sDA and ASE calculation grids should be no more than 2 feet (600 millimeters) square and laid out across the regularly occupied area at a work plane height of 30 inches (760 millimeters) above finished floor (unless otherwise defined). Use an hourly time-step analysis based on typical meteorological year data, or an equivalent, for the nearest available weather station. Include any permanent interior obstructions. Moveable furniture and partitions may be excluded.

<u>CS only</u>
If the finishes in the space will not be completed, use the following default surface reflectances: 80% for ceilings, 20% for floors, and 50% for walls. Assume that the entire floor plate, except for the core, will be regularly occupied space.

OR

### Option 2. Simulation: Illuminance Calculations (1–3 points, 1-2 points Healthcare)

Perform computer simulations for illuminance at 9 a.m. and 3 p.m. on a clear-sky day at the equinox for each regularly occupied space. Healthcare projects should use the regularly occupied spaces located in the perimeter area determined under EQ Credit Quality Views.

Demonstrate illuminance levels are between 300 lux and 3,000 lux at both 9 a.m. and 3 p.m. Spaces with view-preserving automatic (with manual override) glare-control devices may demonstrate compliance for only the minimum 300 lux illuminance level.

Points are awarded according to Table 2.

**Table 2. Points for Option 2**

| *New Construction, Core and Shell, Schools, Retail, Data Centers, Warehouses and Distribution Centers, Hospitality* | | *Healthcare* | |
|---|---|---|---|
| *Percentage of regularly occupied floor area* | *Points* | *Percentage of regularly occupied floor area within perimeter area* | *Points* |
| 55% | 1 | 55% | 1 |
| 75% | 2 | 75% | 2 |
| 90% | 3 | 90% | Exemplary performance |

Calculate illuminance intensity for sun (direct component) and sky (diffuse component) for clear-sky conditions as follows:

- Use typical meteorological year data, or an equivalent, for the nearest available weather station.
- Select one day within 15 days of September 21 and one day within 15 days of March 21 that represent the clearest sky condition.
- Use the average of the hourly value for the two selected days.

Exclude blinds or shades from the model. Include any permanent interior obstructions. Moveable furniture and partitions may be excluded.

<u>Core and Shell only</u>
Assume the following default surface reflectances if the finishes in the space will not be completed: 80% for ceilings, 20% for floors, and 50% for walls. Assume that the entire floor plate, except for the core, will be regularly occupied space.

OR

**Option 3. Measurement (1-3 points, 1-2 points Healthcare)**

Measure illuminance in each regularly occupied space. Healthcare projects should use the regularly occupied spaces located in the perimeter area determined under EQ Credit Quality Views.

Achieve illuminance levels between 300 lux and 3,000 lux. Spaces with view-preserving automatic (with manual override) glare-control devices may demonstrate compliance for only the minimum 300 lux illuminance level.

Points are awarded according to Table 3.

**Table 3. Points for Option 3**

| *New Construction, Core and Shell, Schools, Retail, Data Centers, Warehouses and Distribution Centers, Hospitality* | | *Healthcare* | |
|---|---|---|---|
| *Percentage of regularly occupied floor area* | *Points* | *Percentage of regularly occupied floor area within perimeter area* | |
| 55% at **one** time in the year | 1 | 55% at **one** time in the year | 1 |
| 75% at **two** times in the year | 2 | 75% at **two** times in the year | 2 |
| 90% at **two** times in the year | 3 | 90% at **two** times in the year | exemplary performance |

With furniture, fixtures, and equipment in place, measure illuminance levels as follows:

- Measure at appropriate work plane height during any hour between 9 a.m. and 3 p.m.
- If pursuing one point, take one measurement in any regularly occupied month. If pursuing two points, take two measurements: one measurement in any regularly occupied month, and take a second as indicated in Table 4.
- For spaces larger than 150 square feet (14 square meters), take measurements on a maximum 10 foot (3 meter) square grid.
- For spaces 150 square feet (14 square meters) or smaller, take measurements on a maximum 3 foot (900 millimeters) square grid.

**Table 4. Timing of measurements for illuminance**

| *If first measurement is taken in …* | *take second measurement in …* |
|---|---|
| January | May-September |
| February | June-October |
| March | June-July, November-December |
| April | August-December |
| May | September-January |
| June | October-February |
| July | November-March |
| August | December-April |
| September | December-January, May-June |
| October | February-June |
| November | March-July |
| December | April-August |

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

The changes include making the three options for daylight credit clearer, more detailed and achievable. For Option 1 of the credit (Simulation: SDA and ASE), the thresholds for SDA 300/50% now have a new lower entry threshold of 40% for 1 point. The stringent 10% ASE threshold is no longer required to be met however spaces exceeding this value are required to identify how they are designed to address resulting glare.

For Option 2 (Simulation: Illuminance Calculations), computer simulations for illuminance need to be performed for each individual regularly occupied space Spaces with view preserving automatic glare-control devices can now show compliance only for the minimum 300 lux level instead of 300-3000 lux levels. Further, a lower entry threshold of 55% is newly introduced for 1 point to encourage daylight performance at design phase and the highest threshold of 90% compliance earns 3 points.

For Option 3 (Measurement), illuminance measurement needs to be performed for each regularly occupied space Spaces with view preserving glare-control devices can now show compliance only for 300 lux level. A lower entry threshold for 55% of floor area and 1 yearly time-point measurement is introduced for 1 point and highest compliance threshold for 90% of floor area earns 3 points.

**Step-by-Step Guidance**

Refer to LEED v4 reference guide with the following modifications:

Option 1. Simulation- Spatial Daylight Autonomy

Step 5. Evaluate compliance for annual sunlight exposure

Record the ASE values for each analysis area however, the ASE value does not need to meet 10% for each analysis area. For the exceeded ASE values, identify how the space is designed to address glare.

Option 2. Simulation- Illuminance Calculation

Step 3. Evaluate illuminance compliance. Follow guidance as per LEED v4 reference guide and record all daylit areas with illuminance levels between 300 lux and 3000 lux, however include spaces that have view preserving automatic glare-control devices, these can demonstrate compliance at 300 lux minimum illuminance level.

Option 3: Measurement

Step 3: Evaluate illuminance compliance. Follow guidance as per LEED v4 reference guide and record all daylit areas with illuminance levels between 300 lux and 3000 lux, however include spaces that have view preserving automatic glare-control devices, these can demonstrate compliance at 300 lux minimum illuminance level.

**Further Explanation**

Connection with Ongoing Building Performance

- LEED O+M EQ prerequisite Indoor Environmental Quality Performance: Strategies to promote connection of building occupants with outdoors and reinforce circadian rhythms by introducing appropriate amount of daylight into newly constructed spaces via measurement and simulation approaches can contribute to better indoor environmental quality and overall occupant satisfaction during operations phase.

# EQ Credit: Quality Views

This credit applies to

- BD+C: New Construction (1 point)
- BD+C: Core & Shell (1 point)
- BD+C: Schools (1 point)
- BD+C: Retail (1 point)
- BD+C: Data Centers (1 point)
- BD+C: Warehouses & Distribution Centers (1 point)
- BD+C: Hospitality (1 point)
- BD+C: Healthcare (1 point)

## INTENT

To give building occupants a connection to the natural outdoor environment by providing quality views.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, HOSPITALITY

Provide occupants in the building with a view to the outdoor natural or urban environment for 75% of all regularly occupied floor area. Auditoriums, conference rooms dedicated to video conferencing, and gymnasiums may be excluded. Views into interior atria may be used to meet up to 30% of the required area.

Views must be through glass with a visible light transmittance (VLT) above 40%. If the glazing has frits, patterns, or tints the view must be preserved. Neutral gray, bronze, and blue-green tints are acceptable.

Views must include at least one of the following:

- nature, urban landmarks, or art; or
- objects at least 25 feet (7.5 meters) from the exterior of the glazing.

Occupants must have direct access to the view and be within three times the head height of the glazing.

WAREHOUSES & DISTRIBUTION CENTERS

For the office portion of the building, meet the requirements above.

For the bulk storage, sorting, and distribution portions of the building, meet the requirements above for 25% of the regularly occupied floor area.

HEALTHCARE

For inpatient units (IPUs), meet the requirements above (1 point).

For other areas, configure the building floor plates such that the floor area within 15 feet (4.5 meters) of the perimeter exceeds the perimeter area requirement (Table 1), and meet the requirements above for the perimeter area (1 point).

**Table 1. Minimum compliant perimeter area, by floor plate area**

| Floor plate area | | Perimeter area | |
|---|---|---|---|
| (square feet) | (square meters) | (square feet) | (square meters) |
| Up to 15,000 | Up to 1 400 | 7,348 | 682 |
| 20,000 | 1 800 | 8,785 | 816 |

| | | | |
|---|---|---|---|
| 25,000 | 2 300 | 10,087 | 937 |
| 30,000 | 2 800 | 11,292 | 1 049 |
| 35,000 | 3 300 | 12,425 | 1 154 |
| 40,000 | 3 700 | 13,500 | 1 254 |
| 45,000 | 4 200 | 14,528 | 1 349 |
| 50,000 and larger | 4 600 and larger | 15,516 | 1 441 |

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

Specific criteria for the glazing characteristics have been added to address challenges with determining acceptable levels of clarity, frits, fibers, patterns, tints and to minimize conflicts with the Pilot Credit for Bird Collision Deterrence.

The view requirements were also revised to better differentiate criteria for view content from criteria for view access and to eliminate potentially redundant requirements.

The requirements for healthcare have been revised for clarity.

Step-by-Step Guidance

Step 1-3. Refer to these steps in the LEED v4 reference guide

Step 4. Identify Site Lines to the Exterior

On floor plans or furniture plans, identify the locations of perimeter and interior glazing and all permanent interior obstructions.

- Determine whether the perimeter and interior glazing meets the credit requirements for VLT, frits/patterns, and tints.
    - Recommended frit patterns to reduce bird collisions and preserve quality views are no thicker than 1/8 inch (3.175 millimeters) and spaced every 2 inches (5.08 centimeters) vertically and 4 inches (10.16 centimeters) horizontally.
- Identify interior features that may block the view to the window, such as structural columns. Vertical columns smaller than 1-foot (0.3 meters) wide and horizontal features smaller than 1-foot (0.3 meters) high typically do not block views. Movable furniture and partitions as well as movable glare control devices may be included, but this is not required.
- Consider performing an initial rough assessment before performing detailed assessment of view quality. Determine whether the regularly occupied floor area with proximity to vision glazing is at least 75% of the total regularly occupied floor area.

Step 5. Assess View Quality

Identify whether the view includes nature, urban landmarks or art, or objects at least 25 feet (7.5 meters) from the exterior of the glazing.

Step 6. Confirm Compliance

Complete the tracking table to confirm that at least 75% of the regularly occupied floor area has access to a quality view. For warehouses and distribution centers and Healthcare projects, See Further Explanation, Rating System Variations section in the LEED v4 Reference Guide.

**Further Explanation**

Healthcare projects refer to the following sections in the LEED v4 Reference guide: Calculations perimeter area, special considerations for healthcare projects,

Required Documentation

- List of regularly occupied spaces, qualifying floor area in each space, and view features
- Sections, elevations, diagrams, renderings, or photos indicating sight lines to glazing do not encounter permanent interior obstructions.
- Floor plans or diagrams identifying the views to nature, urban landmarks, or objects at least 25 feet (7.5 meters) accessible to the occupants.
- Glazing specifications confirming compliance with VLT, frit/pattern, and tint requirements.

Connection to Ongoing Performance

- LEED O+M EQ prerequisite Indoor Environmental Quality Performance: Strategies to promote connection of building occupants to natural outdoor environment by providing quality views in newly constructed buildings can contribute to better indoor environmental quality and overall occupant satisfaction during operations phase.

# EQ Credit: Acoustic Performance

This credit applies to

- BD+C: New Construction (1 point)
- BD+C: Schools (1 point)
- BD+C: Data Centers (1 point)
- BD+C: Warehouses & Distribution Centers (1 point)
- BD+C: Hospitality (1 point)
- BD+C: Healthcare (1-2 points)

## INTENT

To provide workspaces and classrooms that promote occupants' well-being, productivity, and communications through effective acoustic design.

## REQUIREMENTS

NC, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY

For all occupied spaces, meet two of the following: HVAC background noise, Sound Transmission, and/or Reverberation time. Meet all three for an exemplary performance point.

Confirm compliance via calculations or measurements in representative rooms, and/or design documentation from a person experienced in the field of acoustics.

### HVAC Background Noise

Achieve maximum background noise levels from heating, ventilating, and air conditioning (HVAC) systems per 2015 ASHRAE Handbook-- HVAC Applications, Chapter 48, Table 1 ; AHRI Standard 885-2008, Table 15; or a local equivalent.

If confirming compliance via measurements, use a sound level meter that conforms to ANSI S1.4 for type 1 (precision) or type 2 (general purpose) sound measurement instrumentation, the International Electrotechnical Commission (2013) IEC 61672-1:2013 Electroacoustics – Sound Level Meters – Part 1: Specifications, or a local equivalent.

Comply with design criteria for HVAC noise levels resulting from the sound transmission paths listed in 2015 ASHRAE Handbook—HVAC Applications, Chapter 48, Table 6; or a local equivalent.

### Sound Transmission

Categorize all occupied spaces by use and desired level of acoustic privacy.

Meet the composite sound transmission class ($STC_C$) ratings or noise isolation class (NIC) listed in Table 1. For NIC measurements, use ASTM E336-17a or Annex A.3 of ANSI S12.60-2010.

**Table 1. Minimum composite sound transmission class ratings or noise isolation class for adjacent spaces**

| Adjacency combinations | | $STC_C$ ** | NIC** |
|---|---|---|---|
| Retail | Retail | 50 | 45 |
| Collaborative / multi-use | Hallway, stairway | 25 | 20 |
| Private | Hallway, stairway | 35 | 30 |
| Confidential | Hallway, stairway | 40 | 35 |
| Collaborative / multi-use | Collaborative / multi-use | 35 | 30 |
| Collaborative / multi-use | Private | 45 | 40 |
| Collaborative / multi-use | Confidential | 50 | 45 |
| Private | Private | 45 | 40 |

| | | | |
|---|---|---|---|
| Private | Confidential | 50 | 45 |
| Confidential | Confidential | 50 | 45 |
| Conference room | Conference room | 50 | 45 |
| Mechanical equipment room* | Hallway, stairway | 50 | 45 |
| Mechanical equipment room* | Occupied area | 60 | 55 |

*Minimum STCc or NIC has to be met unless proven that the equipment noise in conjunction with the sound isolation performance of the partitions and doors will not exceed the maximum background noise requirements of the adjacent space.

**If a sound masking system is implemented at a minimum level of 40 dBA, the STCc ratings or NIC values in Table 1 may be lowered by 5 points. This applies to all space types except mechanical equipment rooms. The sound masking system must be designed by an acoustical professional and meet the following criteria:

- The overall level for sound masking must be set by an acoustical professional and must not exceed 48 dBA in open offices, libraries, cafeterias, corridors/hallways, 45 dBA in enclosed offices, and 42 dBA in conference rooms, and wellness rooms. The combined level of masking and HVAC background noise must not exceed these limits.
- The system design and commissioning must provide overall level uniformity of +/-1 dBA and one-third octave band uniformity of +/-2 dB from at least 100 to 5,000 Hz when tested according to ASTM E1573-18
- The sound masking spectrum must conform to the National Research Council of Canada COPE Optimum Masking Spectrum or an alternate spectrum if specified by an acoustical engineer.

### Reverberation Time

Meet the reverberation time requirements in Table 2 (adapted from Table 9.1 in the Performance Measurement Protocols for Commercial Buildings[3]).

Table 2. Reverberation time requirements

| Room type | Application | T60 (sec), at 500 Hz, 1000 Hz, and 2000 Hz |
|---|---|---|
| Hotel/motel | Individual room or suite | < 0.6 |
| | Meeting or banquet room | < 0.8 |
| Office building | Executive or private office | < 0.6 |
| | Conference room | < 0.6 |
| | Teleconference room | < 0.6 |
| | Open-plan office without sound masking | < 0.8 |
| | Open-plan office with sound masking | 0.8 |
| Courtroom | Unamplified speech | < 0.7 |
| | Amplified speech | < 1.0 |
| Performing arts space | Drama theaters, concert and recital halls | Varies by application |
| Laboratories | Testing or research with minimal speech communication | < 1.0 |
| | Extensive phone use and speech communication | < 0.6 |
| Church, mosque, synagogue | General assembly with critical music program | Varies by application |
| Library | | < 1.0 |
| Indoor stadium, gymnasium | Gymnasium and natatorium | < 2.0 |
| | Large-capacity space with speech amplification | < 1.5 |

[3] Adapted from ASHRAE (2007d), ASA (2008), ANSI (2002), and CEN (2007)

SCHOOLS

### HVAC Background noise

Achieve a background noise level of 35 dBA or less from heating, ventilating, and air-conditioning (HVAC) systems in classrooms and other core learning spaces.

### Sound Transmission

Design classrooms and other core learning spaces to meet the sound transmission class (STC) requirements of ANSI S12.60–2010 Part 1, or a local equivalent.  Exterior windows must have an STC rating of at least 35, unless outdoor and indoor noise levels can be verified to justify a lower rating.

HEALTHCARE

Design the facility to meet Option 1 (1 point) and/or Option 2 (1 point).

### Option 1. Speech Privacy, Sound Isolation, and Background Noise (1 point)

*Speech Privacy and Sound Isolation*

Design sound isolation to achieve speech privacy, acoustical comfort, and minimal annoyance from noise-producing sources. Consider sound levels at both source and receiver locations, the background sound at receiver locations, and the occupants' acoustical privacy and acoustical comfort needs.

Design the facility to meet the criteria outlined in the following sections, as applicable:

- 2018 FGI Guidelines for Design and Construction of  Hospitals—Section 1.2-6.1.5 and Section 1.2-6.1.6
- 2018 FGI Guidelines for Design and Construction of Outpatient Facilities—Section 1.2-5.1.6 and Section 1.2-5.1.6.2
- 2018 FGI Guidelines for Design and Construction of Residential Health, Care, and Support Facilities--Section 2.5-8.6

*Background Noise*

Consider background noise levels generated by all building mechanical-electrical-plumbing systems, air distribution systems and other facility noise sources under the purview of the project building design-construction team.

Design the facility to meet the criteria outlined in the following sections, as applicable:

- 2018 FGI Guidelines for Design and Construction of  Hospitals—Section 1.2-6.1.4 (Table 1.2-5)
- 2018 FGI Guidelines for Design and Construction of Outpatient Facilities—Section 1.2-5.1.4 (Table 1.2-5)
- 2018 FGI Guidelines for Design and Construction of Residential Health, Care, and Support Facilities--Section 2.5-8.4 (Table 2.5-5)

Calculate or measure sound levels in representative rooms and spaces of each type to confirm compliance with criteria in the above-referenced tables using a sound level meter that conforms to ANSI S1.4 for type 1 (precision) or type 2 (general purpose) sound measurement instrumentation. For spaces not listed in Table 1.2-2, refer to ASHRAE 2015 Handbook, Chapter 48, Sound and Vibration Control, Table 1.

### Option 2. Acoustical Finishes and Site Exterior Noise (1 point)

Meet the requirements for acoustical finishes and site exterior noise.

*Acoustical Finishes*

Specify materials, products systems installation details, and other design features to meet the following:

- 2018 FGI Guidelines for Design and Construction of  Hospitals—Section 1.2-5.1.3 (Table 1.2-4)
- 2018 FGI Guidelines for Design and Construction of Outpatient Facilities—Section 1.2-5.1.3 (Table 1.2-4)

- 2018 FGI Guidelines for Design and Construction of Residential Health, Care, and Support Facilities--Section 2.5-8.3 (Table 2.5-4)

Calculate or measure the average sound absorption coefficients for representative unoccupied rooms of each type in the building to confirm conformance with the requirements.

*Site Exterior Noise*
Minimize the effect on building occupants of site exterior noise produced by road traffic, aircraft flyovers, railroads, on-site heliports, emergency power generators during maintenance testing, outdoor facility MEP and building services equipment, etc. Also minimize effects on the surrounding community from all facility MEP equipment and activities as required to meet (1) local applicable codes or (2) background noise requirements above, whichever is more stringent.
Comply with the 2018 FGI Guidelines for the following noise sources:

- heliports, A1.3-3.6.2.2;
- generators, 2.1-8.3.3.1;
- mechanical equipment, 2.1-8.2.1.1; and
- building services, A2.2-5.3

Measure and analyze data to determine the exterior noise classification (A, B, C, or D) of the facility site and design the building envelope to meet the following, as applicable:

- 2018 FGI Guidelines for Design and Construction of  Hospitals—Table 1.2-3
- 2018 FGI Guidelines for Design and Construction of Outpatient Facilities— Table 1.2-3
- 2018 FGI Guidelines for Design and Construction of Residential Health, Care, and Support Facilities—Table 2.5-3

For exterior site exposure categories B, C, or D, calculate or measure the sound isolation performance of representative elements of the exterior building envelope to determine the composite sound transmission class (STCc) rating for representative façade sections. Measurements should generally conform to ASTM E966-18, Standard Guide for Field Measurements of Airborne Sound Insulation of Building Façades and Façade Elements.

## GUIDANCE

Refer to the LEED v4 reference guide, with the following additions and modifications:

**Behind the Intent**

Beta Update

The credit now requires any two of three sound performance requirements to be met in form of HVAC background noise, sound transmission/isolation and reverberation time to provide more flexibility to project teams. Further, projects can comply with an International Electrotechnical Commission standard for HVAC background noise measurement. Minimum sound transmission class ratings table is significantly revised to include multiple space types and adjacency combinations Projects can now meet either minimum STC ratings or corresponding minimum NIC ratings

Sound reinforcement requirements have been removed and sound masking requirements are modified into sound transmission/isolation with clearer criteria for sound masking in different space types concurrent with any HVAC background noise in the spaces.

Finally, some existing standards referenced for this credit were changed to their most recent version as follows:

- 2011 ASHRAE Handbook- HVAC Applications → 2015 ASHRAE Handbook- HVAC Applications
- Healthcare: FGI 2010 → FGI 2018

**Step-by-Step Guidance**

Follow LEED v4 reference guide with the following modifications:

Step 2. Review Acoustic Criteria
Meet any two of three performance areas from HVAC background noise, sound isolation (that includes sound masking system requirements) and reverberation time instead of all four.

Step 3: Address HVAC background noise. Follow LEED v4 reference guide for this section with the exception of referring to newer 2015 HVAC Applications ASHRAE Handbook.

Step 4: Verify HVAC background noise. Follow LEED v4 reference guide for this section in addition to referring to newly introduced standard for HVAC background noise measurement –International Electrotechnical Commission IEC 61672-1:2013 Electroacoustics – Sound Level Meters- Part 1 Specifications or a local equivalent.

Step 7: Verify sound isolation. Follow LEED v4 reference guide for this section. A NIC rating within 3-5 points of the specified STC rating may be considered compliant. For each space, list the maximum STC or NIC rating, design STC or NIC rating and data to support reported values. Determine whether the project will have any associated sound masking systems.

Step 11: Select sound reinforcement and masking systems. Follow the credit requirements under sound transmission/isolation for sound level and system uniformity for the specific spaces using sound masking systems.

<u>Healthcare</u>

Step 2: Follow the LEED v4 reference guide with the exception of referring to 2015 FGI Guidelines for Design and Construction of Health Care Facilities and the Sound and Vibration Design Guidelines for Health Care Facilities.

**Further Explanation**
Follow the LEED v4 Reference Guide with the following modifications:

### Masking systems and meeting masking system requirements
Follow LEED v4 reference guide for these sections. Comply with newer requirements in revised credit for sound masking- meet STC or NIC ratings as well as HVAC background noise levels in conjunction with sound masking requirements for specific space types having varied environmental noise levels (as specified for open spaces, enclosed offices or conference rooms etc.)

### Required Documentation
Follow the LEED v4 reference guide with the following modifications:

- For sound isolation requirements of all projects, either STC or NIC ratings for space adjacencies are acceptable.
- Sound masking systems documentation needs to be submitted under sound isolation rather than separately.
- Healthcare: For site exterior noise (Option 2), provide mitigation narrative for each 2015 FGI guideline.

### Connection with Ongoing Building Performance
- LEED O+M EQ prerequisite Indoor Environmental Quality Performance: Strategies to minimize HVAC background noise, exterior noise, reverberation time etc. in newly constructed buildings can help contribute to better indoor environmental quality and overall occupant satisfaction during operations phase.

# IN Credit: Innovation

This credit applies to

- BD+C: New Construction (1-5 points)
- BD+C: Core and Shell (1-5 points)
- BD+C: Schools (1-5 points)
- BD+C: Retail (1-5 points)
- BD+C: Data Centers (1-5 points)
- BD+C: Warehouses and Distribution Centers (1-5 points)
- BD+C: Hospitality (1-5 points)
- BD+C: Healthcare (1-5 points)

## INTENT

To encourage projects to achieve exceptional or innovative performance to benefit human and environmental health and equity. To foster LEED expertise throughout building design, construction, and operation and collaboration toward project priorities.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

To achieve all five innovation points, a project team must achieve at least one pilot credit, at least one innovation credit and no more than two exemplary performance credits.

Option 1. Innovation (1 point)
Achieve significant, measurable environmental performance using a strategy not addressed in the LEED green building rating system.

Identify the following:
- the intent of the proposed innovation credit;
- proposed requirements for compliance;
- proposed submittals to demonstrate compliance; and
- the design approach or strategies used to meet the requirements.

Examples of innovation may be found in the LEED Innovation Catalog.

AND/OR

Option 2. Pilot (1 point)
Achieve one pilot credit from USGBC's LEED Pilot Credit Library.

AND/OR

Option 3. Additional Strategies
- Innovation (1-3 points)
  Defined in Option 1 above.
- Pilot (1-3 points)
  Meet the requirements of Option 2.
- Exemplary Performance (1–2 points)
  Achieve exemplary performance in an existing LEED v4 prerequisite or credit that allows exemplary performance, as specified in the LEED Reference Guide, v4 edition. An exemplary performance point is typically earned for achieving double the credit requirements or the next incremental percentage threshold.

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following additions:

**Step-by-Step Guidance**

Follow steps in the LEED v4 reference guide, with the following additions:

Step 2. Develop Innovation Point Strategy

- If projects pursue a pilot ACP, they are exempted from the requirement to pursue at least one pilot credit. To achieve all five points in the Innovation credit under this approach, projects may select one of the following point combinations:
    - 4 innovation and 1 exemplary performance
    - 3 innovation and 2 exemplary performance

**Further Explanation**

Connection to Ongoing Performance

- LEED O+M IN credit Innovation: Many innovation strategies are also available in the LEED O+M v4.1 credit Innovation. Other innovation strategies focus on innovative performance tracking or operations practices that can be initiated during design and construction and set up a project for success in achieving higher performance scores.

# IN Credit: LEED Accredited Professional

This prerequisite applies to

- BD+C: New Construction (1 point)
- BD+C: Core and Shell (1 point)
- BD+C: Schools (1 point)
- BD+C: Retail (1 point)
- BD+C: Data Centers (1 point)
- BD+C: Warehouses and Distribution Centers (1 point)
- BD+C: Hospitality (1 point)
- BD+C: Healthcare (1 point)

## INTENT

To encourage the team integration required by a LEED project and to streamline the application and certification process.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL NC, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

At least one principal participant of the project team must be a LEED Accredited Professional (AP) with a specialty appropriate for the project.

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following addition:

**Further Explanation**

Connection to Ongoing Performance

- LEED O+M IN credit Innovation: A LEED Accredited Professional encourages integration of LEED expertise and collaboration toward project priorities. As such, it is a requirement to achieve Innovation points in LEED v4.1 O+M.

# RP Credit: Regional Priority

This prerequisite applies to

- BD+C: New Construction (1-4 points)
- BD+C: Core and Shell (1-4 points)
- BD+C: Schools (1-4 points)
- BD+C: Retail (1-4 points)
- BD+C: Data Centers (1-4 points)
- BD+C: Warehouses and Distribution Centers (1-4 points)
- BD+C: Hospitality (1-4 points)
- BD+C: Healthcare (1-4 points)

## INTENT

To provide an incentive for the achievement of credits that address geographically specific environmental, social equity, and public health priorities.

## REQUIREMENTS

NC, CS, SCHOOLS, RETAIL NC, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, HOSPITALITY, HEALTHCARE

Earn up to four of the six Regional Priority credits. These credits have been identified by the USGBC regional councils and chapters as having additional regional importance for the project's region. A database of Regional Priority credits and their geographic applicability is available on the USGBC website, http://www.usgbc.org.

One point is awarded for each Regional Priority credit achieved, up to a maximum of four.

## GUIDANCE

There are no substantive changes to the credit requirements; refer to the LEED v4 reference guide, with the following addition:

**Further Explanation**

Connection to Ongoing Performance

- LEED O+M IN credit Innovation: Regional approaches can be applied as innovation strategies in the LEED O+M v4.1 credit Innovation and set up a project for success in achieving higher performance scores.

# Appendix 1. Use Types and Categories

**Table 1. Use Types and Categories**

| Category | Use type |
|---|---|
| Food retail | Supermarket |
| | Grocery with produce section |
| Community-serving retail | Convenience store |
| | Farmers market |
| | Hardware store |
| | Pharmacy |
| | Other retail |
| Services | Bank |
| | Family entertainment venue (e.g., theater, sports) |
| | Gym, health club, exercise studio |
| | Hair care |
| | Laundry, dry cleaner |
| | Restaurant, café, diner (excluding those with only drive-thru service) |
| Civic and community facilities | Adult or senior care (licensed) |
| | Child care (licensed) |
| | Community or recreation center |
| | Cultural arts facility (museum, performing arts) |
| | Education facility (e.g., K—12 school, university, adult education center, vocational school, community college) |
| | Government office that serves public on-site |
| | Medical clinic or office that treats patients |
| | Place of worship |
| | Police or fire station |
| | Post office |
| | Public library |
| | Public park |
| | Social services center |
| Community anchor uses (BD+C and ID+C only) | Commercial office (100 or more full-time equivalent jobs) |
| | Housing (100 or more dwelling units) |

Adapted from Criterion Planners, INDEX neighborhood completeness indicator, 2005.

# Appendix 2. Default Occupancy Counts

Use Table 1 to calculate default occupancy counts.  Only use the occupancy estimates if occupancy is unknown.

For the calculation, use gross floor area, not net or leasable floor area.  Gross floor area is defined as the sum of all areas on all floors of a building included within the outside faces of the exterior wall, including common areas, mechanical spaces, circulation areas, and all floor penetrations that connect one floor to another. To determine gross floor area, multiply the building footprint (in square feet or square meters) by the number of floors in the building.  Exclude underground or structured parking from the calculation.

Table 1. Default Occupancy Numbers

| | Gross square feet per occupant | | Gross square meters per occupant | |
|---|---|---|---|---|
| | Employees | Transients | Employees | Transients |
| General office | 250 | 0 | 23 | 0 |
| Retail, general | 550 | 130 | 51 | 12 |
| Retail or service (e.g., financial, auto) | 600 | 130 | 56 | 12 |
| Restaurant | 435 | 95 | 40 | 9 |
| Grocery store | 550 | 115 | 51 | 11 |
| Medical office | 225 | 330 | 21 | 31 |
| R&D or laboratory | 400 | 0 | 37 | 0 |
| Warehouse, distribution | 2,500 | 0 | 232 | 0 |
| Warehouse, storage | 20,000 | 0 | 1860 | 0 |
| Hotel | 1,500 | 700 | 139 | 65 |
| Educational, daycare | 630 | 105 | 59 | 10 |
| Educational, K–12 | 1,300 | 140 | 121 | 13 |
| Educational, postsecondary | 2,100 | 150 | 195 | 14 |

Sources:
ANSI/ASHRAE/IESNA Standard 90.1–2004 (Atlanta, GA, 2004).
2001 Uniform Plumbing Code (Los Angeles, CA)
California Public Utilities Commission, 2004–2005 Database for Energy Efficiency Resources (DEER) Update Study (2008).
California State University, Capital Planning, Design and Construction Section VI, Standards for Campus Development Programs ( Long Beach, CA, 2002).

City of Boulder Planning Department, Projecting Future Employment—How Much Space per Person (Boulder, 2002).
Metro, 1999 Employment Density Study (Portland, OR 1999).
American Hotel and Lodging Association, Lodging Industry Profile Washington, DC, 2008.
LEED for Core & Shell Core Committee, personal communication (2003 - 2006).
LEED for Retail Core Committee, personal communication (2007)
OWP/P, Medical Office Building Project Averages (Chicago, 2008).
OWP/P, University Master Plan Projects (Chicago, 2008).
U.S. General Services Administration, Childcare Center Design Guide (Washington, DC,2003).

# Appendix 3. Retail Process Load Baselines

Table 1a. Commercial kitchen appliance prescriptive measures and baseline for energy cost budget (IP units)

| | Baseline energy usage for energy modeling path | | | | Levels for prescriptive path | |
|---|---|---|---|---|---|---|
| Appliance type | Fuel | Function | Baseline efficiency | Baseline idle rate | Prescriptive efficiency | Prescriptive idle rate |
| Broiler, underfired | Gas | Cooking | 30% | 16,000 Btu/h/ft² peak input | 35% | 12,000 Btu/h/ft² peak input |
| Combination ovens, steam mode (P = pan capacity) | Elec | Cooking | 40% steam mode | 0.37P+4.5 kW | 50% steam mode | 0.133P+0.6400 kW |
| Combination ovens, steam mode | Gas | Cooking | 20% steam mode | 1,210P+35,810 Btu/h | 38% steam mode | 200P+6,511 Btu/h |
| Combination ovens, convection mode | Elec | Cooking | 65% convection mode | 0.1P+1.5 kW | 70% convection mode | 0.080P+0.4989 kW |
| Combination ovens, convection mode | Gas | Cooking | 35% convection mode | 322P+13,563 Btu/h | 44% convection mode | 150P+5,425 Btu/h |
| Convection oven, full-size | Elec | Cooking | 65% | 2.0 kW | 71% | 1.6 kW |
| Convection oven, full-size | Gas | Cooking | 30% | 18,000 Btu/h | 46% | 12,000 Btu/h |
| Convection oven, half-size | Elec | Cooking | 65% | 1.5 kW | 71% | 1.0 kW |
| Conveyor oven, > 25-inch belt | Gas | Cooking | 20% | 70,000 Btu/h | 42% | 57,000 Btu/h |
| Conveyor oven, ≤ 25-inch belt | Gas | Cooking | 20% | 45,000 Btu/h | 42% | 29,000 Btu/h |
| Fryer | Elec | Cooking | 75% | 1.05 kW | 80% | 1.0 kW |
| Fryer | Gas | Cooking | 35% | 14,000 Btu/h | 50% | 9,000 Btu/h |
| Griddle (based on 3 ft model) | Elec | Cooking | 60% | 400 W/ft² | 70% | 320 W/ft² |

| | | | | | | |
|---|---|---|---|---|---|---|
| Griddle (based on 3 ft model) | Gas | Cooking | 30% | 3,500 Btu/h/ft² | 38% | 2,650 Btu/h/ft² |
| Hot food holding cabinets (excluding drawer warmers and heated display), 0 < V < 13 ft³ (V = volume) | Elec | Cooking | na | 40 W/ft³ | Na | 21.5V Watts |
| Hot food holding cabinets (excluding drawer warmers and heated display), 13 ≤ V < 28 ft³ | Elec | Cooking | na | 40 W/ft³ | Na | 2.0V + 254 Watts |
| Hot food holding cabinets (excluding drawer warmers and heated display), 28 ft³ ≤ V | Elec | Cooking | na | 40 W/ft³ | Na | 3.8V + 203.5 Watts |
| Large vat fryer | Elec | Cooking | 75% | 1.35 kW | 80% | 1.1 kW |
| Large vat fryer | Gas | Cooking | 35% | 20,000 Btu/h | 50% | 12,000 Btu/h |
| Rack oven, double | Gas | Cooking | 30% | 65,000 Btu/h | 50% | 35,000 Btu/h |
| Rack oven, single | Gas | Cooking | 30% | 43,000 Btu/h | 50% | 29,000 Btu/h |
| Range | Elec | Cooking | 70% | | 80% | |
| Range | Gas | Cooking | 35% | na | 40% and no standing pilots | na |
| Steam cooker, batch cooking | Elec | Cooking | 26% | 200 W/pan | 50% | 135 W/pan |
| Steam cooker, | Gas | Cooking | 15% | 2,500 Btu/h/pan | 38% | 2,100 Btu/h/pan |

| | | | | | | |
|---|---|---|---|---|---|---|
| batch cooking | | | | | | |
| Steam cooker, high production or cook to order | Elec | Cooking | 26% | 330 W/pan | 50% | 275 W/pan |
| Steam cooker, high production or cook to order | Gas | Cooking | 15% | 5,000 Btu/h/pan | 38% | 4,300 Btu/h/pan |
| Toaster | Elec | Cooking | — | 1.8 kW average operating energy rate | Na | 1.2 kW average operating energy rate |
| Ice machine, IMH (ice-making head, H = ice harvest), H ≥ 450 lb./day | Elec | Ice | 6.89 - 0.0011H kWh/100 lb. ice | na | $37.72*H^{-0.298}$ kWh/100 lb. ice | na |
| Ice machine, IMH (ice-making head), H ≤ 450 lb./day | Elec | Ice | 10.26 – 0.0086H kWh/100 lb. ice | na | $37.72*H^{-0.298}$ kWh/100 lb. ice | na |
| Ice machine, RCU (remote condensing unit, w/o remote compressor, H < 1,000 lb./day | Elec | Ice | 8.85 - 0.0038H kWh/100lb ice | na | $22.95*H^{-0.258}$ + 1.00 kWh/100 lb. ice | na |
| Ice machine, RCU (remote condensing unit), 1600 > H ≥ 1000 lb./day | Elec | ice | 5.10 kWh/100 lb. ice | Na | $22.95*H^{-0.258}$ + 1.00 kWh/100 lb. ice | na |
| Ice machine, RCU (remote condensing unit), H ≥ 1600 lb./day | Elec | Ice | 5.10 kWh/100lb ice | Na | -0.00011*H + 4.60 kWh/100 lb. ice | na |
| Ice machine, SCU (self- | Elec | Ice | 18.0 - 0.0469H | Na | $48.66*H^{-0.326}$ + 0.08 | na |

| | | | | | | |
|---|---|---|---|---|---|---|
| contained unit), H < 175 lb./day | | | kWh/100lb ice | | kWh/100 lb. ice | |
| Ice machine self-contained unit, H ≥ 175 lb./day | Elec | Ice | 9.80 kWh/100 lb. ice | Na | $48.66*H^{-0.326}$ + 0.08 kWh/100 lb. ice | na |
| Ice machine, water-cooled ice-making head, H ≥ 1436 lb./day (must be on chilled loop) | Elec | Ice | 4.0 kWh/100 lb. ice | Na | 3.68 kWh/100 lb. ice | na |
| Ice machine, water-cooled ice-making head, 500 lb./day < H < 1436 (must be on chilled loop) | Elec | Ice | 5.58 – 0.0011H kWh/100 lb. ice | Na | 5.13 - 0.001H kWh/100 lb. ice | na |
| Ice machine, water-cooled ice-making head, H < 500 lb./day (must be on chilled loop) | Elec | Ice | 7.80 – 0.0055H kWh/100 lb. ice | Na | 7.02 - 0.0049H kWh/100 lb. ice | na |
| Ice machine, water-cooled once-through (open loop) | Elec | Ice | Banned | Banned | Banned | Banned |
| Ice machine, water-cooled SCU (self-contained unit), H < 200 lb./day (must be on chilled loop) | Elec | Ice | 11.4 – 0.0190H kWh/100 lb. ice | Na | 10.6 - 0.177H kWh/100 lb. ice | na |
| Ice machine, water-cooled self- | Elec | Ice | 7.6 kWh/100 lb. ice | Na | 7.07 kWh/100 lb. ice | na |

| | | | | | | |
|---|---|---|---|---|---|---|
| contained unit, H ≥ 200 lb./day (must be on chilled loop) | | | | | | |
| Chest freezer, solid or glass door | Elec | Refrig | 0.45V + 0.943 kWh/day | Na | ≤ 0.270V + 0.130 kWh/day | na |
| Chest refrigerator, solid or glass door | Elec | Refrig | 0.1V + 2.04 kWh/day | Na | ≤ 0.125V + 0.475 kWh/day | na |
| Glass-door reach-in freezer, 0 < V < 15 $ft^3$ | Elec | Refrig | 0.75V + 4.10 kWh/day | Na | ≤ 0.607V + 0.893 kWh/day | na |
| Glass-door reach-in freezer, 15 ≤ V < 30 $ft^3$ | Elec | Refrig | .75V + 4.10 kWh/day | Na | ≤ 0.733V – 1.00 kWh/day | na |
| Glass-door reach-in freezer, 30 ≤ V < 50 $ft^3$ | Elec | Refrig | .75V + 4.10 kWh/day | Na | ≤ 0.250V + 13.50 kWh/day | na |
| Glass-door reach-in freezer, 50 ≤ V $ft^3$ | Elec | Refrig | 0.75V + 4.10 kWh/day | Na | ≤ 0.450V + 3.50 kWh/day | na |
| Glass-door reach-in refrigerator, 0 < V < 15 $ft^3$ | Elec | Refrig | 0.12V + 3.34 kWh/day | Na | ≤ 0.118V + 1.382 kWh/day | na |
| Glass-door reach-in refrigerator, 15 ≤ V < 30 $ft^3$ | Elec | Refrig | 0.12V + 3.34 kWh/day | Na | ≤ 0.140V + 1.050 kWh/day | na |
| Glass-door reach-in refrigerator, 30 ≤ V < 50 $ft^3$ | Elec | Refrig | 0.12V + 3.34 kWh/day | Na | ≤ 0.088V + 2.625 kWh/day | na |
| Glass-door reach-in refrigerator, 50 ≤ V $ft^3$ | Elec | Refrig | 0.12V + 3.34 kWh/day | Na | ≤ 0.110V + 1.500 kWh/day | na |

| | | | | | | |
|---|---|---|---|---|---|---|
| Solid-door reach-in freezer, 0 < V < 15 ft³ | Elec | Refrig | 0.4V + 1.38 kWh/day | Na | ≤ 0.250V + 1.25 kWh/day | na |
| Solid-door reach-in freezer, 15 ≤ V < 30 ft³ | Elec | Refrig | 0.4V + 1.38 kWh/day | Na | ≤ 0.400V – 1.000 kWh/day | na |
| Solid-door reach-in freezer, 30 ≤ V < 50 ft³ | Elec | Refrig | 0.4V + 1.38 kWh/day | Na | ≤ 0.163V + 6.125 kWh/day | na |
| Solid-door reach-in freezer, 50 ≤ V ft³ | Elec | Refrig | 0.4V + 1.38 kWh/day | Na | ≤ 0.158V + 6.333 kWh/day | na |
| Solid-door reach-in refrigerator, 0 < V < 15 ft³ | Elec | Refrig | 0.1V + 2.04 kWh/day | Na | ≤ 0.089V + 1.411 kWh/day | na |
| Solid-door reach-in refrigerator, 15 ≤ V < 30 ft³ | Elec | Refrig | 0.1V + 2.04 kWh/day | Na | ≤ 0.037V + 2.200 kWh/day | na |
| Solid-door reach-in refrigerator, 30 ≤ V < 50 ft³ | Elec | Refrig | 0.1V + 2.04 kWh/day | Na | ≤ 0.056V + 1.635 kWh/day | na |
| Solid-door reach-in refrigerator, 50 ≤ V ft³ | Elec | Refrig | 0.1V + 2.04 kWh/day | Na | ≤ 0.060V + 1.416 kWh/day | na |
| Clothes washer | Gas | Sanitation | 1.72 MEF | Na | 2.00 MEF | na |
| Door-type dish machine, high temp | Elec | Sanitation | na | 1.0 kW | Na | 0.70 kW |
| Door-type dish machine, low temp | Elec | Sanitation | na | 0.6 kW | Na | 0.6 kW |
| Multitank rack conveyor dish machine, high temp | Elec | Sanitation | na | 2.6 kW | Na | 2.25 kW |

| | | | | | | |
|---|---|---|---|---|---|---|
| Multitank rack conveyor dish machine, low temp | Elec | Sanitation | na | 2.0 kW | Na | 2.0 kW |
| Single-tank rack conveyor dish machine, high temp | Elec | Sanitation | na | 2.0 kW | Na | 1.5 kW |
| Single-tank rack conveyor dish machine, low temp | Elec | Sanitation | na | 1.6 kW | Na | 1.5 kW |
| Undercounter dish machine, high temp | Elec | Sanitation | na | 0.9 kW | Na | 0.5 kW |
| Undercounter dish machine, low temp | Elec | Sanitation | na | 0.5 kW | Na | 0.5 kW |
| The energy efficiency, idle energy rates, and water use requirements, where applicable, are based on the following test methods:<br>ASTM F1275 Standard Test Method for Performance of Griddles<br>ASTM F1361 Standard Test Method for Performance of Open Deep Fat Fryers<br>ASTM F1484 Standard Test Methods for Performance of Steam Cookers<br>ASTM F1496 Standard Test Method for Performance of Convection Ovens<br>ASTM F1521 Standard Test Methods for Performance of Range Tops<br>ASTM F1605 Standard Test Method for Performance of Double-Sided Griddles<br>ASTM F1639 Standard Test Method for Performance of Combination Ovens<br>ASTM F1695 Standard Test Method for Performance of Underfired Broilers<br>ASTM F1696 Standard Test Method for Energy Performance of Single-Rack Hot Water Sanitizing, ASTM Door-Type Commercial Dishwashing Machines<br>ASTM F1704 Standard Test Method for Capture and Containment Performance of Commercial Kitchen Exhaust Ventilation Systems<br>ASTM F1817 Standard Test Method for Performance of Conveyor Ovens<br>ASTM F1920 Standard Test Method for Energy Performance of Rack Conveyor, Hot Water Sanitizing, Commercial Dishwashing Machines<br>ASTM F2093 Standard Test Method for Performance of Rack Ovens<br>ASTM F2140 Standard Test Method for Performance of Hot Food Holding Cabinets<br>ASTM F2144 Standard Test Method for Performance of Large Open Vat Fryers<br>ASTM F2324 Standard Test Method for Prerinse Spray Valves<br>ASTM F2380 Standard Test Method for Performance of Conveyor Toasters<br>ARI 810-2007: Performance Rating of Automatic Commercial Ice Makers | | | | | | |

ANSI/ASHRAE Standard 72–2005: Method of Testing Commercial Refrigerators and Freezers with temperature setpoints at 38°F for medium-temp refrigerators, 0°F for low-temp freezers, and -15°F for ice cream freezers

Table 1b. Commercial Kitchen Appliance Prescriptive Measures and Baseline for Energy Cost Budget (SI units)

| | Baseline energy usage for energy modeling path | | | | Levels for prescriptive path | |
|---|---|---|---|---|---|---|
| Appliance type | Fuel | Function | Baseline efficiency | Baseline idle rate | Prescriptive efficiency | Prescriptive idle rate |
| Broiler, underfired | Gas | Cooking | 30% | 50.5 kW/m² | 35% | 37.9 kW/m² |
| Combination oven, steam mode (P = pan capacity) | Elec | Cooking | 40% steam mode | 0.37P+4.5 kW | 50% steam mode | 0.133P+0.6400 kW |
| Combination oven, steam mode | Gas | Cooking | 20% steam mode | (1 210P+ 35 810)/3 412 kW | 38% steam mode | (200P+6 511)/ 3 412 kW |
| Combination oven, convection mode | Elec | Cooking | 65% convection mode | 0.1P+1.5 kW | 70% convection mode | 0.080P+0.4989 kW |
| Combination oven, convection mode | Gas | Cooking | 35% convection mode | (322P+ 13 563)/ 3412 kW | 44% convection mode | (150P+5 425)/ 3412 kW |
| Convection oven, full-size | Elec | Cooking | 65% | 2.0 kW | 71% | 1.6 kW |
| Convection oven, full-size | Gas | Cooking | 30% | 5.3 kW | 46% | 3.5 kW |
| Convection oven, half-size | Elec | Cooking | 65% | 1.5 kW | 71% | 1.0 kW |
| Conveyor oven, > 63.5 cm belt | Gas | Cooking | 20% | 20.5 kW | 42% | 16.7 kW |
| Conveyor oven, < 63.5 cm belt | Gas | Cooking | 20% | 13.2 kW | 42% | 8.5 kW |
| Fryer | Elec | Cooking | 75% | 1,05 kW | 80% | 1.0 kW |
| Fryer | Gas | Cooking | 35% | 4.1 kW | 50% | 2.64 kW |

| | | | | | | |
|---|---|---|---|---|---|---|
| Griddle (based on 90-cm model) | Elec | Cooking | 60% | 4.3 $kW/m^2$ | 70% | 3 .45 $kW/m^2$ |
| Griddle (based on 90-cm model) | Gas | Cooking | 30% | 11 $kW/m^2$ | 33% | 8.35 $kW/m^2$ |
| Hot food holding cabinets (excluding drawer warmers and heated display) 0 < V < 0.368 $m^3$ (V = volume) | Elec | Cooking | na | 1.4 $kW/m^3$ | Na | (21.5*V)/0.0283 $kW/m^3$ |
| Hot food holding cabinets (excluding drawer warmers and heated display), 0.368 ≤ V < 0.793 $m^3$ | Elec | Cooking | na | 1.4 $kW/m^3$ | Na | (2.0*V + 254)/0.0283 $kW/m^3$ |
| Hot food holding cabinets (excluding drawer warmers and heated display), 0.793 $m^3$ ≤ V | Elec | Cooking | na | 1.4 $kW/m^3$ | Na | (3.8*V + 203.5)/0.0283 $kW/m^3$ |
| Large vat fryer | Elec | Cooking | 75% | 1.35 kW | 80% | 1.1 kW |
| Large vat fryer | Gas | Cooking | 35% | 5.86 kW | 50% | 3.5 kW |
| Rack oven, double | Gas | Cooking | 30% | 19 kW | 50% | 10.25 kW |
| Rack oven, single | Gas | Cooking | 30% | 12.6 kW | 50% | 8.5 kW |
| Range | Elec | Cooking | 70% | na | 80% | na |
| Range | Gas | Cooking | 35% | na | 40% and no standing pilots | na |
| Steam cooker, | Elec | Cooking | 26% | 200 W/pan | 50% | 135 W/pan |

| | | | | | | |
|---|---|---|---|---|---|---|
| batch cooking | | | | | | |
| Steam cooker, batch cooking | Gas | Cooking | 15% | 733 W/pan | 38% | 615 W/pan |
| Steam cooker, high production or cook to order | Elec | Cooking | 26% | 330 W/pan | 50% | 275 W/pan |
| Steam cooker, high production or cook to order | Gas | Cooking | 15% | 1.47 kW/pan | 38% | 1.26 kW/pan |
| Toaster | Elec | Cooking | na | 1.8 kW average operating energy rate | Na | 1.2 kW average operating energy rate |
| Ice machine, IMH (ice making head, H = ice harvest) H ≥ 204 kg/day | Elec | Ice | 0.0015 - $5.3464E^{-07}$ kWh/kg ice | na | $\leq 13.52*H^{-0.298}$ kWh/100 kg ice | na |
| Ice machine, IMH (ice making head), H < 204 kg/day | Elec | Ice | 0.2262 - $4.18E^{-04}$ kWh/kg ice | na | $\leq 13.52*H^{-0.298}$ kWh/100 kg ice | na |
| Ice machine, RCU (remote condensing unit, w/o remote compressor) H < 454 kg/day | Elec | Ice | 0.1951 - $1.85E^{-04}$ kWh/kg ice | na | $\leq 111.5835H^{-0.258}) + 2.205$ kWh/100 kg ice | na |
| Ice machine, RCU (remote condensing unit) 726 > H ≥ 454 kg/day | Elec | Ice | 0.1124 kWh/kg ice | na | $\leq 111.5835H^{-0.258}) + 2.205$ kWh/100 kg ice | na |
| Ice machine, RCU (remote condensing unit), H ≥ 726kg/day | Elec | Ice | 0.1124 kWh/kg ice | na | ≤ -0.00024H + 4.60 kWh/100 kg ice | na |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ice machine, SCU (self-contained unit), H < 79 kg/day | Elec | Ice | 0.3968 - $2.28E^{-03}$ kWh/kg ice | na | $236.59H^{-0.326}$ +0.176 kWh/100 kg ice | na |
| Ice machine, SCU (self-contained unit), H ≥ 79 kg/day | Elec | Ice | 0.2161 kWh/kg ice | na | $236.59H^{-0.326}$ +0.176 kWh/100 kg ice | na |
| Ice machine, water-cooled ice-making head, H ≥ 651 kg/day(must be on a chilled loop) | Elec | Ice | 0.0882 kWh/kg ice | na | ≤ 8.11 kWh/100 kg ice | na |
| Ice machine, water-cooled ice-making head, 227 ≤ H < 651 kg/day (must be on a chilled loop) | Elec | Ice | 0.1230 - $5.35E^{-05}$ kWh/kg ice | na | ≤ 11.31 - 0.065H kWh/100 kg ice | na |
| Ice machine, water-cooled ice-making head, H < 227 kg/day( must be on a chilled loop) | Elec | Ice | 0.1720 - $2.67E^{-04}$ kWh/kg ice | na | ≤ 15.48 - 0.0238H kWh/100 kg ice | na |
| Ice machine, water-cooled once-through (open loop) | Elec | Ice | Banned | Banned | Banned | Banned |
| Ice machine, water cooled SCU (self-contained unit) H < 91 kg/day (must be on a chilled loop) | Elec | Ice | 0.2513 - $9.23E^{-04}$ kWh/kg ice | na | ≤ 23.37- 0.086H kWh/100 kg ice | na |
| Ice machine, water cooled SCU (self-contained unit) H ≥ 91 kg/day (must | Elec | Ice | 0.1676 kWh/kg ice | na | 15.57 kWh/100 kg ice | na |

| | | | | | | |
|---|---|---|---|---|---|---|
| be on a chilled loop) | | | | | | |
| Chest freezer, solid or glass door | Elec | Refrig | 15.90V + 0.943 kWh/day | na | 9.541V + 0.130 kWh/day | na |
| Chest refrigerator, solid or glass door | Elec | Refrig | 3.53V + 2.04 kWh/day | na | ≤ 4.417 V + 0.475 kWh/day | na |
| Glass-door reach-in freezer, 0 < V < 0.42 $m^3$ | Elec | Refrig | 26.50V + 4.1 kWh/day | na | ≤ 21.449V + 0.893 kWh/day | na |
| Glass-door reach-in freezer, 0.42 ≤ V < 0.85 $m^3$ | Elec | Refrig | 26.50V + 4.1 kWh/day | na | ≤ 25.901V – 1.00 kWh/day | na |
| Glass-door reach-in freezer, 0.85 ≤ V < 1.42 $m^3$ | Elec | Refrig | 26.50V + 4.1 kWh/day | na | ≤ 8.834V + 13.50 kWh/day | na |
| Glass-door reach-in freezer, 1.42 ≤ V $m^3$ | Elec | Refrig | 26.50V + 4.1 kWh/day | na | ≤ 15.90V + 3.50 kWh/day | na |
| Glass-door reach-in refrigerator, 0 < V < 0.42$m^3$ | Elec | Refrig | 4.24V + 3.34 kWh/day | na | ≤ 4.169V + 1.382 kWh/day | na |
| Glass-door reach-in refrigerator, 0.42 ≤ V < 0.85 $m^3$ | Elec | Refrig | 4.24V + 3.34 kWh/day | na | ≤ 4.947V + 1.050 kWh/day | na |
| Glass-door reach-in refrigerator, 0.85 ≤ V < 1.42 $m^3$ | Elec | Refrig | 4.24V + 3.34 kWh/day | na | ≤ 3.109V + 2.625 kWh/day | na |
| Glass-door reach-in refrigerator, 1.42 ≤ V $m^3$ | Elec | Refrig | 4.24V + 3.34 kWh/day | na | ≤ 3.887V + 1.500 kWh/day | na |
| Solid-door reach-in freezer, 0 < V < 0.42 $m^3$ | Elec | Refrig | 14.13V + 1.38 kWh/day | na | ≤ 8.834V + 1.25 kWh/day | na |

| | | | | | | |
|---|---|---|---|---|---|---|
| Solid-door reach-in freezer, 0.42 ≤ V < 0.85 $m^3$ | Elec | Refrig | 14.13V + 1.38 kWh/day | na | ≤ 4.819V – 1.000 kWh/day | na |
| Solid-door reach-in freezer, 0.85 ≤ V < 1.42 $m^3$ | Elec | Refrig | 14.13V + 1.38 kWh/day | na | ≤ 5.760V + 6.125 kWh/day | na |
| Solid-door reach-in freezer, 1.42 ≤ V $m^3$ | Elec | Refrig | 14.13V + 1.38 kWh/day | na | ≤ 5.583V + 6.333 kWh/day | na |
| Solid-door reach-in refrigerator, 0 < V < 0.42$m^3$ | Elec | Refrig | 3.53V + 2.04 kWh/day | na | ≤ 3.145V + 1.411 kWh/day | na |
| Solid-door reach-in refrigerator, 0.42 ≤ V < 0.85 $m^3$ | Elec | Refrig | 3.53V + 2.04 kWh/day | na | ≤ 1.307V + 2.200 kWh/day | na |
| Solid-door reach-in refrigerator, 0.85 ≤ V < 1.42 $m^3$ | Elec | Refrig | 3.53V + 2.04 kWh/day | na | ≤ 1.979V + 1.635 kWh/day | na |
| Solid-door reach-in refrigerator, 1.42 ≤ V $m^3$ | Elec | Refrig | 3.53V + 2.04 kWh/day | na | ≤ 2.120V + 1.416 kWh/day | na |
| Clothes washer | Gas | Sanitation | 1.72 MEF | | 2.00 MEF | |
| Door-type dish machine, high temp | Elec | Sanitation | na | 1.0 kW | Na | 0.70 kW |
| Door-type dish machine, low temp | Elec | Sanitation | na | 0.6 kW | Na | 0.6 kW |
| Multitank rack conveyor dish machine, high temp | Elec | Sanitation | na | 2.6 kW | Na | 2.25 kW |
| Multitank rack conveyor dish machine, low temp | Elec | Sanitation | na | 2.0 kW | Na | 2.0 kW |
| Single-tank rack | Elec | Sanitation | na | 2.0 kW | Na | 1.5 kW |

| | | | | | | |
|---|---|---|---|---|---|---|
| conveyor dish machine, high temp | | | | | | |
| Single-tank rack conveyor dish machine, low temp | Elec | Sanitation | na | 1.6 kW | Na | 1.5 kW |
| Undercounter dish machine, high temp | Elec | Sanitation | na | 0.9 kW | Na | 0.5 kW |
| Undercounter dish machine, low temp | Elec | Sanitation | na | 0.5 kW | Na | 0.5 kW |

The energy efficiency, idle energy rates, and water use requirements, where applicable, are based on the following test methods:

ASTM F1275 Standard Test Method for Performance of Griddles
ASTM F1361 Standard Test Method for Performance of Open Deep Fat Fryers
ASTM F1484 Standard Test Methods for Performance of Steam Cookers
ASTM F1496 Standard Test Method for Performance of Convection Ovens
ASTM F1521 Standard Test Methods for Performance of Range Tops
ASTM F1605 Standard Test Method for Performance of Double-Sided Griddles
ASTM F1639 Standard Test Method for Performance of Combination Ovens
ASTM F1695 Standard Test Method for Performance of Underfired Broilers
ASTM F1696 Standard Test Method for Energy Performance of Single-Rack Hot Water Sanitizing, ASTM Door-Type Commercial Dishwashing Machines
ASTM F1704 Standard Test Method for Capture and Containment Performance of Commercial Kitchen Exhaust Ventilation Systems
ASTM F1817 Standard Test Method for Performance of Conveyor Ovens
ASTM F1920 Standard Test Method for Energy Performance of Rack Conveyor, Hot Water Sanitizing, Commercial Dishwashing Machines
ASTM F2093 Standard Test Method for Performance of Rack Ovens
ASTM F2140 Standard Test Method for Performance of Hot Food Holding Cabinets
ASTM F2144 Standard Test Method for Performance of Large Open Vat Fryers
ASTM F2324 Standard Test Method for Prerinse Spray Valves
ASTM F2380 Standard Test Method for Performance of Conveyor Toasters
ARI 810-2007: Performance Rating of Automatic Commercial Ice Makers
ANSI/ASHRAE Standard 72–2005: Method of Testing Commercial Refrigerators and Freezers with temperature setpoints at 38°F (3°C) for medium temp refrigerators, -18°C for low-temp freezers, and -26°C for ice cream freezers.

Table 2. Supermarket refrigeration prescriptive measures and baseline for energy cost budget

| Item | Attribute | Prescriptive measure | Baseline for energy modeling path |
|---|---|---|---|
| Commercial Refrigerator and Freezers | Energy Use Limits | ASHRAE 90.1-2010 Addendum g. Table 6.8.1L | ASHRAE 90.1-2010 Addendum g. Table 6.8.1L |
| Commercial Refrigeration Equipment | Energy Use Limits | ASHRAE 90.1-2010 Addendum g. Table 6.8.1M | ASHRAE 90.1-2010 Addendum g. Table 6.8.1M |

Table 3. Walk-in coolers and freezers prescriptive measures and baseline for energy cost budget

| Item | Attribute | Prescriptive measure | Baseline for energy modeling path |
|---|---|---|---|
| Envelope | Freezer insulation | R-46 | R-36 |
| | Cooler insulation | R-36 | R-20 |
| | Automatic closer doors | Yes | No |
| | High-efficiency low- or no-heat reach-in doors | 40W/ft (130W/m) of door frame (low temperature), 17W/ft (55W/m) of door frame (medium temperature) | 40W/ft (130W/m) of door frame (low temperature), 17W/ft (55W/m) of door frame (medium temperature) |
| Evaporator | Evaporator fan motor and control | Shaded pole and split phase motors prohibited; use PSC or EMC motors | Constant-speed fan |
| | Hot gas defrost | No electric defrosting. | Electric defrosting |
| Condenser | Air-cooled condenser fan motor and control | Shaded pole and split phase motors prohibited; use PSC or EMC motors; add condenser fan controllers | Cycling one-speed fan |
| | Air Cooled condenser design approach | Floating head pressure controls or ambient subcooling | 10°F (-12°C) to 15°F (-9°C) dependent on suction temperature |
| Lighting | Lighting power density (W/sq.ft.) | 0.6 W/sq.ft.<br>(6.5 W/sq. meter) | 0.6 W/sq.ft.<br>(6.5 W/sq. meter) |
| Commercial Refrigerator and Freezers | Energy Use Limits | N/A | Use an Exceptional Calculation Method if attempting to take savings |
| Commercial Refrigerator and Freezers | Energy Use Limits | N/A | Use an Exceptional Calculation Method if attempting to take savings |

Table 4. Commercial kitchen ventilation prescriptive measures and baseline for energy cost budget

| Strategies | Prescriptive measure | Baseline |
| --- | --- | --- |
| Kitchen hood control | ASHRAE 90.1-2010 Section 6.5.7.1, except that Section 6.5.7.1.3 and Section 6.5.7.1.4 shall apply if the total kitchen exhaust airflow rate exceeds 2,000 cfm (960 L/s) (as opposed to 5,000 cfm (2,400 L/s) noted in the ASHRAE 90.1-2010 requirements) | ASHRAE 90.1-2010 Section 6.5.7.1 and Section G3.1.1 Exception (d) where applicable |

# Appendix 4. Base Ratios for Parking Capacity

Table 1. Base ratios for parking spaces, by building type

| Use | Size or condition | Parking Spaces |
|---|---|---|
| Arena | | 0.33/seat |
| Assisted living | | 0.35/DU |
| Boarding house, B&B, convent, and other sleeping rooms | | 1/unit or room plus 2 for owner and staff |
| Church | | 0.4/seat |
| College, university | School population:<br><br>students, faculty and staff | 0.4/school population |
| Condo, townhouse | | Use Owned Apartment ratios |
| Consumer services (including banks) | | 4.6/1,000 $ft^2$ (5.0/100 $m^2$) |
| Convention centers not in hotel, or in hotel but exceeding 50 $ft^2$ per guest room (4.65 $m^2$ per guest room) | < 25,000 $ft^2$<br><br>(2 325 $m^2$) | 30/1,000 $ft^2$ (32.29/100 $m^2$) |
| Convention centers not in hotel, or in hotel but exceeding 50 $ft^2$ per guest room (4.65 $m^2$ per guest room) | 25,000 $ft^2$ to 50,000 $ft^2$<br><br>(2 325 $m^2$ to 4 650 $m^2$) | Scaled<br><br>If x is $ft^2$, 30-[10 x (x-25,000)/25,000] spaces per 1,000 $ft^2$<br><br>If y is $m^2$ per room, 32.3-[10.8 x<br><br>(y-2325)/2325] spaces per 100 $m^2$ GLA |
| Convention centers not in hotel, or in hotel but exceeding 50 $ft^2$ per guest room (4.65 $m^2$ per guest room) | 50,000 $ft^2$ to 100,000 $ft^2$<br><br>(4 650 to 9 300 $m^2$) | Scaled<br><br>If x is $ft^2$, 20-(10 x (x-50,000)/50,000)<br><br>spaces per 1,000 $ft^2$<br><br>If y is $m^2$ per room, 10.8-[10.8 x<br><br>(y-4650)/4650] spaces per 100 $m^2$ GLA |

| | | |
|---|---|---|
| Convention centers not in hotel, or in hotel but exceeding 50 $ft^2$ per guest room (4.65 $m^2$ per guest room) | 100,000 to 250,000 $ft^2$<br><br>(9 300 to 23 225 $m^2$) | Scaled<br><br>If x is $ft^2$, 10-(4 x (x-100,000)/ 150,000) spaces per 1,000 $ft^2$<br><br>If y is $m^2$ per room, 10.8-[4.3 x<br><br>(y-9300)/13925] spaces per 100 $m^2$ GLA |
| Convention centers not in hotel, or in hotel but exceeding 50 ft per guest room (4.65 m per guest room) | More than 250,000 ft2 (23 225 m2) | 6/1,000 ft2 (6.5/100 m2) |
| Data processing, telemarketing | | 6.0/1,000 ft2 (6.5/100 m2) |
| Day care | | 0.3/licensed student |
| Dry cleaners | | Use General and Convenience Retail ratio |
| Elderly housing | | 0.5/DU |
| Elementary school | | Higher of 0.2/auditorium or gym seat, or 0.25/student |
| Fast food | With or without drive-through | 15/1,000 $ft^2$ (16/100 $m^2$) |
| Free-standing discount super store | | 5.5/1,000 $ft^2$ (5.92/100 $m^2$), including<br><br>outdoor sales areas |
| General and convenience retail | Not in shopping center | 2.75/1,000 $ft^2$ (2.96/100 $m^2$) |
| General light industrial, industrial park, and manufacturing | | 1.85/1,000 $ft^2$ (1.99/100 $m^2$) |
| Government office building | | Use Office Building radio if general office only; otherwise, parking study prepared for complex |
| Health, fitness club | | 7/1,000 $ft^2$ (7.5/100 $m^2$) |
| Heavy, hard goods, furniture store, carpet store | | 2.5/1,000 $ft^2$ (2.7/100 $m^2$) |

| | | |
|---|---|---|
| High school | | Higher of 0.3/auditorium or gym seat, or 0.3/student |
| High-turnover restaurant | No bar | 15/1,000 $ft^2$ (16/100 $m^2$) |
| High-turnover restaurant | With bar | 20/1,000 ft2 (21.5/100 m2) |
| Hospital | | 1.1/employee |
| Hotel, motel | | 1.25/room. Add 10/1,000 $ft^2$ (10.8/100 $m^2$) for lounge/restaurant. Add conference/ banquet at following rates:<br><br>1. < 20 $ft^2$/room (1.86 $m^2$/room): none<br><br>2. 20 $ft^2$/room (1.86 $m^2$/room) to 50 ft2/room (4.65 $m^2$/room): Scaled<br><br>If x is $ft^2$ per room, 30-[10 x (x-20)/30] spaces per 1,000 $ft^2$ GLA conference banquet.<br><br>If y is $m^2$ per room, 32.3-[10.8 x (y-1.86)/2.79] spaces per 100 $m^2$ GLA conference banquet<br><br>3. > 50 $ft^2$/room (4.65 $m^2$/room): 20/1,000 $ft^2$ (21.5/100 $m^2$) |
| Junior or community college | School population: students, faculty and staff | 0.25/school population |
| Live theater | | 0.4/seat |
| Medical, dental office building | Not on hospital campus | 4.5/1,000 $ft^2$ (4.8/100 $m^2$) |
| Medical, dental office building | On hospital campus | 4/1,000 $ft^2$ (4.3/100 $m^2$) |
| Mini-warehouse | | 1.75/100 units |
| Movie theater with matinee | 1 screen | 0.5/seat |
| Movie theater with matinee | 2 to 5 screens | 0.33/seat |
| Movie theater with matinee | 5 to 10 screens | 0.3/seat |

| | | |
|---|---|---|
| Movie theater with matinee | More than 10 screens | 0.27/seat |
| Nightclub | | 19/1,000 $ft^2$ (20.5/100 $m^2$) |
| Nursing home | | 0.5/bed |
| Office building | < 25,000 $ft^2$ (2 325 $m^2$) | 3.8/1,000 $ft^2$ (4.1/100 $m^2$) |
| Office building | 25,000 to 100,000 $ft^2$ (2 325 to 9 300 $m^2$) | Scaled<br><br>If x is $ft^2$, 3.8-[0.4 x (x-25,000)/ 75,000] spaces per 1,000 $ft^2$<br><br>If y is $m^2$, 4.1-[0.43 x (y-2325)/6975] spaces per 100 $m^2$ |
| Office building | 100,000 $ft^2$ (9 300 $m^2$) | 3.4/1,000 $ft^2$ (3.67/100 $m^2$) |
| Office building | 100,000 to 500,000 $ft^2$ (9 300 to<br><br>46 500 $m^2$) | Scaled<br><br>If x is $ft^2$: 3.4-[0.6 x (x-100,000)/ 400,000]<br><br>spaces per 1,000 $ft^2$<br><br>If y is $m^2$: 3.67-[0.67 x (y-9300)/<br><br>37 200] spaces per 100 $m^2$ |
| Office building | More than 500,000 $ft^2$<br><br>(more than 46 500 m2) | 2.8/1,000 $ft^2$ (3.0/100 $m^2$) |
| Other public assembly | | 0.25/person in permitted capacity where not seated, or 0.3/seat where seated |
| Owned accessory dwelling unit | | 1/Accessory DU. Den must be counted as bedroom if it has closet. Ratios include 0.15 space per unit for visitors. |
| Owned apartment | Efficiency | 1/DU for efficiency units. Den must be counted as bedroom if it has closet. Ratios include 0.15 space per unit for visitors. |
| Owned apartment | With bedroom | 1.75/DU for first bedroom plus 0.25 space for each additional bedroom. |

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| | | Den must be counted as bedroom if it has closet. Ratios include 0.15 space per unit for visitors. |
| Pharmacy | With or without drive-through | Use General and Convenience Retail ratio |
| Pro baseball stadium | | 0.35/seat |
| Pro football stadium | | 0.31/seat |
| Quality restaurant | | 20/1,000 $ft^2$ (21.5/100 $m^2$) |
| Rental apartment | Efficiency | 1/DU for efficiency units. Den must be counted as bedroom if it has closet. Ratios include 0.15 space per unit for visitors. |
| Rental apartment | With bedroom | 1.5/DU for first bedroom plus 0.25 space for each additional bedroom. Den must be counted as bedroom if it has closet. Ratios include 0.15 space per unit for visitors. |
| Rental apartment | In college or university housing district | 1/DU for efficiency and 1-bedroom units plus 0.5 space for each additional bedroom. Den must be counted as bedroom if it has closet. Ratios include 0.15 space per unit for visitors. |
| Shopping center, not more than 10% GLA in nonretail uses | < 400,000 $ft^2$ (37 200 $m^2$) GLA | 4/1,000 $ft^2$ (4.3/100 $m^2$) |
| Shopping center, not more than 10% GLA in nonretail uses | 400,000 to 600,000 $ft^2$<br><br>(37 200 $m^2$ to 55 750 $m^2$) GLA | Scaled:<br><br>If x is $ft^2$, 4+[0.5 x (x-400,000)/ 200,000] spaces per 1,000 $ft^2$<br><br>If y is $m^2$, 4.3+[0.5 x (y-37 200)/<br><br>18 550] spaces per 100 $m^2$ |
| Shopping center, not more than 10% GLA in nonretail uses | More than 600,000 $ft^2$<br><br>(55 750 $m^2$) GLA | 4.5/1,000 $ft^2$ (4.8/100 $m^2$) |

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| Shopping center, more than 10% GLA in other uses | | Shared parking analysis |
| Single-family detached residential | < 2000 $ft^2$ (186 $m^2$) | 1/DU |
| Single-family detached residential | 2,000 to 3,000 $ft^2$ (186 to 279 $m^2$) | 2/DU |
| Single-family detached residential | More than 3,000 $ft^2$ (280 $m^2$) | 3/DU |
| Specialty super stores, home improvement | | 4.5/1,000 $ft^2$ (4.8/100 $m^2$), including outdoor sales areas |
| Supermarket, convenience market | | 6.75/1,000 $ft^2$ (7.3/100 $m^2$) |
| Video rental | | Use General and Convenience Retail ratio |
| Warehousing | | 0.67/1,000 $ft^2$ (0.72/100 $m^2$) |

DU = dwelling unit

GLA = gross leasable area

Adapted from PCC Recommended Zoning Ordinance Provisions (2006), by Parking Consultants Council (PCC), National Parking Association, published by Institute of Transportation Engineers, Transportation Planning Handbook, 3rd edition.

# Appendix 5. Detailed Summary of Changes

**Changes from LEED v4**

| **INTEGRATIVE PROCESS** | | |
|---|---|---|
| Prerequisite | Integrative Project Planning and Design | - None |
| Credit | Integrative Process | - Updated documentation from worksheet to project team letter<br>- Introduced new topics for analysis including assessment for resilience, , social equity, and health & well-being |

| **LOCATION AND TRANSPORTATION** | | |
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| Credit | LEED for Neighborhood Development Location | - None |
| Credit | Sensitive Land Protection | - Options 1 and 2 are now titled “Previously Developed Land” and “Avoidance of Sensitive Land”, respectively<br>- “Minor improvements within wetland buffers” language was moved from the rating system language to the guide |
| Credit | High-Priority Site | - Title changed to High Priority Site and Equitable Development<br>- Removed Option 1, Historic District<br>- Restructured credit with Option 1, Priority Site (1 point) and Option 2, Equity and Community Benefits (1 point)<br>- Under Option 1, added Path 1, Economically Disadvantaged Community Location and Path 2, Brownfield Remediation<br>- Under Option 2, added Path 1, Equity and Community Benefits and Path 2, Affordable Housing |
| Credit | Surrounding Density and Diverse Uses | - Added Data Centers to Warehouse and Distribution Centers pathway<br>- Added Option 3, Walkable Location<br>- Under Option 1 for Schools, added Path 2, Connected Site |
| Credit | Access to Quality Transit | - Added intermediate thresholds at 2 and 4 points<br>- Added 3 point threshold for Schools |

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| | | • Reduced lowest weekend minimum from 40 to 30 trips<br>• Allowed projects to only count the weekend day with the higher number of trips rather than an average (i.e. Saturday for most U.S. projects)<br>• Removed language about circular routes<br>• Moved language about overlapping trips paragraph/express service for inclusion in the Reference Guide<br>•<br>• Added Path 2, Project-sponsored transit |
| Credit | Bicycle Facilities | • Long-term bicycle storage for residential projects revised to a requirement of 15% of regular building occupants rather than 30%<br>• Allowed on-site bicycle sharing stations to count for 50% of the long-term and short-term bicycle storage space for all projects<br>• Included language from a LEED Interpretation about showers for projects with a high occupancy count<br>• Extended the distance to short-term storage to 200ft (60m) and long-term storage to 300ft (90m)<br>• Allowed indoor storage as long as it meets the distance requirement. Exempted vertical distance travelled by elevator from walking distance requirements.<br>• For Schools, required connection to 50% dwelling units in attendance boundary or bus rapid transit station, passenger rail station or ferry terminal. Required 1 ½ mile bicycling distance for grades 8 and below, 3-mile for grades 9 up.<br>• Increased the time allowed for completion of planned bicycle network from one year to three years |
| Credit | Reduced Parking Footprint | • Removed Case 1 and 2<br>• Required 30% parking reduction for all projects<br>• Updated to 4th edition of ITE Parking Generation standard<br>• Removed carpool preferred parking requirement<br>• Added new Options: Option 1. Reduce Parking, Option 2. Carshare, and Option 3. Unbundling Parking. For documentation of Option 2, required projects to show legal agreement between carshare company and project |

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| Credit | Green Vehicles | - Changed credit title to reflect focus on electric vehicles (EVs)<br>- Removed preferred parking requirements<br>- Removed Option 2. Liquid, gas, or battery facilities and replaced with Option 2. Electric Vehicle Charging Infrastructure (EV Ready)<br>- Removed Option 1. Green Passenger Vehicles and replaced with Option 1. Electric Vehicle Charging for school projects. Added Option 2. Electric Vehicle Charging Infrastructure.<br>- Schools Option 3. now requires at least 1 electric bus and 50% electric non-bus vehicles. ACEEE standard has been removed but encouraged as a reference in the guide<br>- Changed Option 1. to Electric Vehicle Charging for warehouse and distribution center projects |
| **SUSTAINABLE SITES** | | |
| Prerequisite | Construction Activity Pollution Prevention | - Updated CGP standard to 2017 |
| Prerequisite | Environmental Site Assessment | - Updated ASTM standard to E1527-13 |
| Credit | Site Assessment | - Added “impervious and pervious surfaces” to “Hydrology” section<br>- Removed TR-55 requirement<br>- Required description of project’s ecoregion from EPA Level III Ecoregion (or local equivalent) |
| Credit | Site Development – Protect or Restore Habitat | - Changed title of credit to only “Protect or Restore Habitat”<br>- Changed thresholds from 30% to 25% and 15% restoration of previously disturbed area<br>- Added new vegetation section<br>- Removed Option 2. Financial Support<br>- Streamlined soils section |
| Credit | Open Space | - Clarified 25% vegetated space vs. 30% total outdoor space requirement<br>- Removed 1.5 FAR requirement for green roofs |
| Credit | Rainwater Management | - Added new percentile reduction thresholds – 80th, 85th, 90th percentile<br>- Added requirement to treat run-off from pollution generating hard surfaces with LID |

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| | | Eliminated the use of "manage" and replaced with "retain (i.e. infiltrate, evapotranspirate, or collect and reuse)"<br>Eliminated Option 2 and Option 3<br>Added a requirement for zero-lot-line (ZLL) projects to retain 70% minimum percentile storm event via infiltrating LID/GI practice. For Path 2, 75%. Path 3, 80%. Added new definition for ZLL.<br>Allowed excess drainage offsite for ZLL projects if appropriate (built to accommodate project)<br>Prohibited detention unless included within holistic LID system |
| Credit | Heat Island Reduction | Required credit calculations for Option 2. Parking Under Cover to include off-street parking<br>Added language referencing new ANSI/CRRC S100 standard for Cool Roof Rating Council's "Rapid Ratings"<br>Roof area that consists of functional, usable spaces may meet the requirements of nonroof measures |
| Credit | Light Pollution Reduction | None |
| Credit | Site Master Plan | None |
| Credit | Tenant Design and Construction Guidelines | None |
| Credit | Places of Respite | Defined "monoculture" |
| Credit | Direct Exterior Access | None |
| Credit | Joint Use of Facilities | None |
| **WATER EFFICIENCY** | | |
| Prerequisite | Outdoor Water Use Reduction | None |
| Prerequisite | Indoor Water Use Reduction | Permitted international projects to calculate water consumption of flow fixtures and fittings at the local standard supply pressure<br>Updated performance standard for commercial clothes washers<br>Identified EU A label for residential appliances as acceptable alternative to ENERGY STAR |

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| Prerequisite | Building-Level Water Metering | ▸ None |
| Credit | Outdoor Water Use Reduction | ▸ Increased points available for Core and Shell projects: 3 total |
| Credit | Indoor Water Use Reduction | ▸ Reduced points available for Core and Shell projects: 4 total<br>▸ Permitted future infrastructure for reclaimed water systems to count in calculations if future systems meet specified requirements |
| Credit | Cooling Tower Water Use | ▸ Updated name: Optimize Process Water Use<br>▸ Updated points available for Core and Shell projects: 3 total<br>▸ Updated requirements to earn 2 points under Option 1: increase max. cycles achieved for 1 point by 25%<br>▸ New Option 2 Optimize Water Use for Cooling (former pilot ACP 94)<br>▸ New Option 3 Process Water Use rewards teams for using recycled alternative water for process uses |
| Credit | Water Metering | ▸ None |
| **ENERGY & ATMOSPHERE** | | |
| Prerequisite | Fundamental Commissioning and Verification | ▸ Updated Cx referenced standard to ASHRAE Guideline 0-2013<br>▸ Updated BECx referenced standard to ASTM E2947-16: Standard Guide for Building Enclosure Commissioning |
| Prerequisite | Minimum Energy Performance | ▸ Updated standard to ASHRAE 90.1-2016<br>▸ Permitted compliance using cost or GHG emissions<br>▸ Permitted on-site renewables for compliance |
| Prerequisite | Building-Level Energy Metering | ▸ None |
| Prerequisite | Fundamental Refrigerant Management | ▸ Hydro-chlorofluorocarbon (HCFC) based refrigerants also prohibited |
| Credit | Enhanced Commissioning | ▸ Commissioning Authority criteria expanded<br>▸ See Prerequisite Fundamental Commissioning and Verification. |
| Credit | Optimize Energy Performance | ▸ See Prerequisite Minimum Energy Performance. |

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| | | ‣ Option 1. Energy Performance Compliance: Two metrics based on GHG emissions and cost, with updated thresholds increasing stringency<br>o On-site renewables permitted for cost and GHG emissions metrics<br>o New off-site renewables permitted for GHG emissions metric using hourly GHG factors where available<br>‣ Option 2. Advanced Energy Design Guide: Added AEDG for Grocery Stores and revised options for CS<br>‣ New Option 3. Systems Optimization: Up to 4 points for demonstrated improvement in building systems: Interior and Exterior Lighting; Daylight controls; Building envelope; HVAC and service water heating equipment efficiency; and Equipment and appliances<br>‣ Option 4. New option for data centers |
| Credit | Advanced Energy Metering | ‣ None |
| Credit | Demand Response | ‣ Credit renamed to Grid Harmonization<br>‣ New requirement to include DR program and technologies in building systems manual<br>‣ Case 2 eligibility no longer contingent on availability of Demand Response program<br>‣ Added additional requirements for projects not pursuing EA credit Enhanced Commissioning<br>‣ New Case 3. Load Flexibility and Management Strategies include Peak Load Optimization and On-site thermal and/or electricity storage (1-2 points) |
| Credit | Renewable Energy Production | ‣ Combined with EA credit Green Power and Carbon Offsets into new EA credit Renewable Energy<br>‣ Allowed more off-site renewables to contribute to compliance<br>‣ Created incentives that reward more impactful investment in renewable energy |
| Credit | Enhanced Refrigerant Management | ‣ Added a requirement to comply with ASHRAE Standard 15-2019: Safety Standard for Refrigeration Systems, as applicable to the project scope<br>‣ Added a requirement for development and implementation of a refrigerant management plan |

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| Credit | Green Power and Carbon Offsets | - Combined with EA credit Renewable Energy Production into new EA credit Renewable Energy |
| **MATERIALS & RESOURCES** | | |
| Prerequisite | Storage and Collection of Recyclables | - None |
| Prerequisite | Construction and Demolition Waste Management Planning | - Removed the prerequisite and made it part of the credit: Construction and Demolition Waste Management |
| Prerequisite | PBT Source Reduction – Mercury | - None |
| Credit | Building Life-Cycle Impact Reduction | - Option 1, 2 & 3: Combined into a single new Option 1: Building and Material Reuse. The credit option has 2 pathways.<br>- Reintroduced pathways from v2009 MRc1.1 and MRc1.2 building re-use credits with slightly modified thresholds to make documentation of reuse simpler.<br>- Option 4: Now called Option 2: Whole Building Life cycle assessment<br>  - Added two additional entry pathways to existing WBLCA requirements for 1 and 2 points.<br>  - Kept the same requirements for earning 3 points by conducting a WBLCA and demonstrating 10% reductions from baseline.<br>- Added a fourth pathway to demonstrate embodied carbon impact reductions by incorporating building re-use and/or salvage materials into WBLCA for 4 points.<br>- Now allows project to pursue Option 1 (Building & Material Reuse) and/or Option 2 (WBLCA). |
| Credit | Building Product Disclosure and Optimization – Environmental Product Declarations | - Option 1: Environmental Product Declaration<br>  - Partial weightings for product contributions in Option 1 removed and all options worth "1 full product".<br>  - Reduced number of products requirement (10 from three manufacturers) for BD&C- CS and BD&C- Warehouses and Distribution Centers.<br>  - Third-party verified EPDs worth 1.5 products.<br>- Option 2: Embodied Carbon/LCA Optimization |

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| | | ▸ Removed the cost requirement pathway.<br>▸ Added  pathway based on number of products rather than cost.<br>▸ Added additional onboarding pathways for EPDs ), starting with manufacturer action plan; followed by tiers of comparative EPD analysis of increasing reductions.<br>▸ All optimization pathways require a narrative that explains how life cycle optimization is or will be achieved. |
| Credit | Building Product Disclosure and Optimization – Sourcing of Raw Materials | ▸ Option 1: Raw Material Sourcing and Extraction Reporting<br>  ▸ Moved entire Option 1 to pilot credit library.<br>  ▸ Point transferred to Option 2.<br>▸ Option 2: Leadership Extraction Practices<br>  ▸ Modify cost threshold from 25% to 15% from three manufacturers for 1 point.<br>  ▸ Add additional cost threshold of 30% from five manufacturers for 2 points.<br>  ▸ Added additional lower tier valuation (50% of cost) to bio-based material pathway.<br>  ▸ Increased valuation of material re-use pathway from 100% to 200% of cost |
| Credit | Building Product Disclosure and Optimization – Material Ingredients | ▸ Option 1: Material Ingredient Reporting:<br>  ▸ Reduced number of products requirement (10 products from three manufacturers) for BD&C- CS and BD&C- Warehouses and Distribution Centers.<br>  ▸ Added new programs to the list of eligible disclosure reports.<br>  ▸ Clarified guidance for manufacturer self-inventories.<br>  ▸ Third-party verified disclosure reports are now worth 1.5 products.<br>▸ Option 2: Material Ingredient Optimization<br>  ▸ Removed the cost requirement pathway.<br>  ▸ Added pathway based on number of products.<br>  ▸ Added two additional onboarding pathways (similar to EPD Option 2), starting with manufacturer action plan to conduct a material ingredient assessment for hazard; followed by tiers to encourage third party validated inventory and assessments for optimized products. |

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<tr><td></td><td></td><td><ul><li><ul><li>Added additional programs and clarified REACH international alternative compliance pathway.</li></ul></li><li>Option 3: Supply Chain Optimization<ul><li>Removed this option.</li></ul></li></ul></td></tr>
<tr><td>Credit</td><td>PBT Source Reduction – Mercury</td><td><ul><li>None</li></ul></td></tr>
<tr><td>Credit</td><td>PBT Source Reduction – Lead, Cadmium, and Copper</td><td><ul><li>None</li></ul></td></tr>
<tr><td>Credit</td><td>Furniture and Medical Furnishings</td><td><ul><li>Option 1 and Option 2: None</li><li>Option 3: Multi-attribute Assessment of Products</li><li>Aligned rating system requirements for EPD and sourcing attributes to modified requirements in MR credits Environmental Product Declarations and Responsible Sourcing of Raw Materials credits.</li></ul></td></tr>
<tr><td>Credit</td><td>Design for Flexibility</td><td><ul><li>None</li></ul></td></tr>
<tr><td>Credit</td><td>Construction and Demolition Waste Management</td><td><ul><li>Option 1: Diversion<ul><li>Simplified diversion to 50%, not including ADC for up to 1 point.</li><li>Removed the material streams documentation.</li><li>Third party verification of recycling rates is optional for Exemplary Performance.</li></ul></li><li>Option 2: Reduction of total waste material<ul><li>The credit now includes requirements for developing a Waste Management Plan (formerly was a prerequisite).</li><li>Updated the threshold for total generated waste to be more consistent with LEED project generation rates. Now worth 2 points.</li><li>Clarified that waste generation target only applies to new construction waste. Clarified that any demolition or renovation waste must be 50% diverted or more but does not count against total generated waste target.</li></ul></li></ul></td></tr>
<tr><td colspan="3">INDOOR ENVIRONMENTAL QUALITY</td></tr>
<tr><td>Prerequisite</td><td>Minimum Indoor Air Quality Performance</td><td><ul><li>Updated referenced standard from ASHRAE 62.1-2010 to 62.1-2016</li><li>Moved Option 2 (option for projects outside of the U.S.) to a regional ACP, and updated referenced standards from EN 15251-2007</li></ul></td></tr>
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| | | to ISO 17772-2017and EN 13779-2007 to EN 16798-3: 2017<br>- Revised credit language to clarify specific sections from 62.1-2016 that are required<br>- For naturally ventilated spaces, reorganized credit language to clarify compliance options, including new option for projects located in historic buildings<br>- Revised requirements for outdoor air monitoring. Monitors are not required for small systems and requirements for constant-volume systems are now more specific.<br>- Revised residential requirements to align with LEED v4.1 multifamily requirements for combustion venting and radon-resistant construction<br>- Revised healthcare credit requirements to align with NC<br>- Updated referenced standard from ASHRAE 170-2008 and FGI 2010 to ASHRAE 170-2017 |
| Prerequisite | Environmental Tobacco Smoke Control | - Added definition for smoking<br>- Clarified 25 feet code exception<br>- Revised requirements for communicating the no-smoking policy: no-smoking signage or other means of enforcement are allowed and signage location is no longer required to be within 10 feet of the building entrances<br>- Revised requirements for residential spaces to align with LEED v4.1 multifamily requirements for EQ prerequisite Environmental tobacco smoke control and EQ prerequisite Compartmentalization |
| Prerequisite | Minimum Acoustic Performance | - U ASHRAE and AHRI references for HVAC background noise have been removed to emphasize ANSI Standard S12.60-2010, Part 1.<br>- Updated reverberation time requirements from standard Construction Technology Update No. 51 to new table based on UK Department for Education performance standard Building Bulletin 93. |
| Credit | Enhanced Indoor Air Quality Strategies | - Updated referenced standards from ASHRAE 52.2-2010 to ASHRAE 52.2-2017,<br>- EN 779-2002 to ISO 16890-2016, and ASHRAE 62.1-2010 to ASHRAE 62.1-2016<br>- Restructured credit from Option 1 and Option 2 to a list of 10 strategies. |

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| | | New strategies are included for (1) filtration of recirculated air, (2) increased ventilation at 15% above prerequisite levels, and (3) operable windows. |
| Credit | Low-Emitting Materials | Restructured credit: deleted option 2, credit achievement is based on # of compliant product categories<br>Revised thresholds for each product category (ranging from 75-100%)<br>Revised product categories- split category for ceilings, walls, thermal, and acoustic insulation into three product categories: (1) ceilings (2) wall panels and (3) insulation<br>Revised terminology for low-emitting criteria ("General emissions evaluation" to "VOC emissions evaluation", "VOC content requirements for wet applied products" to "VOC content evaluation", "Composite wood evaluation" to "Formaldehyde emissions evaluation", "furniture evaluation" to "furniture emissions evaluation", and formalized inherently non-emitting sources and salvaged and reused materials as compliance criteria rather than exceptions/exclusions.)<br>Updated referenced standard for CDPH standard method v1.1 to CDPH standard method v1.2<br>Moved  international requirements. to regional ACPs and for VOC emissions, revised referenced standard for testing from AgBB 2010 to CEN TS 15616 and VOC limits from AgBB 2010 to AgBB 2018 and clarified international requirement for formaldehyde limit of 10 micrograms per cubic meter<br>Updated referenced standard for SCAQMD Rule 1113 from June 3, 2011 to February 5, 2015 date<br>Updated referenced standard for SCAQMD Rule 1168 from July 1, 2005 to October 6, 2017 date<br>Added referenced standard for adhesives and sealants: TRGS 610 (January 2011)<br>Added referenced standards for composite wood: EPA TSCA Title VI, EN 717-1-2014, and structural composite wood industry standards<br>Updated referenced standard for ANSI/BIFMA M7.1-2011 to ANSI/BIFMA M7.1-2011(R2016)<br>Updated referenced standard for ANSI/BIFMA e3-2011 to ANSI/BIFMA e3- |

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| | | 2014e and ANSI/BIFMA e3-2019 (updated version)<br>▸ Added exemplary option for furniture emissions evaluation if ANSI/BIFMA e3-2014e section 7.6.3 is met in addition to section 7.6.2<br>▸ Removed HC and schools requirements for exterior applied products. Requirements will be moved to a new pilot credit. |
| Credit | Construction Indoor Air Quality Management Plan | ▸ Updated referenced standard from ASHRAE 52.2-2010 to ASHRAE 52.2-2017<br>▸ Updated referenced standard from EN 779-2002 to ISO 16890-2016<br>▸ Changed tobacco product prohibition to smoking prohibition and included definition for smoking<br>▸ Changed smoking prohibition to include any smoking building openings (not just entrances)<br>▸ Updated referenced standard from FGI 2010 to FGI 2018 |
| Credit | Indoor Air Quality Assessment | ▸ Revised requirements for option 2. Air testing, Added 1 point option for testing particulate matter and inorganic gases and 1 point option for testing volatile organic compounds<br>▸ Removed concentration limit for TVOC. TVOC value is required to be determined and used as screening approach- future investigation needed if 500 µg/m3 is exceeded<br>▸ Revised approach for particulate matter to ISO clean room standard for concentration limits and particle monitor devices for the test methods (from concentration limits based on U.S. EPA NAAQS and gravimetric test methods)<br>▸ Revised concentration limit for ozone to align with latest U.S. EPA NAAQS<br>▸ Added and revised allowed test methods<br>▸ Reduced list of individual VOCs to be included in testing<br>▸ Lowered concentration limit for formaldehyde<br>▸ Added exemplary performance option for projects that test for full list of VOCs from CDPH SM v1.2-2017 |
| Credit | Thermal Comfort | ▸ Updated referenced standard from ASHRAE 55-2010 to ASHRAE 55-2017 |

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| | | • Updated referenced standard for ASHRAE Applications Handbook 2011 edition to 2015 edition<br>• Updated referenced standard from EN 15251 to ISO 17772-2017 |
| Credit | Interior Lighting | • Removed strategies for lamp life, direct overhead lighting, and surface illumination ratio.<br>• Decreased the threshold for light fixture luminance from 2,500 candela per square meter (cd/m2) to 7,000 cd/m2 and added Unified Glare Rating as a new option.<br>• Increased the threshold for Color rendering index from CRI of 80 to CRI of 90 and added Color Fidelity Index as a new option.<br>• Strategy for lighting control has been simplified to a single requirement for dimmable or multilevel lighting in regularly occupied spaces.<br>• Combined surface reflectance requirements and decreased thresholds from 85% for ceilings and 60% for walls to 80% for ceilings and 55% for walls. Requirements for floors are removed<br>• Revised requirements for healthcare to only address lighting controls (removed shading requirement) with and lowered the threshold to 75%. |
| Credit | Daylight | • Revised Option 1, ASE is required to be calculated but removed specific 10% threshold<br>• Revised thresholds and points for Options 1, 2, and 3<br>• Revised Option 1 to require sDA to be calculated for each individual space in addition to average sDA for all regularly occupied floor area<br>• Clarified healthcare requirements only apply to regularly occupied spaces in the perimeter area<br>• Added reference to IES LM-83-12 for sDA and ASE<br>• Added exceptions for 3000 lux value if view-preserving automatic (with manual override) glare-control devices are used<br>• Removed glare control devices requirement for tenant spaces in core and shell projects. |
| Credit | Quality Views | • Added criteria for glazing characteristics.<br>• Updated criteria for view content from criteria for view access. |

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| | | ‣ Clarified requirements for healthcare. |
| Credit | Acoustic Performance | ‣ Revised to allow for two of 3 criteria for 1 point<br>‣ Updated referenced standard from 2011 AHSRAE Handbook—HVAC Applications to 2015 ASHRAE Handbook—HVAC Applications<br>‣ Added additional option for sound measurements: IEC 61672-1:2013<br>‣ Added NIC option for sound transmission<br>‣ Revised sound transmission table: added NIC option for compliance, revised adjacency combinations and associated STCc ratings<br>‣ Added option for using reduced STCc ratings or NIC values if sound masking is used<br>‣ Deleted sound reinforcement and sound masking requirements<br>‣ Revised reverberation time table<br>‣ Updated referenced standards for Healthcare from FGI 2010 to FGI 2018 |
| **INNOVATION** | | |
| Credit | Innovation | ‣ Added reference to the Innovation Catalog<br>‣ Added clarification in Reference Guide that pilot ACPs may substitute for pilot credits in requirement for full five points |
| Credit | LEED Accredited Professional | ‣ None |
| **REGIONAL PRIORITY** | | |
| Credit | Regional Priority | ‣ None |