LEED v4.1 BUILDING DESIGN AND CONSTRUCTION

Getting started guide for beta participants

July 2019

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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!

Highlights of LEED v4.1 BD+C

Integrative Process	• The credit has a more balanced approach for project teams to understand, improve, and document both the process and outcomes of integrated design through a new documentation approach of a project team letter. • Project teams have greater flexibility to tell the story of their integrative process and earn more points for exemplary performance for new areas of interdisciplinary analysis at the frontier of green building, including social equity and public health. Projects can also demonstrate their thoughtful site selection decisions.
Location and Transportation	• Reduced Parking Footprint recognizes variations in consumer behavior; preferred parking requirements are removed and three new credit options are added that reward projects for no off-street parking, providing carshare parking, or unbundling parking. • Green Vehicles is renamed Electric Vehicles; the credit now refers to electric vehicles only and offers a new option rewarding the installation of electric vehicle infrastructure. • Bicycle Facilities requirements better accommodate diverse project-types; storage requirements are more representative of common site conditions and differing shower amounts were added for large-occupancy projects.
Sustainable Sites	• Protect or Restore Habitat is more accessible for projects with a reduced restoration threshold, new soil and vegetation guidance, and lowered financial requirements. • Rainwater Management requirements are more applicable and achievable; the credit features a reduced minimum percentile storm events and more guidance for zero-lot-line projects.

	• Site Assessment is more relevant to international project teams; the US specific TR-55 standard is no longer required.
Water Efficiency	• Updates to Indoor Water Use Reduction recognize variations in standard supply pressure across the globe and the European product labeling program. • Cooling Tower and Process Water Use requirements are adjusted to be more relevant and achievable for projects; two new credit options incorporate a previous pilot credit and reward the use of alternative recycled water to meet process water demand. • Core and Shell only: Points are re-allocated from Indoor Water Use Reduction to Outdoor Water Use Reduction and Cooling Tower and Process Water Use to better align with Core and Shell scope of work.
Energy and Atmosphere	• The referenced standard for energy performance is updated to ASHRAE 90.1-2016; projects are now required to demonstrate performance against two metrics: cost and greenhouse gas emissions. • Optimize Energy Performance includes a new prescriptive option for individual systems optimization in BD+C. • Renewable Energy Production and Green Power and Carbon Offsets are combined into a new credit, Renewable Energy, to better address diverse methods of renewables procurement and evolving global renewables markets. • Demand Response is updated to Grid Harmonization to recognize role of buildings in supporting grid-scale de-carbonization; the new credit option rewards technologies and strategies for building load flexibility and management.
Materials and Resources	• To encourage greater uptake of all Materials and Resources credits, additional credit pathways and updated credit achievement thresholds are introduced for several credits, including Building Life-Cycle Impact Reduction and Building Product Disclosure and Optimization (BPDO) credits. • The credit category fine-tunes requirements with revised credit achievement thresholds to acknowledge variations for different project types and scopes of work. These updates include revised thresholds for number of products, cost and manufacturers in BPDO credits for smaller and/or less material intensive projects and project types such as Warehouses and Core and Shell to make credits more achievable. • The Construction and Demolition Waste credit is revised for challenging project sites and features updated total waste reduction thresholds. • Greater emphasis and weighting is given to embodied carbon reductions through building reuse, salvage, whole building LCA, and EPDs.
Indoor Environmental Quality	• The calculation methodology in the Low-Emitting Materials credit is restructured to be more straightforward and organized around product categories. The compliance thresholds have also been adjusted. • The air quality testing option for Indoor Air Quality Assessment has been revised with two testing pathways and a small list of required contaminants. • The entry points for both the Daylight and Acoustic Performance credits are lowered to encourage more projects to consider daylight and acoustic performance during design. Both credits also give more flexibility to the designer to appropriately address important design considerations: including excessive sunlight (for daylight) and sound transmission between spaces (for acoustics).

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	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	Cooling Tower 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	Construction and Demolition Waste Management Planning	P	P	P	P	P	P	P	P
Prerequisite	PBT Source Reduction – Mercury								P
Credit	Building Life-Cycle Impact Reduction	5	6	5	5	5	5	5	5
Credit	Building Product Disclosure and Optimization – EPD	2	2	2	2	2	2	2	2
Credit	Building Product Disclosure and Optimization – Sourcing of Raw Materials	2	2	2	2	2	2	2	2
Credit	Building Product Disclosure and Optimization – 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 Cooling Tower 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	Cooling Tower and 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 the LEED v4 PDF form as usual for the credit.
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.

More Stringent Code Requirements

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 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:

Energy-Related Systems

Establish an energy performance target 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.

AND

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.

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 delta, 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 social equity and public health.

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:

Required Documentation

- Project Team Letter

Exemplary Performance

Project teams may choose an additional lens through which to demonstrate the outcomes and benefits of an integrative process for an Exemplary Performance point. Optional issue areas to carry out analysis relevant to the project include: site selection, social equity, health & well-being, or another topic not yet addressed.

Site Selection

Before site selection, analyze project goals to identify and select the building site or base building that will provide the most opportunities and fewest barriers for project. Assess at least two potential locations or base building options, taking into consideration at least the following:

- *Building site attributes.* Assess the building's location and site design characteristics.

- *Transportation.* Assess the tenant occupants' transportation needs for commuting to and from the site, including convenient access to alternative transportation that meets occupants' needs.

- *Occupant and community well-being.* Assess the building's ability to provide daylight and views, indoor air quality, and other indoor environmental quality characteristics. Identify community assets and the proximity of vulnerable populations surrounding the project. Assess the project's ability to provide positive social, economic, and environmental benefits for existing community members, as well as any potential negative impacts.

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.

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 avoid the development of environmentally sensitive lands 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 and community health of the surrounding area.

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 and 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

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

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 4. 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 5. A factor of 28% is applied to adjusted target income as the recommended maximum percentage of income that households should spend on homeownership.

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 promote walkability, and transportation efficiency and reduce vehicle distance traveled. To improve public health by encouraging daily physical activity.

Requirements

NC, CS, SCHOOLS, 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 only
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.

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.

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

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.

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.

Further Explanation

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.

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

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 if the service is also made available to the public.

Table 1. Minimum daily 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.

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.

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.

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.

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 one year 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.

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.

RETAIL

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.

HEALTHCARE

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:

Core and Shell

Refer to Appendix 2, Default Occupancy Counts, for occupancy count requirements and guidance.

Retail

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.

Historic Urban Locations

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 effect 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 Off-Street Parking (1 point)

Do not provide off-street parking.

OR

Option 2. 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 recommended by the Parking Consultants Council, as shown in the Institute of Transportation Engineers' Transportation Planning Handbook, 4th edition, Table 11-12.

OR

Option 3. Carshare (1 point)

Provide dedicated parking for carshare vehicles. Provide at least one vehicle parking space for every 100 occupants, rounded up. If the project has fewer than 100 occupants, provide one carshare vehicle parking space.

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

OR

Option 4. Unbundling Parking (1 point)

Sell parking separately from all property sales or leases.

Implement a daily parking fee at a cost equal to or greater than the daily 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 2. Reduce Parking.
- Disregard any references related to carpool preferred parking.
- Disregard any references to Cases 1 and 2.
- Refer to 4th edition of the ITE standard 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 Off-street 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 3. 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 1. No Off-street Parking, the project team must provide calculations to demonstrate a 100% reduction from the baseline and local requirement. In other words, a project team must provide evidence in their documentation that the local requirement and the base ratio (applied to their project space type) in the ITE Parking Generation Manual, 5th edition are not zero.
- For Option 3. 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 4. Unbundling Parking, provide documentation that shows the project will implement a daily parking fee at a cost equal to or greater than the daily 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.

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 Charging (1 point)

Install *electrical vehicle supply equipment (EVSE)* in 2% 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.
- 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.
- Be *vehicle-to-grid (V2G)* connected (e.g. ISO 15118 compliant) and 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 Charging Infrastructure (1 point)

Make 6% of parking spaces or at least 6 spaces, whichever is greater, *EV Ready*.

To be *EV Ready,* meet all of the following:

- Install listed raceway capable of accommodating a 208/240-volt dedicated branch circuit.
- The raceway shall not be less than trade size 1 (nominal 1-inch inside diameter).
- The raceway shall originate at the main service or subpanel and shall terminate into a listed cabinet, box or enclosure in close proximity to the proposed location of the EV space.
- The service panel and/or subpanel shall provide capacity to install a 40-ampere minimum dedicated branch circuit and space(s) reserved to permit installation of a branch circuit overcurrent protective device.

Multiple Panel Spaces required:

- When multiple charging spaces are required, raceway(s) is/are required to be installed at the time of construction.

- The raceway(s) shall originate at a service panel or subpanel(s) serving the area, and shall terminate in close proximity to the proposed location of the charging equipment into listed cabinet(s), box(es), enclosure(s) or equivalent.
- Construction documents shall indicate raceway termination point and proposed location of future EV spaces and EV chargers. Construction documents shall also provide information on amperage of future EVSE, raceway method(s), wiring schematics and electrical load calculations to verify electrical panel service capacity and electrical system, including any on-site distribution transformer(s), have sufficient capacity to simultaneously charge all EVs at all required EV spaces at full rated amperage of the EVSE
- Plan design shall be based upon a 40-ampere minimum branch circuit.
- Electrical calculations shall substantiate the design of the electrical system, to include the rating of equipment and any on-site distribution transformers and have sufficient capacity to simultaneously charge all required EVs at its full rated amperage.
- The service panel or subpanel(s) shall have sufficient capacity to accommodate the required number of dedicated branch circuit(s) for the future installation of the EVSE.

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.

WAREHOUSES & DISTRIBUTION CENTERS

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 to limit truck idling at the dock.

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

- ISO 15118, Road vehicles - Vehicle to grid communication interface

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).
- vehicle-to-grid (V2G) a system in which electric vehicles communicate with an electric distribution grid to provide demand response services by allowing electricity to flow to and from the grid or by curbing the vehicle's charge rate.

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.

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

SCHOOLS, HEALTHCARE

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 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

Option 1. On-Site Restoration (2 points except Healthcare, 1 point Healthcare)

Using native or adapted vegetation, restore 25% (including the building footprint) of all portions of the site identified as previously disturbed. Vegetated roof surfaces may be included if the plants are native or adapted and provide habitat.

Soils

Restore all soils on site that have been disturbed or replace all soils removed by current construction activities that will later serve as the final vegetated area.

- Restore or replace soils to a minimum depth of 12 inches (30.48 centimeters) or depth of root ball for larger plant materials.
- Provide a soils test of imported soils that includes recommended amendments. Incorporate test recommended amendments prior to planting.
- Imported soils must be reused for functions comparable to their original function.
- Imported soils may not include the following:
  - 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; or
  - soils from other *greenfield* sites
  - sphagnum peat moss

Vegetation

Use only plant species that are appropriate for the project's EPA Level III ecoregion and that are suitable for site conditions, climate, and design intent. Both native and adapted vegetation may qualify. Native grasses may be used in conjunction with a variety (two or more) of native or adapted vegetation species.

- Use only plant species not currently listed as invasive on any federal or qualifying regional lists.
- Protect the root zone of trees found on site. Planting within the one foot (0.30 meter) radius per inch (2.54 centimeters) Diameter Breast Height (DBH) should be avoided.
- Conserve endangered species.

Schools only:
Dedicated athletic fields that are solely for athletic uses are exempted from the soil restoration criteria. These areas may not count toward the minimum required area.

OR
Option 2. Financial Support (1 point)
Provide financial support equivalent to at least $0.20 per square foot (US$2 per square meter) for the total site area (including the building footprint).

Financial support must be provided to a conservation land trust or accredited conservation organization within the same EPA Level III ecoregion or the project's state (or within 100 miles of the project [160 kilometers] for projects outside the U.S.). For U.S. projects, the land trust must be accredited by the Land Trust Alliance.

For projects outside of the U.S., the conservation land trust must either be a project supported by The Nature Conservancy or World Land Trust.

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. For instance, the percent of the site that must be restored has been reduced from 30% to 25%, Option 2. Financial Support now requires spending only 20 cents (USD) per square foot, and a vegetation section has been added to more explicitly address issues concerning species habitat. Soils requirements have been streamlined and require a simple test of any imported soil. For international projects pursuing Option 2. Financial Support, the credit now recognizes global options for ensuring the quality of conservation land trusts receiving funds, including support from The Nature Conservancy or World Land Trust.

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

- Option 1. On-site Restoration:
  - Verify that at least 25%, rather than 30%, of previously disturbed areas will be restored.
  - Soil tests are only required for imported soils, not soils in situ.
  - Native grasses may be used in conjunction with a variety (two or more) of native or adapted vegetation species.
- Option 2. Financial Support:
  - Determine the amount of financial support by replacing all instances of $0.40/ft^2 with $0.20/ft^2 and $4/m^2 with $2/m^2 in the equations.

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, 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.
- Either intensive or extensive vegetated roofs can be applied to the credit if the applicant demonstrates that the proposed native or adapted plants provide habitat supporting endemic wildlife populations of the site region with a diversity of species. Examples of vegetated roof habitat benefits to be provided include wildlife nesting, cover, respite, and food sources.

- Soil Restoration:
  - Disregard Table 2. Soil restoration guidelines.
    1. Restore or replace soils to a minimum depth of 12 inches (30.48 centimeters) or depth of root ball for larger plant materials.
    2. Test the imported soils and incorporate test recommended amendments.
  - Specialized engineered soil media may be required for other applications including athletic fields, vegetated roofs, infiltration raingardens, green walls, trees in a paving, bioswales, green vehicle easements, steep slopes, food gardens and constructed wetlands.
  - Take samples of imported soils and send them to a laboratory for testing and analysis for horticultural suitability, fertility and physical characteristics. Local government agencies may offer inexpensive testing of soil samples and guidance around sampling procedures and topsoil suppliers may offer standardized testing of their products.
  - Soil sample test results must include the components listed in Table 3 and should include amendment recommendations impacting infiltration rates based on the horticultural needs of designed restoration vegetation.
  - Table 3. Soil sample test result components should also include the following:
    - Physical aspects:
      USDA Soil Classification
      % Gravel
      % Sand
      % Silt
      Estimated infiltration rate (metric per hour)

Required Documentation

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

- Soil test analysis results with recommended amendments to be provided; provide documentation of amendments.
- Projects outside the US: Confirmation that conservation project is supported by The Nature Conservancy or World Land Trust.
- Projects outside U.S.: Verification that conservation organization is nationally or locally recognized; description of qualifications and mission of conservation organization

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
- **The Nature Conservancy**: https://www.nature.org
- **World Land Trust**: https://www.worldlandtrust.org/
- **United Nations Environment Programme, List of accredited environmental organizations:** https://www.unenvironment.org/civil-society-engagement/accreditation/list-accredited-organizations
- **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

Exemplary Performance

- Option 1. Double the 25% restoration requirement (restore at least 50%).
- Option 2. Double the financial donation requirement (provide at least $0.40 per square foot or $4.00 per square meter).

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).

25% of the minimum 30% total outdoor space requirement must be 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:

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

Extensive or intensive vegetated roofs that are physically accessible can be used toward the minimum 25% 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, and 25% of the minimum 30% total outdoor space requirement must be vegetated. 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.

Requirements

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

Treat run-off from pollutant-generating impervious surfaces (i.e. vehicle pavement, service courts, trash enclosures) using *low-impact development (LID)* practice.

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

In a manner best replicating *natural site hydrology* processes, retain (i.e. infiltrate, evapotranspirate, or collect and reuse) *on site* the runoff from the developed site for, at minimum, the 80th percentile of regional or local rainfall events 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.

For all projects, the use of coal tar sealants shall be prohibited in any application exposed to stormwater, wash waters, condensates, irrigation water, snowmelt, or icemelt.

Examples of acceptable techniques include the following:

- planting rain gardens with *native* or *adapted* plant material (e.g. trees 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 100% of the runoff from at minimum, the 80th percentile of regional or local rainfall events.

A combination of LID approaches are recommended (but not required) as they are holistic measures which maximize benefits. In contrast to LID, conventional stormwater techniques include grey infrastructure, such as detention or retention ponds, pipes, and vaults. Conventional grey infrastructure devices may be accepted only if integrated within a holistic LID system (i.e. a combination of LID techniques).

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.

Table 1. Points for percentile of rainfall retained

Percentile of Rainfall Retained	Points	Points Healthcare
80th Percentile	1	1
85th Percentile	2	2
90th Percentile	3	-

Zero Lot Line projects only (1-3 points except Healthcare, 1-2 points Healthcare)
The following requirement applies to zero lot line projects in urban areas with a minimum density of 1.5 FAR. Treat run-off from pollutant-generating impervious surfaces (i.e. vehicle pavement, service courts, trash enclosures) using low-impact development (LID) practice/green infrastructure (GI) (or a traditional stormwater treatment device if LID/GI is not feasible for lack of space). Any above-ground setback area must be designed and used as a pedestrian-oriented space (e.g. restaurant seating, outdoor displays, private vendors, or related public purpose).

In a manner best replicating natural site hydrology processes, retain on site the runoff from the developed site for, at minimum, the 70th percentile of regional or local rainfall events, using LID/GI. Points are awarded according to Table 2.

Table 2. Points for percentile of rainfall retained on Zero Lot Line projects

Percentile of Rainfall Retained	Points	Points Healthcare
70th Percentile	1	1
75th Percentile	2	2
80th Percentile	3	-

If the Zero Lot Line project meets the credit requirements and achieves at least the minimum percentile threshold of rainfall retained, additional volume can be retained offsite so long as the LID/GI system is designed to accommodate use by the project.

Guidance

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

Behind the Intent

Beta Update

To make this credit more achievable, 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.

Requirements for zero-lot-line (ZLL) projects have also been reduced. To ensure clarity, a more refined definition for ZLL 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.

Step-by-Step Guidance

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

- Option 2 is no longer available for this credit. Follow guidance for Option 1 in LEED v4 for direction on how to achieve the credit in LEED v4.1.
- 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.

Further Explanation

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

- Green Infrastructure and Low-Impact Development Strategies: 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: Projects following the zero lot line path should refer to the new v4.1 definition of "zero lot line project" to confirm the status of the project. A slightly more set-back above-grade footprint is only acceptable as zero lot line if the setback space above-ground is dedicated for pedestrian use and the below-grade (i.e. a parking garage or lower level area) perimeter aligns with the overall LEED property boundary. In other words, the above area that is set back can still be considered zero lot line if the below area meets the property line and the above area is dedicated for pedestrian use.

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"

Definitions

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

- **evapotranspiration** the combination of evaporation and plant transpiration into the atmosphere. Evaporation occurs when liquid water from soil, plant surfaces, or water bodies becomes vapor. Transpiration is the movement of water through a plant and the subsequent loss of water vapor.
- **rainwater infiltration** a natural hydrological process by which rainwater flows into and through subsurface soil and other porous materials.
- **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.
- **capture (rainwater) and reuse** rainwater that has been captured and treated for reuse.
- **Zero Lot Line project** a project whose building footprint, exclusive of any required setbacks or easements (such as rights-of-way), rests directly on, or nearly aligns with, the LEED project boundary on multiple sides and covers at least 90% of the total site area.

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 effects on microclimates and human 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 a three-year aged SRI of at least 32 (if three-year 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:
  - Equation 2, within the "summed for all high-reflectance roof areas" portion, replace 'Required SR' in the denominator with 'Required SRI'.

- 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/m^2 (nits) during nighttime hours and 2000 cd/m^2 (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:

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, 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 and staff with the health benefits associated with direct access to the natural environment.

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 meet the requirements for outdoor air contaminant concentrations enumerated in EQ Credit Enhanced Indoor Air Quality Strategies, Option 2 and 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 water consumption.

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 water consumption.

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; the supply pressure must be consistent in the baseline and proposed case.

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 • makeup water meters • conductivity controllers and overflow alarms • 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

Healthcare, Retail, Schools, and Hospitality Only

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 OR Provide thermal recovery heat exchanger that cools drained discharge water below code-required maximum discharge temperatures while simultaneously preheating inlet makeup water OR 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 addition:

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.
- 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 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 water consumption.

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 water consumption.

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/panincluding 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 For 48-inch sterilizer, 7.5 gal/U.S. tray	For 1520-mm sterilizer, 28.5 liters/DIN tray 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 Cooling Tower and 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.

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: Cooling Tower and 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 water used for mechanical processes and cooling tower makeup while controlling microbes, corrosion, and scale in the condenser water system.

Requirements

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

Option 1. Cooling Tower Water Use (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 $CaCO_3$)	1000 ppm
Total alkalinity	1000 ppm
SiO_2	100 ppm
Cl^-	250 ppm
Conductivity	2000 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.

Table 2. Points for cooling tower cycles

Cooling tower cycles	*Points (all except CS)*	*Points (CS)*
Maximum number of cycles achieved without exceeding any filtration 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 OR 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 OR 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 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. No Cooling Tower (2 points)

For projects without cooling towers or evaporative condensers, projects may earn full credit if all conditions are met:

- the baseline system designated for the building using ASHRAE 90.1-2016 Appendix G Table G3.1.1 includes a cooling tower (systems 7 & 8)
- the project design case does not include a cooling tower
- the design case mechanical system does not use the latent heat of the evaporative cooling of water.
- the project does not receive any cooling from a District cooling system

All other system types are ineligible for credit.

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 water use. Eligible subsystems may include:

- Boilers
- Humidification systems

- Other subsystems using process water

Projects whose cooling is provided by district cooling systems are eligible to achieve Option 3 if the district cooling 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

In some climate zones, efficient systems design can eliminate the need for a cooling tower by decreasing the water intensity of the building cooling process.

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 Cooling Tower and 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 2. No Cooling Tower

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 include a cooling tower.

Step 2. Develop building cooling systems design.
Consider viable on-site alternatives to water-cooled systems for the building and the impacts of cooling systems design on building energy use.

Projects receiving thermal energy from District Cooling Systems may not pursue Option 2.

Step 3. Document compliance.
Demonstrate that building mechanical systems design eliminates the need for a cooling tower or other system that uses the latent heat of the evaporative cooling of water.

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 building water use.

- 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 water 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.

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 is designated as systems 7 or 8 under ASHRAE 90.1-2016 Appendix G Table G3.1.1			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

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 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, or 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.

Project teams that intend to pursue EA Credit Enhanced Commissioning should note a difference in the CxA qualifications: for the credit, the CxA may not be an employee of the design or construction firm nor a subcontractor to the construction firm.

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.

Data Centers only

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

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 reduce the environmental and economic harms of excessive energy use 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.

For projects using Normative Appendix G *Performance Rating Method:*

- Greenhouse gas emissions: The total greenhouse gas emissions, 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.

  US and Canada:
  - use U.S. Environmental Protection Agency's (EPA) regional grid mix coefficients to calculate GHG emissions by energy source; or
  - use hourly emissions profiles from U.S. Environmental Protection Agency's (EPA) AVoided Emissions and geneRation Tool (AVERT)

  International:
  - use national grid mix coefficients from the International Energy Agency CO2 Emissions from Fuel Combustion 2017 report to calculate GHG emissions by energy source
  - ISO 52000-1:2017: Greenhouse gas emission factors for each building energy source shall be determined consistently with ISO Standard 52000-1:2017 and published for the country or region where the project is located

- Exception to Mandatory Measures requirements: For ASHRAE 90.1-2016 mandatory controls provisions that are quantified in the Appendix G *Performance Rating Method*, (e.g. lighting occupancy sensor controls, lighting daylighting controls, automated receptacle controls, etc.), projects may model the *Proposed Building Performance* control parameters identically to the

Baseline Building Performance control parameters 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 minimum ASHRAE Standard 90.1-2016 performance requirements.

Guidance

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

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 Option 1: Energy Performance Compliance, identify whether the mandatory provisions have been quantified in the Appendix G Performance Rating Method (e.g. lighting occupancy sensor controls, lighting daylighting controls, automated receptacle controls, etc.). For mandatory measures where Appendix G provides a methodology for demonstrating savings between the Baseline Building Performance (BBP) and the Proposed Building Performance (PBP), projects may model the Proposed

Building Performance control parameters identically to the Baseline Building Performance control parameters in lieu of compliance with the mandatory provisions.

Step 3. Identify energy use target for building

This step is required for all projects pursuing credit under EA credit Optimize Energy Performance, 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 EA credit Optimize Energy Performance, 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 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. 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 also 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.

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 (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 *Common Issues with Energy Modeling*).
- Energy costs and greenhouse gas emissions offset by on-site or on-campus renewable energy systems count towards energy savings for compliance with the prerequisite when these systems are included on the building permit or on a master site permit including the building for a contiguous campus consistent with ASHRAE Standard 90.1-2016 Section G2.4.1 requirements. ASHRAE 90.1-2016 defines on-site renewable energy as "energy generated from renewable sources produced at the building site", which includes on-site photovoltaics systems, wind generators, or thermal or electric generation from biofuel sourced from the project or campus site, but does not include electric generation or thermal generation from off-site renewable sources.
- Energy costs and greenhouse gas emissions offset by 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 the related credit, but may not be included in the model for prerequisite compliance.

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 Energy 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 (see *Further Explanation, Finalizing the Energy Models*).

Compare the proposed model with the baseline model to determine the anticipated energy cost and greenhouse gas emissions savings (see *Further Explanation, Energy Savings*). Either 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

$PCI_t = [BBUEC + (BPF \times BBREC)] / BBP$

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*)

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.

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, 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 or cost savings for the project, which can help gauge progress toward an energy savings 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 (see *Further Explanation, Energy Modeling Process Overview).* 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 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 expands on the Appendix G requirements.

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 schools and 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, assure 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.

Finalizing the Energy Models

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

- Replace all instances of ASHRAE 90.1-2010 with ASHRAE 90.1-2016
- 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.

Schedules

Refer to the LEED v4 reference guide.

Energy Savings

For EA prerequisite Minimum Energy Performance and EA credit Optimize Energy Performance, modeled energy savings must be reported on an energy cost basis using actual utility rates, and on a greenhouse gas emissions basis using approved coefficients.

Ensure that utility rates and emissions factors are applied consistently between the baseline building performance and proposed building performance models for each energy source, as well as for any applicable renewable energy calculations in EA prerequisite Minimum Energy Performance, EA credit Optimize Energy Performance, and EA credit Renewable Energy.

Energy Cost

Using energy cost savings as a metric for overall building energy efficiency is important for several reasons. It aligns with the energy modeling procedures in ASHRAE 90.1–2016, Appendix G, and provides a uniform metric for all fuel types. 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. And finally, the energy cost savings metric can help designers understand energy consumption because in many cases, cost and environmental impacts of each fuel source are correlated.

For prerequisite compliance on-site renewable energy that complies with ASHRAE 90.1-2016 requirements may be modeled as "free" in the Proposed energy model. Per ASHRAE 90.1-2016, to qualify as an on-site system, the renewable energy must be generated on-site from renewable sources produced at the building, and the system must be part of the project scope of work. For LEED, projects that are in the scope of work for a contiguous campus development that includes the LEED project, and are generated on the campus from on-site renewable resources produced at the campus may also be modeled as on-site renewable system. 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 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.

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.

Projects in the U.S. and Canada may use the U.S. Environmental Protection Agency's (EPA) regional grid mix coefficients to calculate GHG electricity emissions. For a more granular picture of greenhouse gas emissions reduced as a result of building efficiency, renewables procurement, and demand response or grid harmonization strategies, projects are encouraged to use hourly electricity emissions profiles in energy model runs. The U.S. Environmental Protection Agency's AVoided Emissions and geneRation Tool (AVERT) provides hourly electricity emissions data for 10 grid regions in the U.S. based on historical patterns of actual generation. To use hourly greenhouse gas emissions, multiply the hourly modeled electric energy consumption by the hourly emissions coefficient, and sum the total annual greenhouse gas emissions for the energy source. 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 non-electric sources in the U.S., the current U.S. EPA coefficients shall be used to calculate GHG emissions by energy source.

International projects may use national coefficients from the International Energy Agency CO2 Emissions from Fuel Combustion 2017 report to calculate GHG emissions by energy source, or determine greenhouse gas emissions factors for each building energy source based on ISO 52000-1:2017 Energy Performance of Buildings. USGBC may accept hourly emissions data for local grid regions, where available, on a case by case basis.

For projects that are using biofuels to generate electricity or heat within the building, contact USGBC to discuss the appropriate method for deriving Greenhouse Gas Emission factors.

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, new off-site renewable energy may also be modeled for credit.

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

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. *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
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. 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. 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). Building Performance Factors represent the ratio of regulated energy cost for a 90.1-2016 versus a 90.1-2004 compliant building.

	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. 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. 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.
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)	Further clarity is provided for identifying the order of priority for determining the Baseline HVAC system types applicable for the building. Additional HVAC system type categorizations added for public assembly, retail buildings up to two floors, hospitals, computer rooms. 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.

	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.
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. 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. 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 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

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

- Refer to Appendix 3. Table 1 for energy consumption values of equipment and refrigeration.

Data Centers

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

If claiming no credit for an upstream district energy system, apply ASHRAE 90.1-2016 requirements, which stipulate that each thermal energy source serving the building shall be modeled as purchased energy, with identical utility rates modeled in the baseline and proposed case. For the GHG emissions metric, use the GHG emissions factors for the relevant energy source.

If claiming credit for an upstream district energy system, contact USGBC to discuss the applicable modeling approach.

International Tips

Option 1. Energy Performance Compliance

Canada: Use the emissions factors 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).

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 stratospheric ozone depletion.

Requirements

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

Do not use chlorofluorocarbon (CFC)-based refrigerants in new heating, ventilating, air-conditioning, and refrigeration (HVAC&R) systems. When reusing existing HVAC&R equipment, complete a comprehensive CFC 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

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 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, or a disinterested subcontractor of the design team.

Option 1. Enhanced Systems Commissioning (3-4 points)

Path 1: Enhanced Commissioning (3 points)

Complete the following commissioning process (CxP) 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 process (CxP) 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.

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.

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. For each energy source serving the building, the GHG emission factors must be identical for the Baseline and Proposed building models.

LEED points are calculated based on the project percent improvement PCI below the PCI_t using metrics of cost and GHG emissions. Total points have been divided equally between the metrics of energy cost and greenhouse gas emissions. Points are awarded according to Table 1 and Table 2.

For project percent improvement for the cost metric, on-site renewable energy may be subtracted from proposed energy cost prior to calculating proposed building performance per ASHRAE Standard 90.1-2016 Section G 2.4.1.

Table 1. Points for percentage improvement in energy performance – % Cost PCI below PCI_t (1-9 points NC and CS, 1-8 points Schools, 1-10 points Healthcare)

New	Points BD+C	Points	Points Schools

Construction	Healthcare, Major Renovation, CS	(except Schools, Healthcare)*	Healthcare	
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	

*BD+C projects except Data Centers with unregulated energy cost exceeding 50% of the total proposed building energy cost, 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.

On-site renewable energy may be subtracted from proposed greenhouse gas emissions prior to calculating proposed building performance per ASHRAE Standard 90.1-2016 Section G 2.4.1. New off-site renewable energy as defined in EA credit Renewable Energy may be subtracted from proposed greenhouse gas emissions prior to calculating proposed building performance.

Table 2. Points for percentage improvement in energy performance – % 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
	100%		EP	

*BD+C projects except Data Centers with unregulated energy cost exceeding 50% of the total proposed building energy cost, 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.

Retail only

For all process loads, define a clear baseline for comparison with the proposed improvements. The baselines in Appendix 3, Tables 1–4, represent industry standards and may be used without additional documentation. Calculate the baseline and design as follows:

- *Appliances and equipment.* For appliances and equipment not covered in Tables 1–4, 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.

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). CS: Minimum 20% of building area must have a complete lighting design.
- *Plug loads,* including equipment and controls (2 points, 0 points CS)
- *HVAC Systems and Controls (*2 points, 1 point CS). CS scope of work must include at least 20% of the building's projected cooling capacity, heating capacity, and fan volume.

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). CS: Minimum 20% of building area must have a complete lighting design

- *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). CS scope of work must include at least 20% of the building's projected cooling capacity, heating capacity, and fan volume)

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). CS: Minimum 20% of building area must have a complete lighting design
- *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. CS scope of work must include at least 20% of the building's projected cooling capacity, heating capacity, and fan volume)

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. CS scope of work must include at least 20% of the building's projected cooling capacity, heating capacity, and fan volume)

Option 3. Systems Optimization (1-4 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: Interior and Exterior Lighting; Daylight controls; Building envelope; HVAC and service water heating equipment efficiency; and Equipment and appliances. Each three strategies selected earns 1 point (*For Core & Shell lighting and HVAC efficiency measures, the project scope of work must include a complete design for at least 20% of the building area to qualify).*

- *Interior and Exterior Lighting:*
  - 15% lighting power reduction
  - 30% lighting power reduction
  - 45% lighting power reduction

- *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).
  - 35%
  - 70%

- *Building envelope:*
  - Climate Zones 1 – 2:

        - 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:
        - 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:
        - 15%
        - 30%
        - 45%
    - Improvement in efficiency for at least 75% of the combined cooling, heating, and service water heating capacity
        - 10%
        - 20%
        - 30%
    - *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:
- 20%
- 40%
- 60%
- 80%
- 100%

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

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 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.

For Table 1:

Percent Cost PCI below PCI_t = 1-PCI/PCI_t

For Table 2:

Calculate PCI and PCIt using metrics of greenhouse gas emissions instead of cost.

Percent GHG Emissions PCI below PCI_t = 1-PCI/PCI_t

If a project consists of Major Renovation or Healthcare and New Construction, use Equation 1 to determine the appropriate percentage improvement target from Table 1 or Table 2 (points for percentage improvement in energy performance).

Equation 1. Target energy savings for additions to existing buildings

> Target percentage = {(existing floor area / total floor area) x target percentage of savings for Major Renovation or Healthcare} + {(new floor area / total floor area) x target percentage of savings for New Construction}

Applying Renewable Energy Savings

Only projects pursuing Option 1 of this credit may count savings from renewable energy systems.

ASHRAE 90.1-2016

For both the metrics of cost and greenhouse gas emissions, calculate the total amount of energy generated by the on-site system and convert this value into the equivalent cost or greenhouse gas emissions offset using the same utility rates and/or Greenhouse gas emission coefficients per energy source used for purchased energy (see *Further Explanation, Equivalent Cost of Renewable Energy*). Calculate the equivalent cost or greenhouse gas emissions offset directly in the energy model through the simulation software, or subtract it from the final energy cost savings calculation.

For the metric of greenhouse gas emissions, projects may also subtract GHG emissions offset by new off-site renewable energy as defined in EA credit Renewable Energy from proposed greenhouse gas emissions prior to calculating proposed building performance. For off-site renewable systems with zero carbon emissions (such as photovoltaic systems, wind turbines, or passive solar thermal energy systems, calculate the total amount of energy generated by the system and convert this value into equivalent greenhouse gas emissions using the same national or regional grid emissions factors used for the fuel replaced by the renewable energy system; use hourly grid emissions factors where available. Apply the equivalent greenhouse gas emissions directly to the energy model through the simulation software, or subtract it from the final greenhouse gas emissions savings calculation.

Equivalent Cost of Renewable Energy

The equivalent cost of the usable energy system can be calculated in two ways, virtual rate or actual utility tariff plus demand rates.

Virtual rate. The project team may use the virtual energy rate determined by the proposed 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 rate plus demand. 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 may use those rates but 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.

For renewable energy sources priced on a basis other than per unit of energy, the project team must account for all the costs associated with the source, such as delivery costs and annual fees. For example, a project that uses heat generated from geothermal steam needs to account for all the equipment, maintenance, and labor costs associated with the geothermal system throughout the year.

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 55% savings in the cost metric, achieve 100% savings in the greenhouse gas emissions metric, or use actual utility rates 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: • 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 • 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 prerequisite 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 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 with communications and ability for the building automation system to accept an external price or control 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 for a maximum of up to two points. All projects must install interval recording meters with communications and the ability for the building automation system to accept an external price 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 (1 point)
- Flexible Operating Scenarios: demonstrate that strategy moves at least 10% of peak load by a time period of 2 hours (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)
- Grid resilience technologies: project served by utilities with resilience programs in place, which leverage strategies such as islanding and part-load operation, automatically achieve this credit (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, 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 Program Not Available

Refer to the LEED v4 reference guide.

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. Use the U.S. Environmental Protection Agency's AVoided Emissions and geneRation Tool (AVERT) provides 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 more of the strategies identified during step 2.

Eligible strategies include peak load optimization, or reducing on-peak load by at least 10% compared to peak electrical demand, or flexible operating scenarios, where a building moves at least 10% of its peak load by a time period of 2 hours. Additionally, the project may install 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.

If a project is served by a utility with a resilience program in place that leverages strategies such as islanding or part-load operation, the project can automatically earn 1 point under this credit by providing documentation of the utility resilience program in place.

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

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 increase building resilience.

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 grid resilience program or 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 and earn at least 1 point under Case 3 by implementing an eligible load flexibility and management strategy.

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 and carbon mitigation projects.

Requirements

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

Use on-site renewable energy systems, procure renewable energy from offsite sources, or offset the greenhouse gas emissions from 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
- Tier 2: Off-site renewable energy produced by a generation asset(s) built within the last 5 years, or contracted to be operational within one year of building occupancy, and generated by either:
  - an asset(s) in the project's grid subregion
    or
  - an asset(s) in a grid subregion with higher greenhouse gas emissions rates**
- Tier 3: Off-site renewable energy that is produced by a generation asset(s) built within the last 5 years or contracted to be operational within one year of building occupancy
- Tier 4: Off-site renewable energy that is Green-e Energy certified or equivalent
- Tier 5: Off-site renewable energy that is produced by a generation asset(s) that meet Green-e's certification criteria (or equivalent) for eligible renewables, has a mechanism to prevent double counting in place, and is third-party certified to an ecolabel standard.

***Grid subregions with average emissions rates that are higher than the national average emissions rate OR subregions with average marginal emissions rates that are higher than the national average marginal emissions rate.*

For all tiers, renewable energy must be contracted, owned or leased for a period of time between 1 and 15 years. Contract lengths less than 15 years are pro-rated linearly based on 1 and 15 year values in Table 1. Shorter contract lengths may require procurement of renewable energy in quantities that exceed the annual energy use of the building. For all tiers, the attributes (age, grid subregion, etc.) of the generation asset(s) are assessed at the beginning of the contract, and the generation asset(s) retain these attributes for the duration of the initial contract or lease term.

All eligible renewable electricity generation used to comply with this credit shall be substantiated through Energy Attribute Certificates (EACs); the project owner must contract for renewable energy and demonstrate that the EACs are retained on behalf of the LEED project.

EACs must be purchased from renewable energy projects located in the same country or region where the LEED project is located.

Tier 1, Tier 2, and Tier 3 renewable energy may contribute to GHG reductions in EA credit Optimize Energy Performance. When claiming credit in EA credit Optimize Energy Performance, projects are required to calculate GHG emissions and avoided emissions using hourly electricity GHG emissions factors for the project's grid subregion.

Points are awarded according to Table 1, based on the percentage of total site energy use.

Table 1. Points for Renewable Energy Procurement

Points	Tier 1	Tier 2		Tier 3		Tier 4		Tier 5	
		15-Year	1-Year	15-Year	1-Year	15-Year	1-Year	15-Year	1-Year
1	2%	20%	150%	30%	225%	40%	300%	50%	375%
2	5%	30%	225%	40%	300%	60%	450%	75%	562.5%
3	10%	40%	300%	50%	375%	80%	600%		
4	20%	50%	375%	60%	450%				
5	40%	60%	450%	70%	525%				
EP	60%	70%	525%	80%	600%	100%	750%	100%	750%

AND/OR

Carbon Offsets

Procure carbon offsets to offset annual building greenhouse gas emissions from energy use.

Carbon offsets must be contracted for at least 15 years.

Points are awarded according to Table 2, based on the percentage of total annual energy emissions offset by the purchase of carbon offsets.

Table 2. Points for Carbon Offsets Procurement

Points	Green-e Climate certified or equivalent Carbon Offsets
1	100%
2	200%

Guidance

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

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 translates 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 energy attribute certificates (EACs) 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, development of new renewables, and real carbon emissions reductions, 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 Procurement options*)

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 and facilitate further control of building energy costs,
- 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.
- 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.

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 for offsetting annual building greenhouse gas emissions specified in the credit language.
To establish the target renewable energy system size for the project, estimate the annual greenhouse gas emissions for the project.

Projects that use the Energy Performance Compliance Path to achieve EA Credit Optimize Energy Performance (Option 1) must base annual greenhouse gas emissions on the whole-building simulation results for the Proposed Building Performance model (see *Further Explanation, Example 1*).

Projects that use the prescriptive path to achieve EA Prerequisite Minimum Energy Performance must use the U.S. Department of Energy's Commercial Buildings Energy Consumption Survey (CBECS) data to estimate annual energy use (see *Further Explanation, Example 2*).

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, EAcs, and/or carbon offsets. Assure that the contract is signed by both parties, and that the contract terms confirm all credit requirements. For on-site and off-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.

Further Explanation

Calculations

Total building annual greenhouse gas emissions

Use Equation 1 to estimate the total building annual greenhouse gas emissions. Projects that use whole-building simulation to comply with EA Credit Optimize Energy Performance must use the results of the model in this calculation. Projects that use the prescriptive path to achieve EA Credit Optimize Energy Performance (Option 2 or 3) must use the U.S. Department of Energy's Commercial Buildings Energy Consumption Survey (CBECS) data to estimate annual energy use.

Equation 1: Total annual greenhouse gas emissions

$$CO2e_T = \sum_i \mathrm{EnergySource_i} \times \mathrm{CO2eCoeff}_i$$

Where:

- $CO2e_T$ is the total building annual greenhouse gas emissions before accounting for renewable resources
- $\mathrm{EnergySource_i}$ is the annual energy consumption of each energy source serving the project (e.g. kWh/year Electricity or therms/year of Natural Gas)

- $CO2eCoeff_i$ is the CO_2 equivalent emissions coefficient per unit of energy generated, consistent with the coefficients from EA Prerequisite Minimum Energy Performance (e.g. metric tons of CO_{2e} per kWh for regional grid electricity, or metric tons of CO2e per therm of natural gas)

Use Equation 2 to estimate the annual greenhouse gas emissions offset by renewable energy for on-site and off-site renewables with zero carbon emissions. Apply the equation separately to calculate greenhouse gas emissions offset for on-site renewable energy, new off-site renewable energy, existing off-site renewable energy, green-e certified EACs and carbon off-sites, and other EACs and carbon offsets as applicable:

Equation 2: Annual greenhouse gas emissions offset by renewable energy, EACs, and carbon offsets

$$CO2e_R = \sum_i \text{RenewableSource}_i \times \text{CO2eCoeff}_i$$

Where:

- $CO2e_R$ is the annual greenhouse gas emissions offset by renewable energy
- RenewableSource_i is the annual energy offset by each renewable source serving the project (e.g. kWh/year Electricity)
- $CO2eCoeff_i$ is the CO_2 equivalent emissions coefficient per unit of energy generated for the energy source replaced by the renewable energy, consistent with the coefficients from EA Prerequisite Minimum Energy Performance (e.g. metric tons of CO_{2e} per kWh for regional grid electricity, or metric tons of CO2e per therm of natural gas)

For renewable energy systems with some carbon emissions (such as biofuel), contact USGBC to discuss the calculation methodology.

Use Equation 3 to estimate the annual percentage greenhouse gas emissions offset through renewables. Apply the equation separately to calculate percentage greenhouse gas emissions offset for on-site renewable energy, new off-site renewable energy, and existing off-site renewable energy as applicable.

Equation 3. Percentage greenhouse gas emissions offset through renewables

% greenhouse gas emissions offset through renewables = $CO2e_R$ / $CO2e_T$

Equation 4. Percent emission reduction from EACs and Carbon Offsets

$CO2e_{R,EACs}$/($CO2e_T$ – $CO2e_{R,Onsite}$ – $CO2e_{R,NewOffsite}$ – $CO2e_{R,ExistingOffsite}$)

For projects with a contract length of less than fifteen years, use Equation 5 to prorate the annual renewable energy purchase, annual EAc purchase, and/or carbon offset purchase:

Equation 5: Proration of off-site renewables, EACs, and Carbon Offsets

Equivalent Annual Purchase Amount = Annual Purchase Amount x Contract Length / 15

For bulk purchase, length of contract should be entered as 1 year.

Sum of points from multiple procurement sources

Using Table 1. add up the applicable points from equation 2, for on-site renewables and new and existing off-site renewables; and equation 4 for EACs and carbon offsets (either Green-e or other), for a

total not to exceed 5 points plus 1 additional exemplary performance point if 100% of emissions are offset using on-site renewable sources.

Renewable Energy Considerations

The renewable energy credit seeks to increase overall demand for renewable energy and the use of grid-source renewable energy and carbon mitigation 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) and/or carbon offsets

The U.S. EPA's Guide to Purchasing Green Power provides additional information on the process of and strategies for procuring renewable energy.

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.

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. 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).

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 LEED construction phase project submission to qualify for on-site renewable energy generation credit.

New Off-Site Renewables

New off-site renewables are defined as those that have come online within the last year or contracted for the building project (or for a portfolio of building projects or tenant improvement spaces) prior to the development of the renewable energy project in which the project is investing.

The renewable energy system must be operational at the time of LEED project construction phase submittal to earn credit.

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).

Investment in new off-site renewables creates new renewable energy supply and displaces 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 fifteen years, or the annual energy renewable energy generation shall be prorated based on the contract term length. A commitment to renew does not qualify as a new renewable resource.

Existing Off-Site Renewables

Existing 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 one year before building occupancy.

Existing off-site renewables, which 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 fifteen years, or the annual energy renewable energy generation shall be prorated based on the contract term length. Alternatively, for utility green tariff programs where a fifteen-year contract is not available, project teams may show compliance with the

fifteen year minimum contract term by demonstrating that the project has an executed contract for the maximum contract length available (with a minimum of one year), and the building owner must provide a signed letter of commitment indicating that the project will continue to renew the renewable contract or engage in an alternate renewable energy contract for a total of fifteen years.

The contract for existing renewable contracts shall confirm that all contributing renewable resources have come online or been built within the last fifteen years to qualify for credit compliance.

Energy Attribute Certificates and Carbon Offsets

The contract for EACs and carbon offsets shall confirm that all contributing renewable resources or carbon offsets are from projects that have come online or been built within the last fifteen years to qualify for credit compliance.
To earn up to three points under the credit, projects may purchase EACs and carbon offsets meeting the Green-e Renewable Energy Standard or the Green-e Climate Standard with an annual purchase amount that offsets 100% to 300% of total annual greenhouse gas emissions for a total of fifteen years.

Projects not using Green-e certified products can earn one point under the credit by purchasing annual EACs and carbon offsets that offset 150% of total annual greenhouse gas emissions for a total of fifteen years. These must be certified under an eco-label developed by an independent organization with transparent accounting process and standards in place which address the following:

- Verifiable chain of custody
- Verifiable age of renewable energy
- Tracking of GHG reductions from eligible projects
- Mechanism to prevent double-counting
- Third party–verified retail transaction

The executed contract must specify the purchasing goals and is valid for the duration indicated in the credit requirements, or includes a bulk purchase amount with the total purchase amount matching the total annual amount indicated in the credit requirements multiplied by fifteen years.

All of the above procurement strategies play an important role in reducing global greenhouse gas emissions. Leveraging a combination of procurement strategies can send important demand signals and spur further investment in renewables markets globally.

Required Documentation

Documentation	On-site system	Off-site Renewables
Renewable system rated capacity	X	X
Calculations to determine energy generated	X	X
Calculations to determine greenhouse gas emissions avoided from renewable generation or off-site procurement	X	X
Documentation of annual greenhouse gas emissions	X	X
Confirmation of renewable attribute ownership	X (if owned by building owner)	
Contract indicating duration and renewable attribute ownership	X (if owned by 3rd party)	X

Contract indicating percentage ownership, lease, or allocation of new off-site renewable system, and specific location of new off-site system		X (New)
If selling EACs for on-site system, contract and Green-e certification for EAC or carbon offset purchase for a minimum of fifteen years	X	
Calculations showing renewable electricity, EACs, or carbon offsets for targeted point threshold		X
Purchase letter or contract of commitment showing renewable electricity, EACs, or carbon offsets for targeted point threshold and confirmation of the age of system		X
Eco-label documentation showing label development, transparent accounting processes and standards, if not Green-e certified		X

Exemplary Performance

For each Tier, procure renewable energy to meet or exceed the percentage of site energy specified in the final row, labeled "EP", of Table 1. Points for Renewable Energy Procurement. Projects can earn up to 1 point for meeting any of the Exemplary Performance thresholds shown in Table 1."

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 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 reduce ozone depletion and support early compliance with the Montreal Protocol 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)

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
$\frac{LCGWP}{} + \frac{LCODP}{} \times 10^5 \leq 100$	$\frac{LCGWP}{} + \frac{LCODP}{} \times 10^5 \leq 13$
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	ODPr: Ozone Depletion Potential of Refrigerant

(0 to 0.2 lb CFC 11/lbr)	(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
$\frac{[\sum (LCGWP + LCODP \times 10^5) \times Qunit\ ]}{Qtotal} \leq 100$	$\frac{[\sum (LCGWP + LCODP \times 10^5) \times Qunit\ ]}{Qtotal} \leq 13$

Calculation definitions for [Σ (LCGWP + LCODP x 10^5) x Qunit] / Qtotal ≤ 100 (IP units)	Calculation definitions for [Σ (LCGWP + LCODP x 10^5) x Qunit] / Qtotal ≤ 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

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 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 waste that is generated by building occupants and hauled to and disposed of in landfills.

Requirements

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

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.

Retail NC

Conduct a waste stream study to identify the retail project's top five recyclable waste streams, by either weight or volume, using consistent metrics. Based on the waste stream study, list the top four waste streams for which collection and storage space will be provided. If no information is available on waste streams for the project, use data from similar operations to make projections. Retailers with existing stores of similar size and function can use historical information from their other locations.

Provide dedicated areas accessible to waste haulers and building occupants for the separation, collection, and storage of recyclable materials for at least the top four recyclable waste streams identified by the waste study. Locate the collection and storage bins close the source of recyclable waste. If any of the top four waste streams are batteries, mercury-containing lamps, or electronic waste, take appropriate measures for safe collection, storage, and disposal.

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 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: Construction and Demolition Waste Management Planning

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 construction and demolition waste disposed of in landfills and incineration facilities by recovering, reusing, and recycling materials.

Requirements

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

Develop and implement a construction and demolition waste management plan:

- Establish waste diversion goals for the project by identifying at least five materials (both structural and nonstructural) targeted for diversion.
- Specify whether materials will be separated or comingled and describe the diversion strategies planned for the project. Describe where the material will be taken and how the recycling facility will process the material including expected diversion rates for each material stream.

Provide a final report detailing all major waste streams generated, including disposal and diversion rates.

Alternative daily cover (ADC) does not qualify as material diverted from disposal. Include materials destined for ADC in the calculations as waste. Land-clearing debris is not considered construction, demolition, or renovation waste that can contribute to waste diversion.

Guidance

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

Behind the Intent

Beta Update

Minor updates were made to clarify the requirements for a waste management plan and estimating diversion in this prerequisite. In response to numerous public comments, clarifications have been made for how to count site separated versus commingled recycling as material streams in LEED and additional guidance has been provided on how to account for waste prevented through source reduction as a possible strategy in a waste management plan.

Further Explanation

Effective Construction Waste Management Strategies

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

Commingled, source separated and counting material streams

Feedback from version 4 and public comment has shown that additional clarifications are needed regarding the contribution of commingled waste as "material streams." The following section provides clarifications about commingled waste in LEED that is applicable to this prerequisite and the M&R Credit: Construction & Demolition Waste Management.

Each source separated material sent to an individual recycler who processes that single material is considered one material stream; materials sent to commingled facilities for mixed-recyclable processing are considered one stream.

For a project to be able to count off-site sorted materials as multiple material streams, the following must be met:

- Project team collects multiple materials on the jobsite (often in one bin)
- The materials are taken to a location where they are separated prior to being processed or otherwise sent for recycling
- Each material that is sent to separate recyclers or processors are considered separate material streams. For example, wood separated and sent to wood recycling directly can count as one unique stream. If mixed materials are sent to a commingled recycling processor, that counts as one stream even if they are made up of multiple materials.
- Each material stream must be measured by weight or volume (and converted to a consistent format) and included in the Waste Management Plan.

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, projects must use an average diversion rate for the facility that generally 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. Mixed recyclable materials that are processed mechanically over the same recycling line are counted as one "stream" in LEED, even if the processing facility separates the output into multiple materials for recovery after processing.

Since commingled recycling counts as one stream, projects are encouraged to seek additional material streams through waste prevention and diversion. Successful projects have implemented the following strategies to count as material streams in LEED:

- Quantify waste prevention design and construction techniques that result in source reduction.
- 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).
- Salvage components from the project renovation and reuse them in the project or for other projects.
- Donate surplus materials.
- Participate in manufacturer take-back programs for products like ceiling tiles or flooring.
- Work with subcontractors and/or finish material suppliers to eliminate or recycle packaging waste and take-back extra materials.

All of the above strategies count as material streams. Multiple bins for source separated materials are not required throughout construction for them to count as a material stream, nor must they be significant portions of the total project waste generation. Material streams should account for 5% of project waste, but that requirement is negotiable for challenging project situations.

In all cases, trash, ADC, and incineration do not count as material streams since they are not forms of waste diversion.

Counting waste prevention techniques/source reduction as a material stream

Reducing waste by thoughtful design results in the reduction of waste at the source. Stopping waste before it is created is always higher priority than managing waste after construction, and therefore LEED v4.1 allows projects to quantify waste prevention through design.

- Source reduction strategies should be incorporated into the design of the project and outlined in the CWM plan. These strategies include reusing existing materials and components, design for modular construction sizes and techniques, specify reduced packaging from vendors, design for industry-standard measurements, eliminate unnecessary finishes, and prefabrication of components or assemblies.
- Calculate waste prevented through source reduction as compared to standard practice. Estimate the amount of materials that would have been required for the system or finish, plus any extras, and estimate an amount that would have gone to waste through typical construction practices. For example, many projects order 10%-15% extra materials for finishes, and some portion of that extra supply likely would end up as waste. Source reduction should be provided on a weight or volume and included as a part of the CWM plan.

Waste recovery strategies

After exploring source reduction 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, depending on what is appropriate for the project location, material stream, and available facilities and haulers.

- Identify diversion options for materials and locate recyclers or organizations that provide diversion options for the material streams targeted. Confirm each facility can accept the types of materials the project plans to send for recycling. Estimate a diversion rate for the facility/organization receiving the material stream, including ADC amounts for commingled recyclables.

- Incineration of some C&D materials 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 CWM plan.
    - Wood-derived fuel, or wood combustion, is considered diversion and not subject to the additional requirements for other forms of incineration.
    - See MR Credit Construction & Demolition Waste Management for additional details on waste-to-energy.

- Using a recycling facility for which recycling rates have been independently certified by a third party, such as the Recycling Certification Institute (recyclingcertification.org) provides assurance that diversion rates are accurate and that materials is actually being diverted from landfill. See *MR Credit Construction and Demolition Waste Management* for more information on third-party validated C&D recycling facilities.

Connection to Ongoing Performance

- LEED O+M MR prerequisite Waste Performance: A similar prerequisite 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.

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

HEALTHCARE

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 prerequisite applies to

- BD+C: New Construction (2-5 points)
- BD+C: Core & Shell (2-6 points)
- BD+C: Schools (2-5 points)
- BD+C: Retail (2-5 points)
- BD+C: Data Centers (2-5 points)
- BD+C: Warehouses & Distribution Centers (2-5 points)
- BD+C: Hospitality (2-5 points)
- BD+C: Healthcare (2-5 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 of the following options.

Option 1. Historic Building Reuse (5 points BD+C, 6 points Core and Shell)

Maintain the existing building structure, envelope, and interior nonstructural elements of a historic building or contributing building in a historic district. To qualify, the building or historic district must be listed or eligible for listing in the local, state, or national register of historic places. Do not demolish any part of a historic building or contributing building in a historic district unless it is deemed structurally unsound or hazardous. For buildings listed locally, approval of any demolition must be granted by the local historic preservation review board. For buildings listed in a state register or the U.S. National Register of Historic Places (or local equivalent for projects outside the U.S.), approval must appear in a programmatic agreement with the state historic preservation office or National Park Service (or local equivalent for projects outside the U.S.).

Any alteration (preservation, restoration, or rehabilitation) of a historic building or a contributing building in a historic district on the project site must be done in accordance with local or national standards for rehabilitation, whichever are applicable. If building is not subject to historic review, include on the project team a preservation professional who meets U.S. federal qualifications for historic architects (or local equivalent for projects outside the U.S.); the preservation professional must confirm conformance to the Secretary of Interior's Standards for the Treatment of Historic Properties (or local equivalent for projects outside the U.S.).

OR

Option 2. Renovation of Abandoned or Blighted Building (5 points BD+C, 6 points Core and Shell)

Maintain at least 50%, by surface area, of the existing building structure, enclosure, and interior structural elements for buildings that meet local criteria of abandoned or are considered blight. The building must be renovated to a state of productive occupancy. Up to 25% of the building surface area may be excluded from credit calculation because of deterioration or damage.

OR

Option 3. Building and Material Reuse (1–4 points BD+C, 2-5 points Core and Shell)

Materials contributing toward this credit may not contribute toward MR Credit Material Disclosure and Optimization – Sourcing of Raw Materials. Path 1 or Path 2 (a/b) may be attempted but combining Path 1 and Path 2 to achieve points is not allowed.

Path 1: Maintain A Combination of Structural and Non-Structural Elements (2-4 points)

Reuse or salvage building materials from off site or on site as a percentage of the surface area, as listed in Table 1. Include structural elements (e.g., floors, roof decking), enclosure materials (e.g., skin, framing), and permanently installed interior elements (e.g., walls, doors, floor coverings, ceiling systems). Exclude from the calculation window assemblies and any hazardous materials that are remediated as a part of the project.

Table 1. Points for reuse of building materials

Percentage of completed project surface area reused	*Points BD+C*	*Points BD+C (Core and Shell)*
25%	2	2
50%	3	3
75%	4	5

OR

Path 2: Maintain Existing Walls, Floors and Roofs (1-3 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).

Percent of existing walls, floors and roof reuse	*Points*
25%	1
50%	2
75%	3

AND/OR

Path 3: Maintain Interior Nonstructural Elements (1 point)

Use existing interior nonstructural elements (e.g. interior walls, doors, floor coverings and ceiling systems) in at least 33% (by area) of the completed building, including additions.

OR

Option 4. Whole-Building Life-Cycle Assessment (1-4 points)

For new construction (buildings or portions of buildings), conduct a 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 building 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. 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.

Healthcare only

For all options in this credit, building materials demolished to create courtyards to increase daylighting may be counted as retained in calculations, provided the new courtyards meet the requirements of EQ Credits Daylight and Quality Views.

Guidance

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

Behind the Intent

Beta Update

In response to public comments and project team inquiries, 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 cannot be re-used wholly, 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.

LEED v4 credit Option 1 (Historic Building reuse) and Option 2 (Renovation of Abandoned and Blighted Building) are unchanged for v4.1. Credit Option 3 (Building and Material Reuse) now includes two pathways (2a and 2b) for calculating building reuse. These changes essentially 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 4, Whole Building Life Cycle Assessment, 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, a 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 large-scale building 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

Option 3: Building and Material Reuse

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

<u>New general guidance for v4.1 applicable to both Paths 1 and 2:</u>

Identify non-structural and structural elements of the existing space (e.g. walls, doors, floor coverings and ceiling systems etc.) that can be retained separately and in combination to select best pathway/approach for re-use (Path 1 or Path 2). Path 1 is the same as current LEED v4 Building and Material re-use credit requiring on site or off site reuse for both structural and interior non-structural elements. Path 2 is the same as LEED v2009 Building reuse credits but with slight modifications to some thresholds: Maintain Existing Walls, Floors and Roofs and Maintain Interior Non-Structural Elements. Path 2 has two parts: Path 2 (to be used for existing structure reuse) and Path 3 (to be used for interior nonstructural reuse). Path 1 or Path 2 may be attempted but combining Path 1 and Path 2 to achieve points is not allowed.

Option 4: Whole Building Life Cycle Assessment

Step 1: 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 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 LEED v4 reference guide for minimum requirements for LCA related to products, functional equivalence, service life and system boundary under Step 1.

Further Explanation

Calculations

Option 3: Building and Material Reuse

<u>Path 1 Calculations</u>

Follow Option 3. Building and Material Reuse LEED v4 reference guide Steps 1, 2 and 3. The original LEED v4 Building and Material Reuse concept and calculation is unchanged (use Equation 2, LEED v4 credit Option 3: Building and Material Reuse).

Equation 2. Percentage of existing building reuse

$$\text{Existing building reuse} = \frac{\text{Surface area reused on-site + Surface area reused from off-site}}{\text{Existing building surface area – hazardous materials area}} \times 100$$

Path 2 Calculations
Refer to LEED v2009 implementation guidance for Building Reuse credits with the following modifications:

Choose if you will be maintaining a certain percentage (25%, 50% or 75% for 1, 2 or 3 points) of the existing building structure (including floor and roof decking) and envelope (the exterior skin and framing, excluding window assemblies and nonstructural roofing materials) AND/OR calculate how to use existing interior nonstructural elements (e.g. interior walls, doors, floor coverings and ceiling systems) in at least 33% (by area) of the completed building, including additions (for 1 point). If the reuse area is close to a credit threshold, recall that off-site salvaged material can be purchased and counted into the design calculation as reuse. Once the scope of all reuse and salvaged materials is determined, ensure that all areas intended for reuse are well-defined and incorporated into the design and construction.

If the project will reuse part of an existing building, inventory the existing conditions. The architect should develop a floor plan showing the location of existing structural components, exterior and party walls, and exterior windows and doors. The drawings must be detailed enough to determine the surface area of all elements to be reused.

Confirm that the elements designated for reuse can be reused and take the necessary steps to acquire or retain and maintain them. 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 Construction and Demolition Waste Management, or MR Credit Building Product Disclosure and Optimization—Sourcing of Raw Materials, Leadership Extraction Practices. To apply the reused portion as Construction and Demolition diversion, determine an approximate weight or volume for existing building elements and include those as distinct material stream(s) in the calculations. To apply the reused portion as Leadership Extraction Practices, 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).

Path 2a Calculations
Refer to v2009 Section 6, Calculations for MR c1.1 (Building re-use: Maintain Walls, Floors and Roof).

This credit is based on the surface areas of major existing structural and envelope elements. 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 building. 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.

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 1 side of the existing wall element. Table 1 provides an example of the calculations for Path 2a.

Table 1. Sample Building Structure and Envelope Reuse Calculation for Path 2a.

Structure/Envelope Element	Existing Area (sf)	Reused Area (sf)	Percentage Reused (%)
Foundation/slab on Grade	11,520	11,520	100
2nd floor Deck	11,520	10,000	87
1st floor interior structural Walls	240	240	100
2nd floor interior structural Walls	136	136	100
Roof Deck	11,520	11,520	100
North Exterior Wall (excl. windows)	8,235	7,150	87
South Exterior Wall (excl. windows)	8,235	8,235	100
East Exterior Wall (excl. windows)	6,535	6,535	100
West Exterior Wall (excl. windows)	6,535	5,820	81
Total	64,476	61,156	95

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.

Path 2b Calculations

Refer to LEED v2009 Section 6, Calculations for MR c1.2 (Building Reuse: Maintain Interior Non Structural Elements)

$$\text{Existing building reuse} = \frac{\text{Area (sf) of all retained interior non-structural elements}}{\text{Total area (sf) of interior non-structural elements}} \times 100$$

Fixed items, such as nonstructural walls and doors, are included in this credit and count toward the percentage of reuse.

Option 4: Whole Building Life Cycle Assessment

Refer to 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. 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).

Within Option 4, 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) 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 building 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”, rounded to the nearest 10^{-4} for all six impact categories.

Required Documentation

Documentation requirement for Option 1 and Option 2 is unchanged.

Documentation requirement for Option 3, Path 1:

- Structural reused elements table and calculations, Path 2: Interior non-structural reused elements table and calculations

Documentation requirement for Option 4, Path 1:

- WBLCA report for structure and enclosure of building

Documentation requirement for 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 % change from baseline building for all impact categories in a narrative form indicating which path was pursued and how reductions were achieved.

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: Building Product Disclosure and Optimization – Environmental Product Declarations

This prerequisite 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 in which the manufacturer is

explicitly recognized as the participant by the program operator are valued as 1.5 products for the purposes of credit achievement calculation.

- USGBC approved program – Products that comply with other USGBC approved environmental product declaration frameworks.

Option 2. Multi-Attribute Optimization (1 point)
Use products that comply with one of the criteria below for 10%, by cost, of the total value of permanently installed products in the project, or use at least 10 permanently installed products sourced from at least three different manufacturers. Products will be valued as below.

Life Cycle Impact Reduction Action Plan (value at 50% by cost or ½ product)

The manufacturer has produced a product specific LCA using EN 15804 or ISO 21930 for the product and has provided a publicly available action plan to mitigate or reduce life cycle impacts. The action plan must be product-specific using the specified PCR functional unit, be critically reviewed, and must include the following information:

- Description of the LCA conducted including the dataset, software or platform used by manufacturer to complete the analysis.
- Identification of the largest life cycle impact areas identified in the analysis and a narrative description of the impact areas targeted for reduction in the action plan.
- Description of specific steps anticipated in implementation of the action plan. Include proposed changes in formulation or manufacturing processes that are planned as part of impact reduction strategy.
- Specific dates and a full timeline for completion of all the steps described in the action plan.

Life Cycle Impact Reductions in Embodied Carbon.

Products that have demonstrated environmental impact reductions for the specified functional unit based on a current third-party EPD or verified LCA that conforms to the comparability requirements of ISO 14025 and ISO 21930.

- 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 (value at 100% by cost or 1 product).
- The comparative analysis must show impact reduction(s) of at least 10% in the global warming potential (GWP) impact category and must include a narrative describing how the impact reductions were achieved. The published comparisons must be third-party verified (value at 150% by cost or 1.5 products).
- The comparative analysis must show impact reduction(s) of at least 20% in the global warming potential (GWP) impact category, and demonstrate at least 5% reduction in two additional impact categories. A narrative describing how the impact reductions were achieved is required. The published comparisons must be third-party verified (value at 200% by cost or 2 products).

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 NOx, kg O3 eq, or kg ethene; and
- depletion of nonrenewable energy resources, in MJ using CML / depletion of fossil fuels in TRACI.

USGBC approved program -- Products that comply with other USGBC approved multi-attribute frameworks.

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 cost (or number of products), up to a maximum of 200% of cost or 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 critical review 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 lowered significantly from 50% to 10% to provide a more reasonable achievement threshold. In addition, Option 2 now offers an alternative metric for achievement if percent of cost is not preferred: procure 10 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 is based on number of products, but Option 2 can be cost-based or number of products. Consider which metric to pursue because 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

Step 1: Specify and select compliant products

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.

Step 3: Count compliant products and materials and compile documentation
Follow LEED v4 guidance keeping in mind that products with EPDs meeting more than one criterion are now all equally weighted at the same valuation factor (not combined factor) with the exception of Type III EPDs that include external verification and external critical review which are valued as 1.5 products.

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: Multi-attribute Optimization

Step 3: Calculate compliance

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: For *cost-based* compliance calculation: Purchase 10%, by cost, of permanently installed products that meet at least one of the requirements listed in Option 2. Compliant products must be sourced from at least 3 different manufacturers. Calculate compliant materials using Equation 2 and the data collected in the tracking tool (see *Further Explanation, Calculations*). For the *number of products* compliance calculation: Choose products that sum to at least 10 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).

Equation 1: Total number of products with environmental product declarations (Option 1)

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}

Equation 2: Percentage of multi-attribute optimization materials cost (Option 2)

% of materials cost = {product cost of materials with Life-Cycle impact reduction action plan X 50% X location valuation factor} + {product cost of materials with any Third-Party verified impact reductions in GWP impact category X 100% X location valuation factor}+{product cost of materials with Third-Party verified impact reductions with a minimum of 10% reduction in GWP impact category X 150% X location valuation factor} +{product cost of materials 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 200% X location valuation factor}

Equation 3: Total number of products with multi-attribution optimization (Option 2)

Total # of products = {# of products with impact reduction 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,

- Product cost = cost of the product contributing toward credit. For assemblies, the cost amount contributing toward credit is based on weight (see *MR Overview, Determining Product Cost, also see below product valuation for Option 2 under Further Explanation*).
- 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 200% of cost.*

Option 1: Additional Guidance for Type III EPDs

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 additional 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 Declarations: Summary Sheets

In addition to the documentation outlined below under Required Documentation, product-specific declarations must provide a cover or summary sheet for LEED v4.1. The summary sheet 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,
- URL link to the publicly available version of the document.

Documentation of EPDs: Summary Sheets

In addition to the documentation outlined below under Required Documentation, industry-wide EPDs must provide a separate cover or summary sheet for LEED v4.1. The summary sheet 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.

Option 2 Multi-attribute Optimization guidance (new for v4.1)

Additional requirements for Action Plan Optimization Pathway:

- The 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 covering life cycle assessment analysis with results. Both the narrative and life cycle assessment report (LCA or EPD) must be submitted for compliance to this option.
- Specifically, the publicly available narrative must include:
    - 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 3 years for the plan).
    - A written narrative describing immediate actions that will be pursued to reduce the overall life cycle impacts of their products within the 3 year timeframe.
        - Examples are projected changes on sourcing more local materials to reduce shipping impacts, reduction in energy usage to manufacturer the product within the manufacturing phase, an anticipation that the product will be designed to use less energy in its use phase, etc.
- The accompanying 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.
- An action plan complete with all the requirements stated above earns 50% by cost or 0.5 product valuation.

Additional requirements for Third-Party Verified Multi-attribute Optimization Pathways:

- A manufacturer has previously conducted a life cycle assessment or published an industry wide or product specific EPD in accordance to Option 1 Requirements above.
- A manufacturer has conducted a second life cycle assessment or published a second industry wide or product specific EPD in accordance to Option 1 Requirements above for the same product type or product after making improvements towards impact reductions and has performed 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. 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 with stated impact reductions with narrative must cover:
    - Validation Period and type of assessment methodology document for previously conducted/published as well as most current life cycle assessment or environmental product declaration.
    - 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 3 years from the second life-cycle assessment conducted).
- Explanation of the actions taken in the third-party certified narratives must include deliberate decisions taken to reduce life-cycle impacts of the product type or product. For example, having a simple energy grid emissions factor update or LCA software update is not a valid narrative for impact reductions. However describing an update made to the product supply chain for manufacturing that now includes suppliers located significantly closer to the main manufacturer, thereby reducing transportation impacts during product manufacturing processes, would be an acceptable change to reflect in the second life cycle assessment.

Product valuations:

- For third party verified comparison narratives explaining any percent impact reduction in GWP via current life cycle assessment or EPD compared with previous life cycle assessment or EPD, value at 100% by cost or 1 product.
- For third party verified comparison narratives explaining 10% impact reduction in GWP 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 150% by cost or 1.5 products.
- For third-party verified comparison narratives explaining 20% 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 200% by cost or 2 products.
- No single product may contribute more than 200% of cost.

Third-Party Verification Program Requirements for Life Cycle Impact Reporting, Comparisons and Narrative:

- 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 completely independent from the individual that created the LCA, or reviewed the EPD to be in compliance with the PCR.
- 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 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 for Option 2:

- Option 1: MR Building Product disclosure and optimization calculator or equivalent tracking tool, EPD/LCA reports and compliant summary documents for products contributing toward credit.
- Option 2: Manufacturer impact reduction action plan with narrative and/or third party verified comparative analysis with narrative explaining how impact reductions thresholds were met, associated baseline LCA/EPD reports and most current LCA/EPD reports used for comparison.
- Option 2: MR Building Product disclosure and optimization calculator or equivalent tracking tool and documentation of compliance with USGBC approved program.

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 20% by cost or 20 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: Building Product Disclosure and Optimization – Sourcing of Raw Materials

This prerequisite 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 20%, 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 40%, 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 raw materials other than wood must be tested using ASTM Test Method D6866 and be legally harvested, as defined by the exporting and receiving country. 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.
    - Bio-based products that meet the Sustainable Agriculture Network's Sustainable Agriculture Standard: value at 100% 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.

- *USGBC approved program.* Other USGBC approved programs meeting responsible sourcing and extraction criteria.

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 or 2 products.

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 20% by cost (for 1 point) or 40% 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: Documentation requirements and guidance for wood remains unchanged. For bio-based products, follow additional specifications as below:

- Products with bio-based claims must be made in accordance to ISO 14021.
- Manufacturers/Programs must provide documentation on the specific product that includes:
    - Confirmation the ASTM D6866 test method was conducted which validates the percent by weight of bio-based material within the product.
    - The type of bio-based raw material used within the product.
    - Confirmation that this raw material was legally harvested via exporting and receiving country.

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
- If the bio-based raw materials meet the Sustainable Agricultural Networks Sustainable Agricultural standard use this formula:
    - 100% * 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 building product disclosure and optimization calculator and documentation of product claims for credit requirements for either 20% by cost or 40% by cost threshold.

Exemplary Performance

Purchase at least 60%, 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: Building Product Disclosure and Optimization – Material Ingredients

This prerequisite 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% (1000 ppm). (10 different permanently installed products from at least three different manufacturers for CS and Warehouses & Distribution Centers)

- *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").
- *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.
- *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 or Declared.
    - Declare labels designated as LBC Compliant that demonstrate content inventory to 0.1% (1000 ppm).
- Living Product Challenge. The included Declare product label must demonstrate content inventory to 0.1% (1000 ppm).
- ANSI/BIFMA e3 Furniture Sustainability Standard. The documentation from the assessor or scorecard from BIFMA must demonstrate the product earned at least 3 points under 7.5.1.3 Advanced Level in e3-2014 or 3 points under 7.4.1.3 Advanced Level in e3-2012.
- Product Lens Certification
- Facts – NSF/ANSI 336: Sustainability Assessment for Commercial Furnishings Fabric at any certification level.
- *USGBC approved program.* Other USGBC approved programs meeting the material ingredient reporting criteria.

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 permanently installed products from at least three different manufacturers that document their material ingredient optimization using the paths below. Choose either 10 compliant products, or select products that constitute at least 10%, by cost, of the total value of permanently installed products in the project.

Material Ingredient Screening and Optimization Action Plan (value at 50% by cost or ½ product)

- The manufacturer has screened the product to at least 1,000 ppm and has provided a publicly available inventory meeting the requirements of Option 1 and completed a detailed action plan to mitigate or reduce known hazards using the principles of green chemistry. The action plan must be product-specific (not company, manufacturer or brand), and must include the following information:
    - Description of the screening or assessment platform used by manufacturer to complete the material ingredient screening and analysis.
    - Identification of the specific green chemistry principles targeted for implementation in the action plan.
    - Description of specific steps anticipated in implementation of the action plan. Include proposed changes in formulation or manufacturing processes that are planned as part of green chemistry optimization strategy.
    - Specific dates and a full timeline for completion of all the steps described in the action plan.

Advanced Inventory & Assessment (value at 100% by cost or 1 product):

- The end use product meets the requirements of any of the following:
    - Manufacturer Inventory or 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 or Manufacturer Inventory must be third party verified.
    - Manufacturer Inventory or HPD: 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 HPD or Manufacturer Inventory must be third-party verified, or Living Product Challenge certified products that include a Red List Free Declare label.
    - Declare labels designated as Red List Free that are third-party verified.
    - Cradle to Cradle. Product has Material Health Certificate or is Cradel to Cradle Certified™ under standard version 3 or later with a Material Health achievement level at the Bronze level or higher.

Material Ingredient Optimization (value at 150% by cost or 1.5 products)

- The end use product has demonstrated a product inventory and assessment of ingredients using any of the following programs:
    - Manufacturer Inventory or HPD: 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.
    - Cradle to Cradle v3 certified product with Material Health category score of Silver or higher, or a Cradle to Cradle certified Material Health Certificate at Silver level or higher.
    - Living Product Challenge. Products certified to the Living Product Challenge which includes achievement of Imperative 09: Transparent Material Health.

International Alternative Compliance Path – REACH Optimization (value at 100% of cost or 1 product).

- End use products and materials have fully inventoried chemical ingredients to 100 ppm and assess each substance against the Authorization List – Annex XIV, the Restriction list – Annex XVII and the SVHC candidate list, (the version in effect June 2013,) proving that no such substance is included in the product. If the product contains no ingredients listed on the REACH Authorization, Restriction, and Candidate list.
- Global Green Tag International: product has a certified Product Health Declaration (PhD) report. Value at 100% or 1 product.

USGBC approved program.

- Products that comply with USGBC approved building product optimization criteria for material ingredient optimization and/or advanced inventory & assessment pathways.

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 cost (or number of products), up to a maximum of 200% of cost or 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 current cost threshold for Option 2 (25% by cost) is reduced to 10% by cost and a newer product number metric (which currently exists for Option 1) is added as an additional pathway for Option 2.
- A restructuring of Option 2 will reward 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 10% of permanently installed products by cost 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 product and material costs and compile documentation

Equation 2 (formerly for product supply chain optimization) is no longer applicable. Therefore, determine the total value of compliant products (under Further Explanation, Calculations) using Equation 1 for compliance based on product cost, or use the new Equation 2 below for product number compliance for material ingredient optimization. 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 Equation 1 or Equation 2 for Option 2 Material Ingredient Optimization (also see *Further Explanation, Material Ingredient Optimization)*

Equation 1. Percentage of compliant materials' cost (Option 2)

% of materials cost = {product cost of materials with Action Plans X 50% X location valuation factor} + {product cost of materials meeting the requirements in section Advanced Inventory and Assessment X 100% X location valuation factor}+{product cost of materials meeting the requirements in section Material Optimization x 150% X location valuation factor}

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,

- Product cost = price charged to the project owner for the product. Each product can be counted only once, even if it meets the requirements of multiple programs.
- Program valuation factor = multiplier assigned to each compliance program:

- Material Ingredient Screening and Optimization Action Plan:
    - All ingredients screened to 1000 ppm, publicly available inventory and detailed action plan for product to mitigate hazard flags, value at 50% by cost or ½ product.
- Advanced Inventory and Assessment
    - A third party-verified HPD or Manufacturer Inventory to 100 ppm level (with no GS LT-1 or GHS Category 1 hazards in end use product), value at 100% by cost or 1 product.
    - A third-party verified HPD or Manufacturer Inventory to 100 ppm with at least 75% by weight of product assessed and remaining 25% inventoried, publicly available Green Screen report, value at 100% by cost or 1 product.
    - Third-party Verified Red List Free Declare Label, value at 100% by cost or 1 product.
    - 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.
    - For international projects: A REACH compliance document validating full inventory of product to 100 ppm level and assessment of all substances in end use product (no ingredients listed on any of three REACH lists), value at 100% by cost or 1 product.
- Material Ingredient Optimization
    - A third-party verified HPD or Manufacturer Inventory to 100 ppm with at least 95% by weight of product assessed and remaining 5% inventoried (with no GS LT-1 or GS BM-1s in end use product), value at 150% by cost or 1 product.
    - 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 Silver level or higher, value at 150% by cost or 1.5 products.

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.

Material Ingredient Reporting

Manufacturer's Inventory

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.

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 completed HPD.

Qualifying HPDs developed under the Open Standard version 2.0, 2.1 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.

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 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 primarily three kinds of Declare labels: 'LBC Red List Free,' 'LBC Compliant' and 'Declared.' Products that receive the status of "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 and Declared status meet LEED v4.1 requirements for disclosure. However, some products that receive the status of "LBC Compliant" 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 website lists labels and 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 International

Global GreenTag International provides a variety of product certifications in North America and over 70 countries worldwide. Global Green Tag's Product Health Declaration (PhD) label 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. 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.

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.

Material Ingredient Optimization

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 re-structured 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) that 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 (for 100% by cost) or for 95% by weight of product (for 150% by cost) and require the remaining percentage by weight product in both cases to be screened using GS List Translator.

Additional Guidance - Material Ingredient Screening and Optimization Action Plan Pathway for Manufacturers and Project teams (new for v4.1)

- The manufacturer has conducted a screening or assessment to determine ingredient hazard scores/classes within each product, identified specific opportunities for improvements via any of the material ingredient reporting formats per Option 1, and has generated a publicly available narrative covering the product analysis of its ingredients and an action plan to address specific improvement areas. Both the narrative and ingredient screening/assessment report must be submitted for compliance to this option.
- Specifically, the publicly available narrative must include:
    - Date of creation of the action plan as well as date of expiration of the plan (a maximum of 5 years from the date of creation).
    - Contact information of the organizational representative responsible for implementation and success of the proposed action plan.
    - A written narrative describing immediate and long-term actions that will be pursued to reduce hazards within their products and which principle(s) of green chemistry related to material ingredients are being adopted by the organization to make the changes within the 5 year timeframe.
        - Examples of action plans can include: identifying planned manufacturing or formulation changes; proposed changes in manufacturing processes; and describing how those changes are expected to achieve the end goal of safer chemistry for the individual products.
        - 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 50% by cost or 0.5 product valuation.

Additional Guidance - Advanced Inventory and Assessment Pathway for Manufacturers and Project teams (new for v4.1)

- Manufacturer Inventory or Health Product Declaration (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 simply 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.

- Manufacturer Inventory or Health Product Declaration (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.
- Third-Party Verified Red List Free Declare Labels or Living Product Challenge labels
  - Product content inventory must also be verified as part of the third party verification process and the third party verified label must be publicly available.
  - Must be verified via an approved third-party verifier/assessor meeting the third party verification requirements stated above.
- 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.
  - Third-party verifiers/auditors must meet the third-party verification requirements stated above.
- International Compliance Path- REACH pathway
  - For international project teams, product has documentation from manufacturer or supplier in form of signed letter showing a full inventory of ingredients for the product down to 100 ppm and an assessment of these ingredients against Authorization List, Restriction List and SVHC List (no ingredients in end use product from any of the three lists).
  - Documentation can be optionally verified by third-party verifier that must meet the third party verification requirements stated above.
  - Global GreenTag 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.

Additional Guidance - Material Ingredient Optimization Pathway for Manufacturers and Project teams (new for v4.1)

- Manufacturer Inventory or HPD (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

by an approved third-party verifier that meets the third-party verification requirements as stated above.

- 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.
  - Third-party verifiers/auditors must meet the third-party verification requirements stated above.
- Living Product Challenge.
  - Products certified to the Living Product Challenge which includes achievement of Imperative 09: Transparent Material Health.

Required Documentation

Follow LEED v4 reference guide documentation requirements with the following modifications:

- Option 1: MR Building Product disclosure and optimization calculator or equivalent tracking tool, documentation of chemical inventory through HPD, labels for C2C, Declare, ANSI/BIFMA, Product lens, Facts, manufacturers' lists of ingredients with GS or GHS reports for proprietary ingredients or other USGBC approved programs.
- Option 2: Manufacturer material ingredient screening/assessment associated with individual product action plan in a detailed narrative for each product and/or third party verified manufacturer inventory/HPD with GreenScreen assessments and/or third party verified labels such as Declare, C2C and/or manufacturers/suppliers' list of ingredients, assessment and declaration for REACH or third party verified REACH labels.
- Option 2: MR Building Product disclosure and optimization calculator or equivalent tracking tool.
- Option 3: Documentation requirements no longer applicable.

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 20% by cost or 20 qualifying 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: 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 the MR prerequisite Waste Performance.

MR Credit: PBT Source Reduction – Mercury

This prerequisite 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) 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 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 prerequisite 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

HEALTHCARE

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 prerequisite 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

HEALTHCARE

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 e3-2010 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: Multi-Attribute Assessment of Products

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 in which the manufacturer is explicitly recognized as the participant by the program operator are valued as 1.5 products for the purposes of credit achievement calculation.

- USGBC approved program – Products that comply with other USGBC approved environmental product declaration frameworks.

- *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 raw materials other than wood must be tested using ASTM Test Method D6866 and be legally harvested, as defined by the exporting and receiving country. 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.
    - Bio-based products that meet the Sustainable Agriculture Network's Sustainable Agriculture Standard: value at 100% 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: Multi-Attribute Assessment of Products

Please refer to the v4.1 beta guide section for BPDO credits EPDs 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 prerequisite 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

HEALTHCARE

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 prerequisite 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 by recovering, reusing, and recycling materials.

Requirements

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

Recycle and/or salvage nonhazardous construction and demolition materials. Calculations can be by weight or volume but must be consistent throughout.

Exclude excavated soil, land-clearing debris from calculations. Include materials destined for alternative daily cover (ADC) in the calculations as waste (not diversion). Include wood waste converted to fuel (biofuel) in the calculations; other types of waste-to-energy are not considered diversion for this credit.

However, for international projects that cannot meet credit requirements using reuse and recycling methods, waste-to-energy systems may be considered waste diversion if the European Commission Waste Framework Directive 2008/98/EC and Waste Incineration Directive 2000/76/EC are followed and Waste to Energy facilities meet applicable European Committee for Standardization (CEN) EN 303 standards.

Option 1. Diversion (1–2 points)

Path 1. Divert 50% and Two Material Streams (1 point)
Divert at least 50% of the total construction and demolition material; diverted materials must include at least two material streams.

OR

Path 2. Divert 50% using Certified Commingled Recycling Facility (1 Point)
Divert at least 50% of the total construction and demolition material. All commingled recycling must be sent to offsite sorting facility(ies) certified by the Recycling Certification Institute or approved equivalent.

OR

Path 3. Divert 75% and Three Material Streams (2 points)
Divert at least 75% of the total construction and demolition material; diverted materials must include at least three material streams.

OR

Path 4. Divert 75% using Certified Commingled Recycling Facility and One More Material Streams (2 points)
Divert at least 75% of the total construction and demolition material; diverted materials must include at least two material streams. All commingled recycling is required to be one of the streams and must be sent to offsite sorting facility(ies) certified by the Recycling Certification Institute or approved equivalent.

OR

Option 2. Reduction of Total (Construction and Demolition) Waste Material (2 points)

Salvage or recycle renovation and demolition debris and utilize onsite waste minimizing design strategies for new construction activities. Achieve the waste generation thresholds in Table 1 and create a narrative describing how a project is addressing waste prevention and/or achieving waste generation thresholds via design strategies and onsite waste minimization practices.

Do not generate more than 7.5 pounds of construction waste per square foot (36.6 kilograms of waste per square meter) of the building's floor area for all BD+C projects except Warehouses and Distribution Centers.

Table 1: Thresholds of compliance for reduction of total waste material

Type of Waste	Building Type	Total Waste Reduction Requirements	Points Available
Waste from renovation and demolition activities	All	Salvage or recycle at least 75%, not including ADC	Required
Waste from new construction activities	All except Warehouses & Distribution Centers	Reduce waste generation to less than 7.5 lbs/sf	2
	Warehouse & Distribution Center projects	Reduce waste generation to less than 2.5 lbs/sf	

Guidance

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

Behind the Intent

Beta Update

Changes in v4.1 seek to make this credit more achievable for tight urban jobsites, encourages better accounting for recycling reporting, and rewards source reduction goals based on project type data. These changes respond to concerns from users and public comment proposals that find on-site waste separation difficult.

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 and define the minimum requirements for a commingled facility certified recycling rate. Finally, the total waste generation pathway has been expanded to account for demolition and renovation waste and differing thresholds for project types that generate less waste overall.

See the changes for v4.1 to *MR Prerequisite: Construction and Demolition Waste Management Planning* for addition guidance on defining material streams, how to account for on-site and off-site commingled recycling, and documenting waste prevention.

Step-by-Step Guidance
Refer to LEED v4 reference guide with the following modifications:

Option 1, Path 2 and Path 4 now include additional diversion thresholds using certified commingled recycling facilities. Choose between Path 1 and Path 2(for 1 point) or Path 3 and Path 4 (for 2 points) if the goal is waste diversion. Choose Option 2 (for 2 points also) if the goal is waste reduction via waste prevention strategies in the design phase followed by jobsite best practices to reduce waste during construction.

Option 1. Diversion
Step 1: Implement CWM plan

Path 2 and 4: Using Certified Recycling Facilities
The newer credit pathways using certified recycling facilities allow project teams to reduce the number of required material streams by one if they take all commingled recyclables to a facility that has achieved third party verification of their recycling rates. These facilities support accurate reporting and nationally consistent metrics for recycling rates.

Requirements for USGBC Approved 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.

Option 2: Reduction of Total Waste

Step 2: Calculate Total Waste Reduction

Replace Step 2 (Calculate total waste reduction) with the following:

Option 2 has updated thresholds for achievement for projects and also includes requirements to document waste prevention techniques undertaken on the project. A narrative, provided in the LEED form, must describe strategies in design and construction 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).

In addition to preventing waste, the project must also recycle at least 75% of all renovation and demolition waste (not including ADC), and not generate more than the required amount per square foot of the building's completed floor area.

Under Option 2, exclude on-site reused materials from the generation numbers. Materials reused on site are not considered waste for the purposes of calculating this option only.

Further Explanation

Waste-to-Energy

Refer to LEED v4 reference guide with the following modifications:

Waste-to-energy is not a widely-used strategy 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 below).

Note: 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.

International Tips

Alternative Compliance Path for International Projects: Waste-to-Energy

In locations where reuse is not possible and/or recycling markets are not sufficient, Waste-to-energy may be considered a viable diversion strategy if the project team follows the European Commission Waste Framework Directive 2008/98/EC and the European Commission Waste Incineration Directive 2000/76/EC. These standards consist of performance metrics of both efficiency and emissions for different types of energy recovery systems. In addition, the facility must meet the applicable European standards based on the fuel type. See Referenced Standards for more information on these directives:

- 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

- For Option 1, MR construction and demolition waste management calculator or equivalent tool tracking total and diverted waste amounts and material streams and documentation of recycling rates for commingled facilities (if using Paths 2 or 4)
- For Option 1, international projects need to submit justification narrative for use of WTE strategy for international teams and documentation of WTE facilities adhering to EN standards (if applicable)
- For Option 2, a narrative for waste prevention/design strategies used on the project to achieve the waste threshold and calculation of total waste per area is required.

Exemplary Performance

Achieve Option 1, Path 3 or Path 4:

- If following Option 1 Path 3: Divert 85% and Four Material Streams
- If following Option 1 Path 4: Divert 85% using Certified Commingled Recycling Facility and Two More Material Streams

OR

Achieve both Option 1 (Path 3 or 4) and Option 2.

Connection to Ongoing Performance

- LEED O+M MR prerequisite Waste Performance: A similar prerequisite 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 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 (and for mixed-mode systems when the mechanical ventilation is activated), meet the requirements for both ventilation (option 1 or option 2) and monitoring.

Mechanical Ventilation

Option 1. ASHRAE Standard 62.1–2016

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.

OR

Option 2. ISO 17772-1:2017 and EN 16798-3: 2017 and

Projects outside the U.S. may instead meet the requirements of ISO Standard 17772-1:2017, Section 6.3, using Method 1—Perceived air quality with Category I or II and local standard for ventilation system design such as EN Standard 16798-3: 2017, Sections 7-10.

Monitoring for mechanical ventilation systems

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 (and for mixed-mode systems when the mechanical ventilation is inactivated), confirm that natural ventilation is an effective strategy for the project by following the flow diagram in the Chartered Institution of Building Services Engineers (CIBSE) Applications Manual AM10, March 2005, Natural Ventilation in Nondomestic Buildings, Figure 2.8 and meet the requirements for both ventilation (option 1, option 2, or option 3) and monitoring.

Natural Ventilation

- Option 1. ASHRAE Standard 62.1-2016
  Meet the requirements of ASHRAE 62.1-2016, Sections 4, 6.4, and 6.5.

  OR

- Option 2. Engineered natural ventilation system
  Meet the requirements of ASHRAE 62.1-2016, Sections 4 and 6.5, and have an engineered natural ventilation system approved by the authority having jurisdiction (per exception 1 of ASHRAE 62.1-2016 section 6.4).

  OR

- Option 3. Historic building
  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, Sections 4, 6.4.1, 6.4.2, 6.4.3, and 6.5.

Monitoring for natural ventilation systems
Comply with at least one of the following 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.

CS only
Mechanical ventilation systems installed during core and shell construction must be capable of meeting projected ventilation levels and monitoring based on the requirements of anticipated future tenants.

Residential only
In addition to the requirements above, if the project building contains residential units, each dwelling unit must meet the requirements of LEED v4.1 Multifamily EQ Prerequisite: Minimum indoor air quality performance, EQ Prerequisite Combustion venting and EQ Prerequisite Radon-resistant construction.

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

Several key standards such as ASHRAE and European standards have been updated to latest versions or to more relevant and locally/globally applicable versions. ASHRAE 62.1-2010-> ASHRAE 62.1-2016 (updated version)

- EN 15251-2007 -> ISO 17772-2017 (global applicability)
- EN 13779-2007 ->EN 16798-3:2017 (local applicability)
- ASHRAE 170-2008 and FGI 2010 -> ASHRAE 170-2017 (updated version)

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 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. For projects outside U.S., follow newly cited standards such as ISO 17772-1: 2017 and EN 16798-3:2017 and the relevant sections for perceived air quality and ventilation system design respectively for each of those instead of EN 13779-2007, section 6.2.3, Outdoor Air.

Step 3. Categorize Spaces: Similarly, instead of using CEN 15251 for ventilates rates, follow Method 1 of ISO 17772-1: 2017, section 6.3.2.2 for calculating ventilation rates required to obtain a desired perceived air quality level and use the highest of these ventilation rate values for design with also checking that any critical sources identified for health risk from specific air pollutants remain below health threshold values.

Mechanically ventilated spaces (and Mixed-Mode spaces when a mechanical ventilation is active)

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)

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 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 ASHRAE 62.1- 2016, sections 4, 5, 6.2, 6.5 and 7, ISO 17772-1:2017 or EN 16798-3: 2017.
- For naturally ventilated and mixed mode ventilated projects, confirmation that projects meets requirements of ASHRAE 62.1-2016, sections 6 and 7.

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. This smoking requirement also applies to any spaces outside the property line that are used for business purposes.

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.

Step-by-Step Guidance
Follow LEED v4 reference guide with the following modifications:

Step 2. Designate Locations Of Exterior Smoking Areas: Locate areas based on the 25 feet rule or maximum extent allowable by local codes. Meet the 25 feet distance for exterior smoking or alternatively follow local codes/government regulations in place for smoking ban in workplace and in public spaces. Research local codes applicable to the building- the code regulations may or may not meet the 25 feet distance rule for exterior smoking.

Step 3: Confirm That Smoking Is Prohibited In Non-designated Areas: Confirm that the 25 feet rule is followed or alternatively comply with maximum allowable distance permitted by local code for smoking in non –designated areas of the building used for business purposes such as sidewalk seating, kiosks and courtyards. Documentation of the regulation if following local code needs to be provided.

Step 4: Determine Locations of No Smoking Signage: Communicate no smoking policy pro-actively 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
Follow LEED v4 reference guide with the following modifications.

Property Line Less Than 25 Feet (7.5 Meters) From the Building:

As in LEED v4, the newer no smoking requirements for this prerequisite still apply to spaces outside the property line used for business purposes. Additionally, if local code is being followed for no smoking policy, the local code also needs to be complied with for spaces falling outside the property line that are used for business purposes as well as for public sidewalks.

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

SCHOOLS

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, Annex A.1; the 2015 ASHRAE Handbook-- HVAC Applications, Chapter 48, Noise and Vibration Control (with errata); AHRI Standard 885–2008; 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

Adhere to the following reverberation time requirements.

Classrooms and Core Learning Spaces < 20,000 Cubic Feet (566 Cubic Meters)

Design classrooms and other core learning spaces to include sufficient sound-absorptive finishes for compliance with the reverberation time requirements specified 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.

Option 1

For each room, confirm that 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.

OR

Option 2

Confirm through calculations described in ANSI Standard S12.60-2010 that rooms are designed to meet reverberation time requirements as specified in that standard.

Classrooms and Core Learning Spaces ≥ 20,000 Cubic Feet (566 Cubic Meters)

Meet the recommended reverberation times for classrooms and core learning spaces described in the NRC-CNRC Construction Technology Update No. 51, Acoustical Design of Rooms for Speech (2002), or a local equivalent for projects outside the U.S.

Exceptions

Exceptions to the requirements because of a limited scope of work or to observe historic preservation requirements will be considered.

Guidance

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

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 prerequisite 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

Option 1. Enhanced IAQ Strategies (1 point)

Comply with all of the following requirements, as applicable.

Mechanically ventilated spaces:

A. entryway systems;
B. interior cross-contamination prevention; and
C. filtration.

Naturally ventilated spaces:

A. entryway systems; and
D. natural ventilation design calculations.

Mixed-mode systems:

A. entryway systems;
B. interior cross-contamination prevention;
C. filtration;
D. natural ventilation design calculations; and
E. mixed-mode design calculations.

A. 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.

B. 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.

C. Filtration

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.

D. Natural Ventilation Design Calculations

Demonstrate that the system design for occupied spaces employs the appropriate strategies in Chartered Institution of Building Services Engineers (CIBSE) Applications Manual AM10, March 2005, Natural Ventilation in Non-Domestic Buildings, Section 2.4.

E. Mixed-Mode Design Calculations

Demonstrate that the system design for occupied spaces complies with CIBSE Applications Manual 13–2000, Mixed Mode Ventilation.

Option 2. Additional Enhanced IAQ Strategies (1 point)

Comply with one of the following requirements

Mechanically ventilated spaces (select one):

A. exterior contamination prevention;
B. increased ventilation;
C. carbon dioxide monitoring; or
D. additional source control and monitoring.

Naturally ventilated spaces (select one):

A. exterior contamination prevention;
D. additional source control and monitoring; or
E. natural ventilation room by room calculations.

Mixed-mode systems (select one):

A. exterior contamination prevention;
B. increased ventilation;
D. additional source control and monitoring; or
E. natural ventilation room-by-room calculations.

A. Exterior Contamination Prevention

Design the project to minimize and control the entry of pollutants into the building. Ensure through the results of computational fluid dynamics modeling, Gaussian dispersion analyses, wind tunnel modeling, or tracer gas modeling that outdoor air contaminant concentrations at outdoor air intakes are below the thresholds listed in Table 1 (or local equivalent for projects outside the U.S., whichever is more stringent).

Table 1. Maximum concentrations of pollutants at outdoor air intakes

Pollutants	Maximum concentration	Standard
Those regulated by National Ambient Air Quality Standards (NAAQS)	Allowable annual average OR 8-hour or 24-hour average where an annual standard does not exist OR Rolling 3-month average	National Ambient Air Quality Standards (NAAQS)

B. Increased Ventilation

Increase breathing zone outdoor air ventilation rates to all occupied spaces by at least 30% above the minimum rates as determined in EQ Prerequisite Minimum Indoor Air Quality Performance.

C. 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.

D. 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.

E. Natural Ventilation Room-by-Room Calculations

Follow CIBSE AM10, Section 4, Design Calculations, to predict that room-by-room airflows will provide effective natural ventilation.

Guidance

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

Behind the Intent

Beta Update

Minor changes for this credit include either updates to recent versions of referenced ASHRAE and European standards or updates to reference more globally applicable standards. The changes made were to the following standards:

- Option 1. Strategy C. Filtration ASHRAE 52.2-2010 → ASHRAE 52.2-2017 (updated version)
- Option 1. Strategy C. Filtration EN 779-2002 → ISO 16890-2016 (global applicability)
- Option 2. Strategy C. Filtration ASHRAE 62.1-2010 → ASHRAE 62.1-2016 (updated version)

Step-by-Step Guidance

Follow LEED v4 reference guide with the following modifications:

Option 1: Enhanced IAQ strategies (Filtration media)

Step 1: Specify compliant filtration media
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.

Option 2. Additional Enhanced IAQ Strategies

Exterior Contamination Prevention

Step 1. Follow guidance per LEED v4 reference guide and use ASHRAE 62.1-2016, Table 5.5.1 that lists minimum separation distances for air intakes.

Carbon Dioxide (CO2) monitoring

Step 2. Design CO2 monitoring system. Follow LEED v4 reference guide with ASHRAE 62.1-2016, Appendix C for determining CO2 concentration set-points.

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.

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 prerequisite 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, human health, productivity, and the environment.

Requirements

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

Use materials on the building interior (everything within the waterproofing membrane) 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
4 product categories	3 points
5 product categories	3 points + exemplary performance
Reach 90% threshold in at least three product categories	Exemplary performance *or 1 additional point if only 1 or 2 points achieved above.*

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*.

The paints and coatings product category includes all interior paints and coatings applied on site.

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*.

The adhesives and sealants product category includes all interior adhesives and sealants 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), wall base, underlayments, and other floor coverings.

Subflooring is excluded.

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), surface wall structures such as gypsum or plaster, cubicle/curtain/partition walls, trim, doors, frames, windows, and window treatments.

Removable/interchangeable fabric panels, built-in cabinetry, and vertical structural elements are excluded.

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.

Overhead structural elements (exposed, finished, and unfinished) are excluded.

Insulation

At least 75% of all insulation, by cost or surface area, meets the *VOC emissions evaluation.*

The insulation material category includes all thermal and acoustic boards, batts, rolls, blankets, sound attenuation fire blankets, foamed-in place, loose-fill, blown, and sprayed insulation.

Insulation for HVAC ducts and plumbing piping are excluded.

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 stand-alone furniture items purchased for the project.

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, hardwood veneer plywood, and structural composite wood not included in the flooring, ceiling, wall panels, or furniture material categories.

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 integral organic-based surface coatings, binders, or sealants.

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

Option 1. 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 school classrooms must be evaluated using the classroom scenario, products used in other spaces must be evaluated using the default private office scenario.

The statement of product compliance must include the exposure scenario(s) used, the amount of wet-applied product applied in mass per surface area (if applicable), the range of total VOCs, and follow guidelines in CDPH Standard Method v1.2-2017, Section 8. Organizations that certify manufacturers' claims must be accredited under ISO Guide 17065.

Option 2. Product has been tested according to EN 16516:2017 and complies with the LCI values from Table 1 of the German AgBB Testing and Evaluation Scheme (2015) and a formaldehyde limit of 10 micrograms per cubic meter. Additionally, the range of total VOCs after 28 days was measured as specified in EN 16516 and 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.

The statement of product compliance must include the amount of wet-applied product applied in mass per surface area (if applicable) and the range of total VOCs. Organizations that certify manufacturers' claims must be accredited under ISO Guide 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. 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, effective February 5, 2016
  - European Decopaint Directive (2004/42/EC)
  - Hong Kong Air pollution control (VOC) Regulation for regulated architectural paints (January 2010)
- Adhesives and sealants:
  - SCAQMD Rule 1168, October 6, 2017
  - Canadian VOC Concentration Limits for Architectural Coatings (SOR/2009-264)
  - Hong Kong Air Pollution Control (VOC) Regulation for regulated adhesives and regulated sealants (April 2012)
  - Free of solvents, as defined in TRGS 610 (January 2011)

Formaldehyde Emissions Evaluation

Product meets one of the following:

- EPA TSCA Title VI or California Air Resources Board (CARB) ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or
- EPA TSCA Title VI or CARB ATCM formaldehyde requirements for no added formaldehyde resins (NAF).

- Tested per EN 717-1:2014 for formaldehyde emissions and complies with emissions class E1.
- Structural composite wood product made with moisture resistant adhesives meeting ASTM 2559, no surface treatments with added urea-formaldehyde resins or coatings, and certified according to one of the following industry standards:
    - Plywood: compliant in accordance with *Voluntary Product Standard - Structural Plywood (PS 1-09), Voluntary Product Standard – Performance Standard for Wood-Based Structural-Use Panels (PS 2-10),* or one of the standards considered by CARB to be equivalent to PS 1 or PS 2: (AS/NZS 2269, EN 636 3S (including CE label), Canadian Standards Association CSA O121 for Douglas fir plywood, CSA O151 for Canadian softwood plywood, for CSA O153 Poplar plywood, or CSAO325 for Construction sheathing)
    - Oriented strand board: specified with the Exposure 1 or Exterior bond classification in accordance with *Voluntary Product Standard – Performance Standard for Wood-Based Structural-Use Panels (PS 2-10)*
    - Structural composite lumber: compliant in accordance with *Standard Specification for Evaluation of Structural Composite Lumber Products (ASTM D 5456-13)*
    - Glued laminated timber: compliant in accordance with *Structural Glued Laminated Timber (ANSI A190.1-2012)*
    - I-joists compliant in accordance with *Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists (ASTM D 5055-13)*
    - Cross-laminated timber: compliant in accordance with *Standard for Performance-Rated Cross-Laminated Timber (PRG 320-15)*
    - Finger-jointed lumber labeled "Heat Resistant Adhesive (HRA)" in accordance with the *American Softwood Lumber Standard (DOC PS-20 2015)*

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 Furniture Sustainability Standard, Sections 7.6.1 (for half credit, by cost) OR 7.6.2 (for full credit, by cost). If 75% of the furniture also complies with Section 7.6.3 in addition to 7.6.2, the category counts for exemplary level (90%). 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 Guide 17065.

Guidance

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

Behind the Intent

Beta Update

In general, 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, and ii) modifying existing standard references CDPH standard method v1.1-> CDPH standard method v1.2 (updated version).

- SCAQMD Rule 1113, June 2011 → SCAQMD Rule 1113, February 2015 (updated version)
- SCAQMD Rule 1168, July 2005 → SCAQMD Rule 1168, October 2017 (updated version)
- AgBB 2010 → CEN TS 16516 (updated testing standard)
- AgBB 2010 → AgBB 2015 (updated VOC limits standard 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)

Newly referenced standards for credit requirements are as below:

- TRGS 610 (January 2011) (for VOC content of adhesives and sealants)
- EPA TSCA Title VI and structural composite wood industry standards (for formaldehyde emissions in composite wood)

Step-by-Step Guidance
Follow LEED v4 reference guide with the following modifications:

Step 1. Research And Specify Low Or Non-Emitting Finishes/Furniture And Salvaged/Reused Materials: Along with low or non-emitting finishes and furniture, also research potential salvaged materials or products that can be reused on the project in the flooring, wall panels, ceilings, furniture and composite wood product categories. Note that salvaged or reused materials or products need to be more than one year old at time of specifying and are exempted from requirements for VOC emissions and content as opposed to any new materials in the same product categories.
Confirm that the third party certifying VOC testing agencies being used for this credit can test and certify materials to the newer versions of the standards in this credit which may have revised thresholds for certain VOCs (for example CDPH Standard Method v1.2 instead of CDPH Standard Method v1.1).

Step 3: Selecting approach: Compliance methodology for credit has been modified significantly so the nomenclature 'Option 1' and 'Option 2' specifying product category or budget calculations as well as the guidance for Option 2 are no longer applicable for this step however the product category approach (previously Option 1) has been revised to be much more straightforward and easier to implement with an overall lower range of thresholds required to be met for VOC emissions evaluation (starting with minimum percentage compliance of 75% by cost or surface area for some product categories).

Option 1: Product category calculations- For wet-applied product categories, 75% (not 90%) of products must now meet emissions criteria, VOC content criteria threshold remains the same (100%) as does the suggested guidance and example for VOC content budget.

Option 2: Budget Calculation Method is no longer applicable for this credit.

Further Explanation
Refer to LEED v4 guidance with the following modification and addition:

CARB ATCM composite wood formaldehyde regulation
The LEM credit now accepts demonstration of compliance to U.S. federal regulation EPA TSCA Title VI as an option to CARB ATCM requirements for formaldehyde in ULEF or NAF resins used in composite wood products. Follow the LEED v4 guidance for CARB ATCM compliance.

TSCA Title VI (Formaldehyde standards for Composite Wood Products Act): In 2017, 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, 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.

ANSI/BIFMA standards: Follow the LEED v4 ref guide and use the updated version of the standard ANSI/BIFMA e3-2014 Furniture Sustainability Standard.

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 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 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 infection control risk assessment standard published by the American Society of Healthcare Engineering and the U.S. Centers for Disease Control and Prevention (CDC) as a guideline 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 prerequisite 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 establish better quality indoor air in the building after construction and during occupancy.

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 (µg/m³)	Allowed Test Methods
Carbon monoxide (CO)	9 ppm; no more than 2 ppm above outdoor levels	ISO 4224 EPA Compendium Method IP-3 GB/T 18883-2002 for projects in China Direct calibrated electrochemical instrument with accuracy of (+/- 2% ppm <50 ppm minimum accuracy).
PM 10	ISO 14644-1:2015, cleanroom class of 8 or lower 50 µg/m³ Healthcare only: 20 µg/m³	Particulate monitoring device with accuracy greater of 5 micrograms/m3 or 20% of reading and resolution (5 min average data) +/- 5 µg/m³
PM 2.5	12 µg/m³ or 35 µg/m³**	
Ozone	0.07 ppm	Monitoring device with accuracy greater of 5 ppb or 20% of reading and resolution (5 min average data) +/- 5 ppb ISO 13964 ASTM D5149 -– 02 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/m³ limit, all other projects should meet the 12 ug/m³ 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/m³, 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; EPA TO-11a, EPA comp. IP-6A ASTM D5197-16
Acetaldehyde 75-07-0	140 $\mu g/m^3$	
Benzene 71-43-2	3 $\mu g/m^3$	ISO 16000-6 EPA IP-1, EPA TO-17, EPA TO-15 ISO 16017-1, 2; 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 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 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

Option 1. ASHRAE Standard 55-2017

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.

OR

Option 2. ISO Standards

Design HVAC systems and the building envelope to meet the requirements of the applicable standard:

- ISO 7730:2005, Ergonomics of the Thermal Environment, analytical determination and interpretation of thermal comfort, using calculation of the PMV and PPD indices and local thermal comfort criteria; and
- ISO 17772-2017, Energy Performance of Buildings- Indoor environmental quality- Part 1. Indoor environmental input parameters for the design and assessment of energy performance of buildings Section A2.

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

Changes for this credit include updates to recent versions of referenced ASHRAE and European standards or updates to reference more globally applicable standards. The changes made were to the following standards:

- ASHRAE 55-2010 → ASHRAE 55-2017 (updated version)
- ASHRAE Applications Handbook 2011 edition → ASHRAE Applications Handbook 2015 edition (updated version)
- EN 15251 → ISO 17772-2017 (global applicability)

Step-by-Step Guidance

Refer to LEED v4 ref guide with the following modifications
Step 4. Select Thermal Comfort Standard
Option 1 is suited for most U.S. project teams who are familiar with ASHRAE Standard 55-2017 that can be used for both mechanically and naturally conditioned spaces. Option 2 now encompasses a slightly different standard ISO 17772-2017 instead of previously available EN 15251-2007 for naturally conditioned spaces but ISO 7730-2005 is still valid for mechanically conditioned spaces as before.

Option 1. ASHRAE Standard 55-2017

Step 1. Select Analysis Method(s) - Use the following sections for the newer ASHRAE Standard 55-2017 for thermal comfort analysis.

For mechanically conditioned spaces, select one of more of the following from section 5.3, Method for Determining Acceptable Thermal Environment in Occupied Spaces:

- Section 5.3.1, Graphic Comfort Zone Model
- Section 5.3.2 Analytical Comfort Zone Model with Normative Appendix B
- Section 5.3.3 Elevated Air Speed Comfort Zone Method

Section 5.3.4 must also be followed for potential sources of local discomfort.

For naturally conditioned spaces, select Section 5.4, Determining Acceptable Thermal Conditions in Occupant-Controlled Naturally Conditioned Spaces. This method is available only for spaces that meet certain criteria (see Further Explanation below, Criteria for Occupant-Controlled Naturally Conditioned Spaces). Spaces that do not meet these criteria must follow one of the mechanically conditioned spaces methods.

For mixed mode spaces, each seasonal conditioning strategy must be documented separately. For example, demonstrate heating season compliance using Section 5.3 and cooling season compliance using Section 5.4.

Step 2: Perform Analysis: Perform analysis exactly as per LEED v4 ref guide for this section if using Section 5.3 or Section 5.4 of the newer ASHRAE Standard 55-2017.

Step 3: Follow design guidelines as per LEED v4 ref guide for this step per Section 6.1 of ASHRAE 55-2017.

Option 2. ISO 7730-2005 and ISO 17772-2017

Step 1. Select Analysis method (s)
Select either ISO 7730-2005 for mechanically conditioned spaces or the newer standard ISO 17772-2017, Section H.2 Default acceptable indoor temperatures for buildings without mechanical cooling systems (i.e. for naturally conditioned spaces). Follow ISO method for spaces that do not meet criteria listed below Further Explanation, Criteria for Occupant- Controlled Naturally Conditioned Spaces.

For mixed mode spaces, each seasonal conditioning strategy must be documented separately. For example, demonstrate heating season compliance using ISO 7730 and cooling season compliance using ISO 17772-2017.

Step 2: Select Building Category
Refer to LEED v4 ref guide for guidance on this section with the exception of following the newer standard ISO 17772-2017 instead of EN 15251-2007. The comparison of comfort acceptability ranges (allowed PMV and PMD percentages) for the two standards and category descriptions still hold valid per Table 1 of LEED v4 ref guide.

Step 3: Perform Analysis
If using ISO 7730-2005, perform the analysis as described in LEED v4 ref guide.
If using ISO 17772-2017, calculate running mean outdoor temperatures for the project' s location as described in Section H.2 of this ISO standard, for times of the year when natural conditioning is used. Use Figure H.1 to establish the upper and lower operative temperature limits of the comfort zone and use Figure H.1 of ISO 17772-2017 to plot running mean outdoor temperatures, comfort zone boundaries, and design operative temperatures as in LEED v4 ref guide.

Further Explanation
Criteria for Occupant-Controlled Naturally Conditioned Spaces

The same set of requirements per LEED v4 ref 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 ref 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 ref 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 ref 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 ref 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 ref 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 demonstrating Option 1 compliance, meet ASHRAE Standard 55-2017 for 80% acceptability with the same submittals and copies of ASHRAE 55-2017, Appendix I, Figure I2, Figure I4 or Figure I5 or predicted worst case indoor conditions for each month on copy of Figure 5.4.
- For demonstrating Option 2 compliance, meet ISO 7730 or ISO 17772-2017 as applicable.

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 prerequisite 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' productivity, comfort, and well-being by providing high-quality lighting.

Requirements

NC, Schools, Data Centers, Warehouses & Distribution Centers, Hospitality

Select one or both of the following two options.

Option 1. Lighting Control (1 point)

For at least 90% of individual occupant spaces, provide individual lighting controls that enable occupants to adjust the lighting to suit their individual tasks and preferences, with at least three lighting levels or scenes (on, off, midlevel). Midlevel is 30% to 70% of the maximum illumination level (not including daylight contributions).

For all shared multioccupant spaces, meet all of the following requirements.

- Have in place multizone control systems that enable occupants to adjust the lighting to meet group needs and preferences, with at least three lighting levels or scenes (on, off, midlevel).
- Lighting for any presentation or projection wall must be separately controlled.
- Switches or manual controls must be located in the same space as the controlled luminaires. A person operating the controls must have a direct line of sight to the controlled luminaires.

Hospitality only

Guest rooms are assumed to provide adequate lighting controls and are therefore not included in the credit calculations.

AND/OR

Option 2. Lighting Quality (1 point)

Choose four of the following strategies.

A. For all regularly occupied spaces, use light fixtures with a luminance of less than 2,500 cd/m^2 between 45 and 90 degrees from nadir.
   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).
B. For the entire project, use light sources with a CRI of 80 or higher. Exceptions include lamps or fixtures specifically designed to provide colored lighting for effect, site lighting, or other special use.
C. For at least 75% of the total connected lighting load, use light sources that have a rated life (or L70 for LED sources) of at least 24,000 hours (at 3-hour per start, if applicable).
D. Use direct-only overhead lighting for 25% or less of the total connected lighting load for all regularly occupied spaces.
E. For at least 90% of the regularly occupied floor area, meet or exceed the following thresholds for area-weighted average surface reflectance: 85% for ceilings, 60% for walls, and 25% for floors.

F. If furniture is included in the scope of work, select furniture finishes to meet or exceed the following thresholds for area-weighted average surface reflectance: 45% for work surfaces, and 50% for movable partitions.
G. For at least 75% of the regularly occupied floor area, meet a ratio of average wall surface illuminance (excluding fenestration) to average work plane (or surface, if defined) illuminance that does not exceed 1:10. Must also meet strategy E, strategy F, or demonstrate area-weighted surface reflectance of at least 60% for walls.
H. For at least 75% of the regularly occupied floor area, meet a ratio of average ceiling illuminance (excluding fenestration) to work surface illuminance that does not exceed 1:10. Must also meet strategy E, strategy F, or demonstrate area-weighted surface reflectance of at least 85% for ceilings.

RETAIL NC

For at least 90% of the individual occupant spaces in office and administrative areas, provide individual lighting controls.

In sales areas, provide controls that can reduce the ambient light levels to a midlevel (30% to 70% of the maximum illumination level not including daylight contributions).

HEALTHCARE

Provide individual lighting controls for at least 90% of individual occupant spaces in staff areas.

For at least 90% of patient positions, provide lighting controls that are readily accessible from the patient's bed. In multioccupant patient spaces, the controls must be individual lighting controls. In private rooms, also provide exterior window shades, blinds, or curtain controls that are readily accessible from the patient's bed. Exceptions include in-patient critical care, pediatric, and psychiatric patient rooms.

For all shared multioccupant spaces, provide multizone control systems that enable occupants to adjust the lighting to meet group needs and preferences, with at least three lighting levels or scenes (on, off, midlevel). Midlevel is 30% to 70% of the maximum illumination level (not including daylight contributions).

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 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 prerequisite 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.

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 only 1 or 2 points achieved above.*	Exemplary performance *or 1 additional point if only 1 point achieved above.*

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 (76 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.

CS only
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.

Core and Shell only
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 Schools, 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 pojnts.

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 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 give building occupants a connection to the natural outdoor environment by providing quality views.

Requirements

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

Achieve a direct line of sight to the outdoors via vision glazing for 75% of all regularly occupied floor area.

View glazing in the contributing area must provide a clear image of the exterior, not obstructed by frits, fibers, patterned glazing, or added tints that distort color balance.

Additionally, 75% of all regularly occupied floor area must have at least two of the following four kinds of views:

- multiple lines of sight to vision glazing in different directions at least 90 degrees apart;
- views that include at least two of the following: (1) flora, fauna, or sky; (2) movement; and (3) objects at least 25 feet (7.5 meters) from the exterior of the glazing;
- unobstructed views located within the distance of three times the head height of the vision glazing; and
- views with a view factor of 3 or greater, as defined in "Windows and Offices; A Study of Office Worker Performance and the Indoor Environment."

Include in the calculations any permanent interior obstructions. Movable furniture and partitions may be excluded.

Views into interior atria may be used to meet up to 30% of the required area.

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

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 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 prerequisite 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

[3] Adapted from ASHRAE (2007d), ASA (2008), ANSI (2002), and CEN (2007)

	Large-capacity space with speech amplification	< 1.5

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. Follow the recommended methodologies and best practices for mechanical system noise control in ANSI Standard S12.60–2010, Part 1, Annex A.1; the 2015 ASHRAE Handbook—HVAC Applications, Chapter 48, Sound and Vibration Control, with errata; AHRI Standard 885–2008; or a local equivalent.

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 1.2-5.1.6 and Section 1.2-5.1.6.2
- 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 1.2-5.1.4 (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.

Healthcare

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 prerequisite 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.

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. 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 ▸ Introduced exemplary performance options for site selection, social equity, and health & well-being
LOCATION AND TRANSPORTATION		
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 ▸ "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 ▸ Removed Option 1, Historic District ▸ Restructured credit with Option 1, Priority Site (1 point) and Option 2, Equity and Community Benefits (1 point) ▸ Under Option 1, added Path 1, Economically Disadvantaged Community Location and Path 2, Brownfield Remediation ▸ 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
Credit	Access to Quality Transit	▸ Allowed privately-run shuttles only when open to the public ▸ Added intermediate thresholds at 2 and 4 points ▸ Added 3 point threshold for Schools ▸ Reduced lowest weekend minimum from 40 to 30 trips ▸ 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)

		▸ Removed language about circular routes ▸ Moved language about overlapping trips paragraph/express service for inclusion in the Reference Guide ▸ Changed “private shuttles” to “privately-run shuttles”
Credit	Bicycle Facilities	▸ Long-term bicycle storage for residential projects revised to a requirement of 15% of regular building occupants rather than 30% ▸ Allowed on-site bicycle sharing stations to count for 50% of the long-term and short-term bicycle storage space for all projects ▸ Included language from a LEED Interpretation about showers for projects with a high occupancy count ▸ Extended the distance to short-term storage to 200ft (60m) and long-term storage to 300ft (90m) ▸ Allowed indoor storage as long as it meets the distance requirement. Exempted vertical distance travelled by elevator from walking distance requirements. ▸ 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.
Credit	Reduced Parking Footprint	▸ Removed Case 1 and 2 ▸ Required 30% parking reduction for all projects ▸ Updated to 4th edition of ITE standard ▸ Removed carpool preferred parking requirement ▸ Added new Options: Option 1. No Off-Street Parking, Option 2. Reduce Parking, Option 3. Carshare, and Option 4. Unbundling Parking. For documentation of Option 3, required projects to show legal agreement between carshare company and project
Credit	Green Vehicles	▸ Only referred to green vehicles as electric vehicles (EV) only. Changed credit title to reflect this. ▸ Removed preferred parking requirements ▸ Removed Option 2. Liquid, gas, or battery facilities and replaced with Option 2. Electric Vehicle Charging Infrastructure ▸ Removed Option 1. Green Passenger Vehicles and replace with Option 1. Electric Vehicle Charging for school projects. Added Option 2. Electric Vehicle Charging Infrastructure. ▸ 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 ▸ 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 ▸ Removed TR-55 requirement ▸ 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” ▸ Changed from 30% to 25% restoration ▸ Added required soils test of imported soils that includes recommended amendments. ▸ Added new vegetation section – pulled from SITES v2 ▸ Revised Option 2. Financial Support cost to $0.20 per square foot (as opposed to $0.40) ▸ For international projects pursuing Option 2. Financial Support, land trust must be a project supported by The Nature Conservancy or the World Land Trust
Credit	Open Space	▸ Clarified 25% vegetated space vs. 30% total outdoor space requirement ▸ Removed 1.5 FAR requirement for green roofs
Credit	Rainwater Management	▸ Added new percentile reduction thresholds – 80th, 85th, 90th percentile ▸ Added requirement to treat run-off from pollution generating hard surfaces with LID ▸ Eliminated the use of “manage” and replaced with “retain (i.e. infiltrate, evapotranspirate, or collect and reuse)” ▸ Eliminated Option 2 and Option 3 ▸ 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. ▸ Allowed excess drainage offsite for ZLL projects if appropriate (built to accommodate project) ▸ 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 ▸ Added language referencing new ANSI/CRRC S100 standard for Cool Roof Rating Council’s “Rapid Ratings”

		▸ 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 ▸ Updated performance standard for commercial clothes washers ▸ Identified EU A+++ label for residential appliances as acceptable alternative to ENERGY STAR
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
Credit	Cooling Tower Water Use	▸ Updated name: Cooling Tower and Process Water Use ▸ Updated points available for Core and Shell projects: 3 total ▸ Updated requirements to earn 2 points under Option 1: increase max. cycles achieved for 1 point by 25% ▸ New Option 2 No Cooling Tower (former pilot ACP 94) ▸ 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 ▸ Updated BECx referenced standard to ASTM E2947-16: Standard Guide for Building Enclosure Commissioning
Prerequisite	Minimum Energy Performance	▸ Updated standard to 90.1-2016 ▸ Permitted compliance using cost or GHG emissions ▸ Permitted on-site renewables for compliance
Prerequisite	Building-Level Energy Metering	▸ None
Prerequisite	Fundamental Refrigerant Management	▸ None
Prerequisite	Enhanced Commissioning	▸ See Prerequisite Fundamental Commissioning and Verification.
Credit	Optimize Energy Performance	▸ See Prerequisite Minimum Energy Performance. ▸ Option 1. Energy Performance Compliance: Two metrics based on GHG emissions and cost o On-site renewables permitted for cost and GHG emissions metrics o New off-site renewables permitted for GHG emissions metric ▸ Option 1. Energy Performance Compliance: New options for data centers ▸ Option 2. Advanced Energy Design Guide: Added AEDG for Grocery Stores and revised options for CS ▸ 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
Credit	Advanced Energy Metering	▸ None
Credit	Demand Response	▸ Credit renamed to Grid Harmonization ▸ New requirement to include DR program and technologies in building systems manual ▸ New Case 3. Load Flexibility and Management Strategies (1-2 points)
Credit	Renewable Energy Production	▸ Combined with EA credit Green Power and Carbon Offsets into new EA credit Renewable Energy ▸ Allowed more off-site renewables to contribute to compliance ▸ Created incentives that reward more impactful investment in renewable energy
Credit	Enhanced Refrigerant Management	▸ None

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	▸ Replaced requirement to approximate diversion amounts per material in plan. Require reporting expected diversion rate per material stream instead.
Prerequisite	PBT Source Reduction – Mercury	▸ None
Credit	Building Life-Cycle Impact Reduction	▸ Option 1 & 2: None. ▸ Option 3: Building and Material Reuse: Reintroduced pathways from v2009 MRc1.1 and MRc1.2 building re-use credits with slightly modified thresholds. ▸ Option 4: Whole Building Life cycle assessment o Added two additional entry pathways to existing WBLCA requirements. ▸ Added a fourth pathway to demonstrate embodied carbon impact reductions by incorporating building re-use and/or salvage materials into WBLCA.
Credit	Building Product Disclosure and Optimization – Environmental Product Declarations	▸ Option 1: Environmental Product Declaration o Partial weightings for product contributions in Option 1 removed and all options worth “1 full product”. o Reduced number of products requirement (10 from three manufacturers) for BD+C- CS and BD+C- Warehouses and Distribution Centers. o Third-party verified EPDs worth 1.5 products. ▸ Option 2: Multi-attribute Optimization o Reduced cost requirement from 50% to 10%. o Added alternative pathway based on number of products. o Added additional onboarding pathways for EPDs (similar to WBLCA credit), starting with manufacturer action plan; followed by tiers of comparative EPD analysis of increasing reductions. o 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 o Moved entire Option 1 to pilot credit library. o Point transferred to Option 2. ▸ Option 2: Leadership Extraction Practices o Modify cost threshold from 25% to 20% from three manufacturers for 1 point.

		○ Add additional cost threshold of 40% from five manufacturers for 2 points. ○ Added additional lower tier valuation (50% of cost) to bio-based material pathway. ▸ 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: Reduced number of products requirement (10 products from three manufacturers) for BD+C- CS and BD+C- Warehouses and Distribution Centers. ▸ Option 2: Material Ingredient Optimization ○ Reduced cost threshold from 25% to 10%. ○ Added alternative pathway based on number of products. ○ 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. ▸ Option 3: Supply Chain Optimization ▸ Move to pilot credit library for revisions.
Credit	PBT Source Reduction – Mercury	▸ None
Credit	PBT Source Reduction – Lead, Cadmium, and Copper	▸ None
Credit	Furniture and Medical Furnishings	▸ Option 1 and Option 2: None ▸ Option 3: Multi-attribute Assessment of Products ▸ Aligned rating system requirements for EPD and sourcing attributes to modified requirements in MR credits BPDO- Environmental Product Declarations and BPDO- Responsible Sourcing of Raw Materials credits.
Credit	Design for Flexibility	▸ None
Credit	Construction and Demolition Waste Management	▸ Option 1: Diversion ○ Added additional pathways for using certified recycling facility for both levels of waste diversion. ▸ Option 2: Reduction of total waste material ○ Updated thresholds for total generated waste to be more consistent with LEED project generation rates. ▸ Clarified that waste generation target only applies to new construction waste. Clarified that any

		demolition or renovation waste must be 75% diverted or more but does not count against total generated waste target.
INDOOR ENVIRONMENTAL QUALITY		
Prerequisite	Minimum Indoor Air Quality Performance	▸ Updated referenced standard from ASHRAE 62.1-2010 to 62.1-2016 ▸ Updated referenced standard from EN 15251-2007 to ISO 17772-2017 ▸ Updated referenced standard from EN 13779-2007 to EN 16798-3: 2017 ▸ Revised credit language to clarify specific sections from 62.1-2016 that are required ▸ For naturally ventilated spaces, reorganized credit language to clarify compliance options, including new option for projects located in historic buildings ▸ Revised requirements for outdoor air monitoring. Monitors are not required for small systems and requirements for constant-volume systems are now more specific. ▸ Revised residential requirements to align with LEED v4.1 multifamily requirements for combustion venting and radon-resistant construction ▸ Revised healthcare credit requirements to align with NC ▸ Updated referenced standard from ASHRAE 170-2008 and FGI 2010 to ASHRAE 170-2017
Prerequisite	Environmental Tobacco Smoke Control	▸ Added definition for smoking ▸ Clarified 25 feet code exception ▸ 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 ▸ 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	▸ None
Credit	Enhanced Indoor Air Quality Strategies	▸ Updated referenced standard for Option 1. Strategy C. Filtration from ASHRAE 52.2-2010 to ASHRAE 52.2-2017 ▸ Updated referenced standard for Option 1. Strategy C. Filtration from EN 779-2002 to ISO 16890-2016 ▸ Updated referenced standard for Option 2, Strategy C. from ASHRAE 62.1-2010 to ASHRAE 62.1-2016

Credit	Low-Emitting Materials	▸ Restructured credit: deleted option 2, credit achievement is based on # of compliant product categories ▸ Revised thresholds for each product category (ranging from 75-100%) ▸ Revised product categories- split category for ceilings, walls, thermal, and acoustic insulation into three product categories: (1) ceilings (2) wall panels and (3) insulation ▸ 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.) ▸ Updated referenced standard for CDPH standard method v1.1 to CDPH standard method v1.2 ▸ Updated international requirements for VOC emissions into formal option, and revised referenced standard for testing from AgBB 2010 to CEN TS 15616 and VOC limits from AgBB 2010 to AgBB 2015 ▸ Clarified international requirement for formaldehyde limit of 10 micrograms per cubic meter ▸ Updated referenced standard for SCAQMD Rule 1113 from June 3, 2011 to February 5, 2015 date ▸ Updated referenced standard for SCAQMD Rule 1168 from July 1, 2005 to October 6, 2017 date ▸ Added dates for Canadian VOC Concentration limits for architectural coatings, Hong Kong air pollution control VOC regulations ▸ Added referenced standard for adhesives and sealants: TRGS 610 (January 2011) ▸ Added referenced standards for composite wood: EPA TSCA Title VI, EN 717-1-2014, and structural composite wood industry standards ▸ Updated referenced standard for ANSI/BIFMA M7.1-2011 to ANSI/BIFMA M7.1-2011(R2016) ▸ Updated referenced standard for ANSI/BIFMA e3-2011 to ANSI/BIFMA e3-2014e ▸ 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 ▸ 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 ▸ Updated referenced standard from EN 779-2002 to ISO 16890-2016

		▸ Changed tobacco product prohibition to smoking prohibition and included definition for smoking ▸ Changed smoking prohibition to include any smoking building openings (not just entrances) ▸ 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 ▸ 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 ▸ 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) ▸ Revised concentration limit for ozone to align with latest U.S. EPA NAAQS ▸ Added and revised allowed test methods ▸ Reduced list of individual VOCs to be included in testing ▸ Lowered concentration limit for formaldehyde ▸ 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 ▸ Updated referenced standard for ASHRAE Applications Handbook 2011 edition to 2015 edition ▸ Updated referenced standard from EN 15251 to ISO 17772-2017
Credit	Interior Lighting	▸ None
Credit	Daylight	▸ Revised Option 1, ASE is required to be calculated but removed specific 10% threshold ▸ Revised thresholds and points for Options 1, 2, and 3 ▸ Revised Option 1 to require sDA to be calculated for each individual space in addition to average sDA for all regularly occupied floor area ▸ Clarified healthcare requirements only apply to regularly occupied spaces in the perimeter area ▸ Added reference to IES LM-83-12 for sDA and ASE ▸ Added exceptions for 3000 lux value if view-preserving automatic (with manual override) glare-control devices are used
Credit	Quality Views	▸ None
Credit	Acoustic Performance	▸ Revised to allow for two of 3 criteria for 1 point

		▸ Updated referenced standard from 2011 AHSRAE Handbook—HVAC Applications to 2015 ASHRAE Handbook—HVAC Applications ▸ Added additional option for sound measurements: IEC 61672-1:2013 ▸ Added NIC option for sound transmission ▸ Revised sound transmission table: added NIC option for compliance, revised adjacency combinations and associated STCc ratings ▸ Added option for using reduced STCc ratings or NIC values if sound masking is used ▸ Deleted sound reinforcement and sound masking requirements ▸ Revised reverberation time table ▸ Updated referenced standards for Healthcare from FGI 2010 to FGI 2018
INNOVATION		
Credit	Innovation	▸ Added reference to the Innovation Catalog ▸ 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