



LEED Green Associate Exam Prep Course

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Course Description and Objectives

Course Description

The LEED Green Associate Exam Preparation Course equips students with a fundamental understanding of green design, construction, and operational practices applicable to commercial and residential buildings.

This course aims to prepare students for the LEED Green Associate Exam. It preps students by explaining the LEED Green Associate Knowledge and Task Domains.

Course Objectives

1. Define LEED, the various rating systems, and the certification process.
2. Discuss the core concepts of green building and outline the various LEED credit categories for different types of buildings, including commercial, residential, new construction, and existing structures.
3. Explain the necessary tasks involved in effectively and safely administering LEED.

Registration

Below is some helpful information regarding registration for the LEED Green Associate exam:

- Register at <http://www.usgbc.org/registration/create-user> with your full name (must match your legal form of identification exactly).
- Apply and pay for the Green Associate Exam at <http://www.usgbc.org/account/credentials>.
- Schedule your exam by visiting <https://www.prometric.com/gbcj>. Select the location, day, and time that you'd like to take the test. You may select to take it at a physical testing center or remotely.
- Record your confirmation number. It will be needed to confirm, cancel, or reschedule your exam on the Prometric website.

Testing Fees

These are the current fees for the LEED Green Associate Exam:

- USGBC® Member: \$200
- Non-Member: \$250
- Student: \$100
- Veteran: Free

Eligibility Requirements

There are no prerequisites needed to take the test, but it is recommended to have exposure to LEED and green building concepts through educational courses, volunteering, or work experience prior to testing.

To be eligible for the LEED Green Associate credential, you must:

- 1) Ask your parent or guardian to complete the Parental Consent form if you are under the age of 18
- 2) Agree to the Disciplinary and Exam Appeals Policy and credentialing maintenance requirements

Where to Take the Exam

Testing at a Physical Testing Center

If you choose to test at a physical testing center, you will go to a Prometric Testing Center. The following list shows additional information about Prometric Testing Centers:

- Prometric Testing Centers
 - Usually open Monday – Saturday from 8 AM – 8 PM (local time)
 - Typically located in a business park and/or office building
 - Video monitored and recorded
 - Quiet setting
- Bring a photo ID with a signature that matches your registration
- Arrive 30 minutes early (account for traffic)

Testing Remotely

If you choose to test remotely, follow these tips:

- Check in advance that your computer meets the technical specifications and that your testing space meets the testing environment requirements (see below).
- Be aware that it is a proctored exam.
- Log on to the ProProctor site 30 minutes early.

Technical Requirements

- Screen Resolution: 1024 x 768 is the minimum resolution required, 1920 x 1080 recommended
- Operating System: Windows 7 or higher | MacOS 10.13 or higher
- Web Browser: Latest Google Chrome
- Webcam Resolution: 640 X 480 pixels external for desktops, internal for laptops
- Microphone: Enabled
- Download Speed: 500 Kbps or greater
- Upload Speed: 384 Kbps
- Only a laptop or desktop computer can be used to take the exam.

- No dual-monitor configurations are permitted for testing (such as a desktop with two monitors or a laptop with a separate monitor).
- Computers must be undocked and have a movable web-cam.
- Download and install the ProProctor application by visiting <https://rpcandidate.prometric.com/>.

Test Environment Requirements

- Space must be indoors (walled), well lit, and free from background noise and disruptions.
- No third party may be present in the room or enter the room for the duration of the exam.
- Area must be free of pens, paper, electronic devices, etc.
- Area must be cleared of content that could potentially provide an unfair advantage during the exam (including items posted on walls).
- Two tissues are permitted in the testing space.
- Space must be set up to eliminate distractions and prevent outside viewing (covering windows may be necessary).

LEED Green Associate Exam

The Test

- 100 questions
 - Multiple choice (recall, application, and analysis questions)
 - Computer-based
 - Closed book
- Total time = 2:20
 - 10-minute introduction
 - 2-hour test
 - 10-minute optional survey
- No scheduled breaks
- Calculator, dry erase board, and marker are provided

Scoring

- Scores range from 125-200.
- A passing score is 170 or higher.
- Harder questions carry more weight.
- Not all questions are scored (15 unscored questions).

Testing Tips

- Read each question on your exam twice! Often the LEED Green Associate Exam will try to trick you by using words like “not” or “isn’t”.
- Answer all questions the first time through.
- Choose the BEST option (there may be more than one correct answer).
- Mark the questions that you are uncertain about.
- Review marked questions in depth.
- Take your time.

Exam Specifications

The following outline provides a general description of exam content areas. Knowledge Domains reflect the rating systems' credit categories and what one needs to know as a LEED Green Associate.

Knowledge Domains

1. LEED Process (16 Questions)

- A. Organization fundamentals
- B. Structure of LEED rating systems
- C. Scope of each LEED rating system
- D. LEED development process
- E. Credit categories
- F. Impact categories
- G. LEED certification process
- H. Other rating systems

2. Integrative Strategies (8 Questions)

- A. Integrative process
- B. Integrative project team members
- C. Standards that support LEED

3. Location and Transportation (7 Questions)

- A. Site selection
- B. Alternative transportation

4. Sustainable Sites (7 Questions)

- A. Site assessment
- B. Site design and development

5. Water Efficiency (9 Questions)

- A. Outdoor water use
- B. Indoor water use
- C. Water performance management

6. Energy and Atmosphere (10 Questions)

- A. Building loads
- B. Energy efficiency

- C. Alternative and renewable energy practices
- D. Energy performance management
- E. Environmental concerns (e.g., sources and energy resources; greenhouse gases; global warming potential; resource depletion; ozone depletion)

7. Materials and Resources (9 Questions)

- A. Reuse
- B. Life-cycle impacts
- C. Waste
- D. Purchasing and declarations

8. Indoor Environmental Quality (8 Questions)

- A. Indoor air quality
- B. Lighting
- C. Sound
- D. Occupant comfort, health, and satisfaction

9. Project Surroundings and Public Outreach (11 Questions)

- A. Environmental impacts of the built environment
- B. Codes
- C. Values of sustainable design
- D. Regional design

Task Domains

Task Domains indicate the tasks necessary to perform LEED safely and effectively. The LEED Task Domains are as follows:

- Communicate broad and basic green building concepts to team or colleagues
- Research and create a library of sustainable building materials
- Assist others with sustainability goals
- Create project profiles/case studies/press releases
- Serve as a green advocate to clients, team members and the general public (e.g. why green building)
- Stay current on any updates to LEED and green strategies in general
- Navigate LEED Online



- Assist project leaders with LEED correspondence to project team members (consultants, contractors, owner, etc.)
- Assist in managing the documentation process
- Assist in managing the LEED certification timeline

Studying for the Exam

LEED Reference Standards

- ACEEE ≥ 45 : Green Vehicles credit
- EPA Construction General Permit: Construction Activity Pollution Prevention prerequisite
- Energy Policy Act/EPAct: Indoor Water Use Reduction prerequisite
- ASHRAE 90: Minimum Energy Performance prerequisite
- Montreal Protocol: Fundamental Refrigerant Management prerequisite
- Center for Resource Solutions: Manages the GREEN-E program
- Green-e: Renewable Energy Production credit AND Greenpower and Carbon Offsets credit
- CBECs: Renewable Energy Production credit AND Greenpower and Carbon Offsets credit
- ISO 14: A product's life cycle
- ASHRAE 62: Minimum IAQ prerequisite
- CIBSE: Minimum IAQ for natural or mixed mode ventilation
- MERV 8: Construction IAQ credit
- MERV 11: Minimum IAQ prerequisite
- MERV 13: Enhanced IAQ credit
- ASHRAE 52: Filtration
- ASHRAE 55: Thermal Comfort credit

Information to Study

- 1) Memorize reference standards and credit requirements.
- 2) On the practice questions, understand why the right answer is right and the wrong answers are wrong. Read the justifications.
- 3) Review key concepts such as:
 - Definition of LEED
 - Triple Bottom Line
 - Embodied energy
 - 40/60 rule
 - MPRs, PRs, and credits
 - Strategy synergies
 - Building facts

- Split vs. standard reviews
- LEED interpretations vs. CIRs
- LEED Process
- USGBC® organization principles
- Examples of LEED thinking

Note: Not all of these concepts are covered in this course.

4) Look on the USGBC® website to understand more about the LEED Process and listed references, including:

- LEED Green Associate Candidate Handbook
- Green Building and LEED Core Concepts Guide, 3rd Edition
- LEED Building Design + Construction Reference Guide, v4 Edition
- LEED v4 Impact Category and Point Allocation Process Overview
- LEED v4 User Guide
- Guide to LEED Certification: Commercial
- LEED Certification Fees
- Rating System Selection Guidance

5) Look at additional resources, including:

- LEED Credit Library
- LEED Pilot Credit Library
- LEED Addenda Database
- Regional Priority Credits
- Innovation Catalog
- Sample Credit Forms
- Foundations of LEED



After the Exam

Exam Results

After completing your exam, your score will be displayed on the screen. Remember, a score of 170 or higher is required to pass. You will also receive a score report via email shortly after your exam. Within 72 hours of your appointment, your exam results will be processed, and your Credentials account will be updated accordingly. If you have earned a credential, it will also be updated in the USGBC® directory.

What Happens When You Pass the Exam?

Once you have successfully passed the LEED Green Associate exam, you are allowed to use the title "LEED Green Associate" as well as the corresponding logo. Please note that "LEED GA" is not an approved abbreviation for the LEED Green Associate credential and should not be used under any circumstances.

After your exam results have been processed, you can easily obtain a copy of your certificate by accessing your usgbc.org account and downloading it from there.

It is mandatory that you meet all the requirements to maintain your credential. If you need more information on how to maintain your credential, please refer to the CMP Guide at <https://www.usgbc.org/resources/cmp-guide>.

LEED Process

What is LEED?

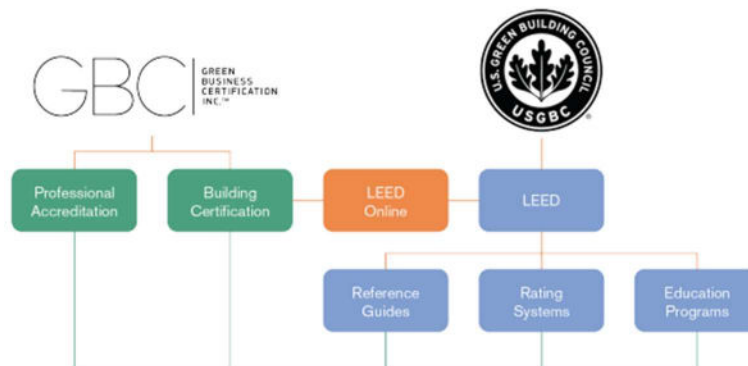
Leadership in Energy and Environmental Design (LEED) is the world's most widely used green building rating system. It measures how environmentally conscience construction projects are. The more conscience, the higher the LEED rating. The higher the LEED rating, the higher energy efficiency and well-being of the inhabitants of the facility. The LEED rating systems are developed by U.S Green Building Council (USGBC®), a nonprofit organization located in Washington, DC.

LEED Thinking

1. LEED takes a whole-building approach to sustainability.
2. LEED takes a life-cycle approach to everything!
3. LEED uses low-impact measures.
4. LEED wants only native and adaptive plants.
5. Non-potable water is best.

GBCI vs USGBC®

Green Business Certification Inc. (GBCI) certifies buildings and maintains credentials for people, while the USGBC® makes the LEED rating systems. The following diagram displays the relationship between GBCI and USGBC®:



*Source: LEED Green Associate V4 Textbook by LeadingGreen

The USGBC®'s mission and vision are given below:

Mission of the USGBC®: *To transform the way buildings and communities are designed, built and operated, enabling an environmentally and socially responsible, healthy and prosperous environment that improves the quality of life.*

Vision of the USGBC®: *Buildings and communities will regenerate and sustain the health and vitality of all life within a generation.*

Credentials/Tiers

LEED Green Associate is the first tier; it is the entry-level certification. Individuals with this credential possess a general knowledge of green building practices and know how to support other professionals.



LEED AP is the second tier. Individuals with this credential have advanced knowledge in green building and expertise in a particular LEED rating system. The specialties are Building Design and Construction (BD+C), Interior Design and Construction (ID+C), Operations and Maintenance (O+M), Homes (H), and Neighborhood Development (ND).



LEED Fellow is the third tier. Individuals with this credential have demonstrated their mastery of LEED technical knowledge and skills and have made significant contributions in teaching, mentoring, or research. They have a history of exemplary leadership, impactful commitment, service, and advocacy in green building and sustainability. To be eligible for nomination, one must have been a LEED AP for at least eight years and have a minimum of ten years of experience in green building. Nomination for the LEED Fellow is done by peers.



LEED Rating Systems

The LEED rating systems cover a wide range, including building design and construction, interior design and construction, building operations and maintenance, new development, as well as homes.

- The LEED for Building Design and Construction (BD+C) rating system is used for new constructions and major renovations. It covers Core and Shell projects, where the basic inside (core) and the outer building envelope (shell) are constructed without adding things like furnishings, interior lighting fixtures, interior walls or ceilings. This rating system includes applications for Schools, Retail, Hospitality, Data Centers, Warehouses & Distribution Centers, and Healthcare buildings.
- The LEED for Interior Design and Construction (ID+C) rating system is used for interior spaces that are a complete interior fit-out. It includes applications for Commercial Interiors, Retail, and Hospitality.
- The LEED for Building Operations and Maintenance (O+M) rating system is used for buildings and spaces that are fully operational and have been occupied for at least one year. The buildings are just undergoing improvement and little to no construction is required. In other words, this rating system is for existing buildings and existing interiors. It includes applications for applications for Schools, Retail, Hospitality, Data Centers, and Warehouses & Distribution Centers.
- The LEED for Homes (H) rating system is used for resident home construction, and it applies for single-family homes, low-rise homes (one to three stories), or mid-rise homes (four to six stories). It can be pursued by developers or by homeowners wanting to build sustainable new construction properties.
- The LEED for New Development (ND) rating system is used for new land development projects or redevelopment projects. It includes projects still in the planning stage as well as built projects.

Use the 40/60 rule to select the appropriate rating system. To do this, first assign a rating system to each square foot of the building, and then choose the most appropriate rating system based on the resulting percentages.

- If a rating system is appropriate for less than 40% of the gross floor area of a LEED project building or space, then that rating system should not be used.
- If a rating system is appropriate for more than 60% of the gross floor area of a LEED project building or space, then that rating system should be used.
- If an appropriate rating system falls between 40% and 60% of the gross floor area, project teams must independently assess their situation and decide which rating system is most applicable.

The entire gross floor area of a LEED project must be certified under a single rating system and is subject to all prerequisites and attempted credits in that rating system, regardless of mixed construction or space usage type.

The rating systems consist of Minimum Program Requirements (MPRs), Prerequisites (PRs), and credits.

- MPRs are fundamental project characteristics for eligibility in a LEED rating system; they are mandatory and administrative.
 - Projects must be in a permanent location on existing land, use reasonable LEED boundaries, and comply with project size requirements.
- PRs are the minimum requirements that all buildings need to meet in order to achieve LEED certification.
 - All PRs must be met for the project to be considered for a certification.
 - Almost every credit category has at least one PR.
- Credits are optional elements that projects can pursue to earn points toward LEED certification. Points are awarded for meeting sustainability criteria. LEED certification is achieved by satisfying all PRs and earning a minimum number of points.
- Synergies among the building strategies is an essential part of designing successful green buildings and getting LEED certified. It is important to understand how different design strategies are interconnected and may contribute to more than one credit category.
- The levels of certification are as follows:



LEED Certification

There are many steps that need to be made for projects to become LEED certified.

1. First, the rating system needs to be selected and the project needs to be registered by the LEED project team.
2. Next, the MPRs, PRs, and credits need to be met and documentation needs to be submitted in LEED Online. Also, a certification application needs to be completed.
3. Last, the GBCI reviews the design and construction to determine if the project meets the LEED requirements.
 - If the GBCI decides that it does meet all requirements, certification is awarded.
 - If certification is denied, project teams can choose to appeal within 25 days of the denial.

Note: A project team can elect to have a combined (standard) review or a split review. In a combined review, all documents are submitted at the end of the construction phase. On the other hand, in a split review, some design prerequisites/credits are submitted for review during the design phase. Any additional design prerequisites/credits and all of the construction prerequisites/credits are submitted at the end of the construction phase. Split reviews are more expensive.

Of course, it costs money to receive a LEED certification.

- The registration fee is \$1,200 for USGBC® members and \$1,500 for non-members.
- There are review fees, but they will vary based on:
 - Gross floor area size (excludes parking)
 - Membership level
 - Rating system
 - Type of review chosen (Combined or Split)

- Additional fees are as follows:
 - Credit Interpretation Requests: \$220
 - LEED Interpretations: \$180-\$380
 - Denied Credit Appeals: \$500-\$800
 - Expedite Fees: \$10,000 per submittal (reduced from 20-25 business days to 10-12 business days)

LEED Volume

The LEED volume program can simplify the process of LEED documentation and accelerate the review process for organizations that plan to certify many new construction projects. It allows organizations to focus on similarities in building design and construction practices, regardless of the location of the projects. LEED volume certification is particularly beneficial for organizations that certify multiple buildings within a given timeframe, especially new construction buildings and commercial interior spaces.

Consider LEED volume certification if you:

- Own multiple buildings or commercial interior spaces that have similar characteristics and require certification
- Established green building practices and have experience with the current version of LEED
- Are willing to form a robust internal system to ensure quality control
- Anticipate a significant number of projects that require LEED certification over the next 3-5 years
- Prioritize efficiency and corporate social responsibility

LEED Campus

LEED campus and multiple building certification is available if project owners have multiple buildings on a single site. It provides various options to assist project owners in determining the most cost-effective way to achieve their goals. Depending on the situation, it could be one certification that applies to several buildings, or it might be reviewing credits once to be used in multiple certifications. Any shared site can qualify as a campus; it is not necessary to be a conventional university or corporate campus. Hospitals, universities, commercial property



management, and even zoos have all used this method with any of the LEED commercial rating systems.

Consider LEED campus certification if you:

- Have two or more buildings situated on a single site (controlled by one entity)
- Would benefit from projects sharing LEED credits and strategies with one another
- Build multiple buildings at the same time
- Manage similar projects that follow the same policies and plans (and share the same vendors)

LEED Online

This is the online platform for LEED projects. The website is <https://www.leedonline.com>. However, you can sign in through <https://www.usgbc.org>. There is a single sign on for all USGBC® and GBCI websites.

You use this platform to register a project, select a rating system, manage project details, assign credits to team members, update and complete documentation, submit to GBCI for review, and earn LEED certification.

Common Misconceptions

- Firms can become LEED APs—only individuals can become LEED APs.
- Individuals can get LEED Certified—only buildings can get LEED Certified.
- Individuals can be USGBC® national members and use the member logo—only firms can be USBGC® national members and use their logo.

Other Rating Systems

There are other Green Building Rating Systems. They include Living Building Challenge, Energy Star, Green Globes (U.S. & Canada), Earthcraft (SE U.S.), and Build-it-Green (California). There are also International Rating Systems. They include BREEAM (UK), Beam (Hong Kong), CASBEE (Japan), and Pearl Rating System for Estidama (UAE).

LEED Project Checklist and Work Plan

This is an example of a checklist for a project to be submitted under the LEED for Building Design and Construction (BD+C) rating system.



LEED v4 for BD+C: New Construction and Major Renovation Project Checklist

Project Name:
Date:

Y ? N



Integrative Process

1

0	0	0	Location and Transportation	16
Y			LEED for Neighborhood Development Location	16
Y			Sensitive Land Protection	1
Y			High Priority Site	2
Y			Surrounding Density and Diverse Uses	5
Y			Access to Quality Transit	5
Y			Bicycle Facilities	1
Y			Reduced Parking Footprint	1
Y			Green Vehicles	1

0	0	0	Materials and Resources	13
Y			Storage and Collection of Recyclables	Required
Y			Construction and Demolition Waste Management Planning	Required
Y			Building Life-Cycle Impact Reduction	5
Y			Building Product Disclosure and Optimization - Environmental Product Declarations	2
Y			Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
Y			Building Product Disclosure and Optimization - Material Ingredients	2
Y			Construction and Demolition Waste Management	2

0	0	0	Sustainable Sites	10
Y			Construction Activity Pollution Prevention	Required
Y			Site Assessment	1
Y			Site Development - Protect or Restore Habitat	2
Y			Open Space	1
Y			Rainwater Management	3
Y			Heat Island Reduction	2
Y			Light Pollution Reduction	1

0	0	0	Indoor Environmental Quality	16
Y			Minimum Indoor Air Quality Performance	Required
Y			Environmental Tobacco Smoke Control	Required
Y			Enhanced Indoor Air Quality Strategies	2
Y			Low-Emitting Materials	3
Y			Construction Indoor Air Quality Management Plan	1
Y			Indoor Air Quality Assessment	2
Y			Thermal Comfort	1
Y			Interior Lighting	2
Y			Daylight	3
Y			Quality Views	1
Y			Acoustic Performance	1

0	0	0	Water Efficiency	11
Y			Outdoor Water Use Reduction	Required
Y			Indoor Water Use Reduction	Required
Y			Building-Level Water Metering	Required
Y			Outdoor Water Use Reduction	2
Y			Indoor Water Use Reduction	6
Y			Cooling Tower Water Use	2
Y			Water Metering	1

0	0	0	Innovation	6
Y			Innovation	5
Y			LEED Accredited Professional	1

0	0	0	Energy and Atmosphere	33
Y			Fundamental Commissioning and Verification	Required
Y			Minimum Energy Performance	Required
Y			Building-Level Energy Metering	Required
Y			Fundamental Refrigerant Management	Required
Y			Enhanced Commissioning	6
Y			Optimize Energy Performance	18
Y			Advanced Energy Metering	1
Y			Demand Response	2
Y			Renewable Energy Production	3
Y			Enhanced Refrigerant Management	1
Y			Green Power and Carbon Offsets	2

0	0	0	Regional Priority	4
Y			Regional Priority: Specific Credit	1
Y			Regional Priority: Specific Credit	1
Y			Regional Priority: Specific Credit	1
Y			Regional Priority: Specific Credit	1

0	0	0	TOTALS	Possible Points: 110
Certified: 40 to 49 points, Silver: 50 to 59 points, Gold: 60 to 79 points, Platinum: 80 to 110				

*Source: USGBC.org

Below is a more detailed breakdown of the work plan. It outlines the steps (recommended by the USGBC®) to certify a project.

✓ Discovery	1. To Initiate the discovery phase- This is the initial research and analysis phase.
✓ Rating System Selection	2. Select LEED Rating System- There are 5 rating system families (<i>BD+C, O+M, ID+C, ND and Homes, which technically falls under the BD+C rating system but has its own reference guide</i>) and 21 adaptations so you may need to spend some time determining which is the best system or adaptation for your building. Use the Rating System Selector and 40/60 rule (pg. 23), if necessary .
✓ Verify MPRs	3. Check Minimum Program Requirements- Verify that you can meet the 3 fundamental MPRs.
✓ Project Goals	4. Establish Project Goals- Use a goal setting workshop to select strategies that make sense in the project site and context that align with the owner's values. <i>Consider goals, budget, schedule, building program requirements, project scope performance targets and the occupants.</i>
✓ Define LEED Project Scope	5. Define LEED Project Scope- Map the LEED project boundary. Ensure that shared amenities, special USGBC programs <i>such as Campus or Volume</i> , and project goals are considered.
✓ Develop Scorecard	6. Develop LEED Scorecard- Select targeted credits and level of LEED certification. Prioritize credits that will bring most value over the longest period of time and provide synergistic benefits (such as a green roof).
✓ Continue Discovery	7. Continue Discovery Phase- Continued meetings, testing, research and analysis.
✓ Continue Iterative Process	8. Continue the Iterative Process
✓ Assign Roles & Responsibilities	9. Assign Roles & Responsibilities- One team member should "take primary responsibility for leading the group through the LEED application and documentation process." ⁽¹⁾ <i>Leader may change between design and construction phase but should be involved through the whole process.</i> Consider assign primary and supporting roles (from different disciplines) for each credit. ⁽²⁾ . <i>Establish a meeting schedule and communication protocol.</i>
✓ Develop Documentation	10. Develop Consistent Documentation- Examples would be having consistent measurements such as FTE, project square footages, boundaries etc...
✓ Submit for Certification	11. Perform Quality Assurance Review & finally Submit for Certification.

1-2. USGBC. *LEED Reference Guide for Building Design and Construction*. 2013 Edition. Pg. 12-13.
Refer to "Devising a LEED Workplan" at <http://www.usgbc.org/guide/bdc>

LEED Credit Categories



1) Integrative Process

The Integrative Process (IP) credit is designed to reward teams for using an integrative and iterative approach to the design, construction, and operation of a building to enhance the efficiency and effectiveness of every system. By looking at interrelationships between building systems (specifically focusing on energy and water), the team should be able to find synergies, increase the project's LEED score, and save money and time by avoiding delays later in the process.

Per USGBC®, the integrative process "should involve rigorous questioning and coordination and challenge typical project assumptions."

Requirements

There are three rules to follow if pursuing this credit:

- 1) Hold a charrette in pre-design. From the pre-design phase (design charrette) to the design phases, it's important to identify and implement opportunities for high performance outcomes across different disciplines and building systems.
- 2) Analyze energy and water systems.
- 3) Inform the design and design documents with these analyses. Research and analysis should inform the Owner's Project Requirements (OPR), Basis of Design (BOD), Design Documents, and Construction.

Energy-Related Systems

During the discovery stage, it is recommended to perform a preliminary energy modeling analysis, commonly known as a "simple box" analysis, before completing the schematic design. This analysis should assess at least two potential strategies from the following categories:

- Site conditions: Shading, exterior lighting, hardscape, landscaping, and adjacent site conditions

- Massing and orientation: Impact on HVAC sizing, energy consumption, lighting, and renewable energy
- Basic envelope attributes: Insulation values, window-to-wall ratios, glazing characteristics, shading, and window operability
- Lighting levels: Interior surface reflectance values and lighting levels in occupied spaces
- Thermal comfort range options
- Plug and process load needs: Equipment, purchasing policies, and layout options
- Programmatic and operational parameters: Multifunction spaces, operating schedules, space allotment per person, teleworking, reduction of building area, and anticipated operations and maintenance

Once the analysis is complete, it should be documented how it informed the OPR and BOD and how it led to the eventual design of the project during the implementation stage. The analysis should inform the building and design of various systems, including building and site program, building form and geometry, building envelope and façade treatments on different orientations, elimination and/or significant downsizing of building systems, and other systems as applicable.

Water-Related Systems

During the discovery stage, it is recommended to conduct a preliminary water budget analysis before the schematic design is completed. Assess the potential non-potable water supply sources and water demand volumes, including:

- Indoor water demand: Flow and flush fixture design case demand volumes, calculated in accordance with Water Efficiency Prerequisite Indoor Water Use Reduction
- Outdoor water demand: Landscape irrigation design case demand volume, calculated in accordance with Water Efficiency Credit Outdoor Water Use Reduction
- Process water demand: Kitchen, laundry, cooling tower, and other relevant equipment demand volumes
- Supply sources: Potential non-potable water supply source volumes, such as on-site rainwater and graywater, municipally supplied non-potable water, and HVAC equipment condensate

During the implementation stage, decisions made during the analysis should be documented in the project's OPR and BOD. At least one on-site, non-potable water supply source should be used for at least two of the water demand elements. The analysis should inform the design of

various systems, including plumbing systems, sewage conveyance and/or on-site treatment systems, rainwater quantity and quality management systems, landscaping, irrigation, and site elements, roofing systems and/or building form and geometry, and other systems as applicable.



2) Location and Transportation

The Location and Transportation (LT) credit category rewards projects located in dense communities with connections to amenities and transportation infrastructure. Location impacts occupant’s behavior and thus the buildings environmental performance.

There are eight total credits under the LT category, as follows:

- LEED for Neighborhood Development Location
- Sensitive Land Protection
- High Priority Site
- Surrounding Density and Diverse Uses
- Access to Quality Transit
- Bicycle Facilities
- Reduced Parking Footprint
- Green Vehicles

LEED for Neighborhood Development Location

This credit seeks to avoid development on inappropriate sites, reduce miles traveled in a vehicle, and encourage daily physical activity.

There are three rules to follow if pursuing this credit:

- 1) Locate your building within a LEED certified neighborhood.
- 2) Figure out the credit points based on the LEED neighborhood’s certification level.
- 3) Seek EITHER this credit OR the other LT credits; not both.

Refer to the following table for more information on points for LEED-ND Location.

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)	Points ID+C
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Certified	8	8	8	5	8
Silver	10	12	10	6	10
Gold	12	16	12	7	12
Platinum	16	20	15	9	18

*Source: USGBC.org

Sensitive Land Protection

The purpose of this credit is to avoid developing on environmentally sensitive land. To achieve this, project teams must develop on a previously developed site (which is land altered by paving or construction). Or, they must avoid locating on land that is prime farmland, in floodplains, a protected habitat, within 100 feet (30 meters) of a body of water, or within 50 feet (15 meters) of a wetland.

Referenced standards include the U.S. Department of Agriculture, list of threatened/endangered species, NatureServe Heritage Program, and the Federal Emergency Management Agency (FEMA).

High Priority Site

The intention of this credit is to encourage project location in areas with development constraints, which can bring both economic and environmental benefits to its surrounding community.

The three paths towards achieving this credit are as follows:

- 1) Locating the project on an infill location in a historic district (1-2 points): An infill site is a site where at least 75% of the land area within half a mile of the project boundary is previously developed.
- 2) Locating on a 'priority designation' site (1-2 points): A priority designation site is a site identified by a federal government agency for priority redevelopment. Below are sites under the priority designation option:
 - a. U.S. Environmental Protection Agency (EPA), National Priorities List
 - b. U.S. Housing and Urban Development, Federal Empowerment Zone, Federal Enterprise Community, or Federal Renewal Community
 - c. U.S. Department of Treasury, Community Development Financial Institutions Fund

- d. U.S. Department of Housing and Urban Development, Qualified Census Tract (QCT), or Difficult Development Area (DDA)
 - e. A local equivalent program administered at the national level for projects outside the U.S.
- 3) Locating on and remediating a brownfield (2-3 points): A brownfield site refers to a piece of real estate where its potential growth, redevelopment, or reuse might be hindered due to the potential existence of hazardous substances, pollutants, or contaminants. The government requires its remediation.

Surrounding Density and Diverse Uses

This credit attempts to conserve land as well as protect farmland and wildlife habitats by encouraging development in areas with existing infrastructure. It promotes walkability, transport efficiency, and daily physical activity.

The credit is based on either the surrounding density or diverse uses as follows:

- 1) Surrounding Density (2-3 points): Calculate residential density, non-residential density, or a combined density. Locate on a site whose surrounding existing density within a ¼ mile (400 meter) radius of the project boundary meets the specified values in the table below.

Table 2: Points for Average Density within ¼ Mile of Project Site

Combined Density (Square feet per acre of buildable land)	Residential Density (DU/acre)	Nonresidential Density (FAR)	Points BD+C (except Core and Shell)	Points BD+C (Core and Shell)	Points ID+C
22,000	7	0.5	2	2	3
35,000	12	0.8	3	4	6

*Source: USGBC.org

- 2) Diverse Uses: The building’s main entrance must be within a half mile walking distance of the main entrance of 4-7 diverse uses (1 point) or 8+ diverse uses (2 points). All walking paths must be less than half a mile.

Note: Only one type of amenity can count in a project (with the exception of two restaurants), one business cannot count as more than one amenity, and the list of diverse uses is based on amenities used most often by most people.

Access to Quality Transit

This credit is important for not only providing access to public transportation, but also ensuring that the quality of transportation is sufficient enough that the access is beneficial to occupants. It aims to reduce greenhouse gas emissions, air pollution, and other environmental/public health harms associated with motor vehicle use. The distance to the transit is measured based on walking distance. The frequency of transit is also taken into account, including both weekdays and weekends. If only considering buses, streetcars, rails, ferries, and other public transportation with a fixed route and regular hours, there should be a minimum of 72 weekday trips within a ¼ mile (400 meters) of the building entry. On the weekend, there should be at least 40 trips. All other types of transit should be within a ½ mile (800 meters) walking distance of the building entry. The following tables provide more information on minimum daily transit service.

Table 3: Minimum Daily Transit Service for Projects with Multiple Transit Types (Bus, Streetcar, Rail, or Ferry)

Weekday Trips	Weekend Trips	Points BD+C (except Core and Shell)	Points BD+C (Core and Shell)	Points ID+C
72	40	1	1	2
144	108	3	3	5
360	216	5	6	7

*Source: USGBC.org

Table 4: Minimum Daily Transit Service for Projects with Commuter Rail or Ferry Service Only

Weekday Trips	Weekend Trips	Points (all projects)
24	6	1
40	8	2
60	12	3

*Source: USGBC.org

Bicycle Facilities

The intent of this credit is to promote bicycling by increasing the amount of bike racks, reduce vehicle distance traveled, and encourage recreational physical activity. To achieve this credit, one needs to identify a bicycle network. A bicycle network is a continuous network consisting of off-street bicycle paths or trails at least 8 feet wide for a two-way path and at least 5 feet wide for a one-way path, physically designated on-street bicycle lanes at least 5 feet wide, or streets designed for a target speed of 25 mph. The project team needs to design or locate the project so a bicycle network is within 200 yards of functional entry that can connect riders with community amenities as well as public transportation.

Commercial or institutional projects have additional requirements. For these projects, the short-term storage should account for at least 2.5% of all peak visitors. But at least four storage spaces should be provided per building. On the other hand, long-term storage should account for at least 5% of regular building occupants. At least four long-term storage spaces should be provided per building (in addition to the short-term storage spaces). In addition, at least one on-site shower and changing facility should be provided for the first 100 regular building occupants, and one additional shower for every 150 regular building occupants thereafter.

Residential projects also have additional requirements. For these projects, the short-term storage should account for at least 2.5% of all peak visitors. But, no fewer than four storage spaces should be provided per building. Long-term storage should be provided for at least 30% of all regular building occupants with at least one storage space per residential unit (in addition to the short-term bicycle storage spaces).

Regardless of the project, short-term bicycle storage must be within 100 feet walking distance of any main entrance and long-term bicycle storage must be within 100 feet walking distance of any functional entry.

Reduced Parking Footprint

This credit aims to reduce environmental harmful effects connected with parking facilities, such as automobile dependence, land consumption, and rainwater runoff. The primary requirement is to meet the minimum local code requirements for parking capacity and then provide parking capacity that is below the base ratios (recommended by the Parking Consultants Council, as shown in the Institute of Transportation Engineers' Transportation Planning Handbook, 3rd edition, Tables 18-2 through 18-4).

Projects that have earned a point in either Surrounding Density and Diverse Uses or Access to Quality Transit (dense and/or transit-served locations) must achieve a 40% reduction from the base ratios. However, if the project team has not fulfilled the Surrounding Density and Diverse Uses credit or the Access to Quality Transit credit (baseline locations), they must achieve a 20% reduction from the base ratios.

Green Vehicles

The final credit of the Location and Transportation category is Green Vehicles. The aim of this credit is to promote the use of alternative fuel automobiles. While some of the terms and requirements of this credit have changed, the general principles remain the same. To achieve this credit, you must provide preferred parking for green vehicles for at least 5% of all parking spaces. Providing a discounted parking rate of at least 20% for green vehicles is an acceptable substitute for preferred parking spaces. It is imperative to clearly identify the green vehicles and enforce either the preferred parking or discounted parking. In addition, you need to install electrical vehicle supply equipment (EVSE) for at least 2% of all parking spaces. The other option is to install liquid or gas alternative fuel fueling facilities or a battery switching station capable of refueling a number of vehicles per day equal to at least 2% of all parking spaces.

It is important to note that you can no longer attain this credit by simply offering green vehicles or a car-sharing program for building occupants. Also, green vehicles must score at least a 45 on the American Council for an Energy Efficient Economy (ACEEE) annual vehicle rating guide (for projects in the U.S.).



3) Sustainable Sites

The Sustainable Sites (SS) credit category is about building context and is particularly focused on the relationship between the project site and the natural environment surrounding it. Credits in this category reward projects for restoring and protecting buildings.

There is one prerequisite and six credits under the SS category. The following is a list of SS prerequisites that you need and credits that you can choose to pursue:

- Construction Activity Pollution Prevention (PR)

- Site Assessment
- Site Development – Protect or Restore Habitat
- Open Space
- Rainwater Management
- Heat Island Reduction
- Light Pollution Reduction

Construction Activity Pollution Prevention: SS Prerequisite

This prerequisite aims to reduce pollution from construction activities.

The requirements for this prerequisite are as follows:

1. Prevent soil loss from storm water runoff and wind by using temporary or permanent seedling/mulching.
2. Stop sedimentation of storm sewers and streams by using silt fences and sediment traps.
3. Avoid polluting the air with dust.

For this prerequisite, Project Teams must create and implement an erosion and sedimentation control plan for all construction activities associated with the project. The plan must abide by the erosion and sedimentation requirements of the 2012 U.S. Environmental Protection Agency (EPA) Construction General Permit (CGP) or its local equivalent, whichever is more stringent. This plan must describe the measures that will be implemented.

Site Assessment

To achieve this credit, assess site conditions prior to starting the design process. Investigate the topography, hydrology, vegetation, climate, soils, human use, as well as health effects, and complete the site survey. Looking at these site elements will inform project design.

Site Development – Protect or Restore Habitat

The intent of this credit is to conserve existing natural areas and restore damaged ones.

The requirement is to restore 30% of previously disturbed portions, using only native/adaptive vegetation, and restore all cleared soils within development footprint. Or, project teams can

provide financial support to a Land Trust Alliance accredited organization within the same EPA Level III ecoregion/project's state. The financial donation requirement is \$0.40 per square foot or \$4 per square meter.

Please note that athletic fields can be excluded from the vegetation and soils requirement if they can prove that the fields are only used for athletic purposes. Similarly, they cannot be counted towards the 30% restoration either.

Open Space

To earn this credit, create a functional outdoor open space that promotes environmental interaction, social interaction, passive recreation, and physical activity. The open space must be physically accessible and be greater than or equal to 30% of the total site area (including building footprint). Below are more requirements for this credit:

- At least 25% of the outdoor space must be vegetated.
- Vegetative roofs qualify and count towards the 25% (only open space).
- Artificial turf doesn't count as hardscape (open space) or vegetative roof.

Rainwater Management

The goal of this credit is to mimic the natural hydrology and water balance of the site, thereby reducing runoff volume and improving water quality. Teams can achieve this by implementing low-impact development (LID) and green infrastructure techniques to manage onsite runoff. There are different options and paths, which vary based on the volume of runoff that needs to be managed.

The first option requires teams to manage a specific percentile of rainfall events on site. To begin, teams must obtain rainfall data for their project location and determine the exact percentile that must be managed on site. Path one (1-2 points) requires the 95th percentile, path two (2-3 points) requires the 98th percentile, and path three (2-3 points) requires the 85th percentile (zero lot projects only).

The second option (2-3 points) requires teams to manage the entire increased runoff volume from natural land cover to post-developed conditions.

Heat Island Reduction

The purpose of this credit is to reduce heat islands and minimize the effects on microclimates as well as human and wildlife habitats.

The Heat Island Effect (HIE) is a phenomenon where hardscape, such as dark and non-reflective pavement and buildings, absorb thermal energy and then release it to the surrounding areas.

Solar Reflectance Index (SRI) is a scale from 0 to 100, with higher SRI indicating better ability to lower the Heat Island Effect. This can be achieved through two measures:

1. Emissivity - It is the ratio of infrared radiation emitted by a surface to the radiation emitted by a black body at the same temperature.
2. Albedo/Reflectance - It is the measure of the surface's ability to reflect sunlight.

There are two options to earn this credit (and it is possible to achieve both options). The first option (1-2 points) explores non-roof and roof measures. The non-roof measures include open grid, vegetation, shade from solar, high SRI paving, vegetated structure, and shade structure. The roof measures look at a high-reflectance roof and a vegetated roof. A low slope indicates a SRI of 64, while a high slope indicates a SRI of 32. The second option (1 point) looks at parking under cover. It is required to have 75% of parking spaces under cover of either a 3-year aged SRI 32 (at least an SRI 39 at installation) roof, vegetated roof covering, or a solar/ wind energy system canopy.

Light Pollution Reduction

The purpose is to enhance night sky access, enhance nighttime visibility, and minimize the negative impact of development on wildlife and people. This credit requires project teams to demonstrate appropriate site lighting based on the lighting zone in which the project is located.

There are two options to achieve this credit:

- The BUG Rating Method: It uses the **Backlight-Uplight-Glare** method of rating each unique luminaire based on its lighting orientation and tilt.
- Calculation Method: It involves ensuring that the total lumens emitted above the horizontal plane do not exceed a certain limit (depending on the lighting zone). Zone 0 should have no ambient lighting, Zone 1 should have 1 ambient lighting, Zone 2 should have moderate ambient lighting, Zone 3 should have moderately high ambient lighting, and Zone 4 should have high ambient lighting.



4) Water Efficiency

The Water Efficiency (WE) credit category requires project teams to look to efficiency first, and then make further reductions by using non-potable and alternative sources of water. This credit uses a whole-project approach, requiring reductions and efficiency in outdoor as well as indoor water uses including process water.

There are three prerequisites and four credits under the WE category. The following is a list of WE prerequisites that you need and credits that you can choose to pursue:

- Outdoor Water Use Reduction (PR)
- Outdoor Water Use Reduction
- Indoor Water Use Reduction (PR)
- Indoor Water Use Reduction
- Building-Level Water Metering (PR)
- Water Metering
- Outdoor Water Use Reduction
- Cooling Tower Water Use

Non-potable water and alternatives to potable water should be used as much as possible. The alternatives to potable water include rainwater, purple pipe H₂O, treated seawater, and graywater.

Outdoor Water Use Reduction: WE Prerequisite

To minimize the use of water outdoors, you can employ two main methods: choosing the right plant species and making your irrigation system more efficient. You can use the EPA's WaterSense Water Budget Tool to document your efforts to reduce water consumption. To get the most flexibility in testing and adjusting your design, it's best to pursue this credit during the early stage of the design phase.

There are two options to meet the requirements:

- Option 1 (No Irrigation Required): Project Teams need to show that no irrigation is necessary. This can be achieved by using xeriscaping, which is a type of landscaping that requires little or no irrigation.

- Option 2: (Reduce Irrigation by 30%): To meet this requirement, Project Teams need to reduce their project's landscape water requirement by at least 30% from the calculated baseline for the site's peak watering month. This reduction can be achieved through plant species selection and irrigation system efficiency, as calculated by the Environmental Protection Agency (EPA) WaterSense Water Budget Tool.

Outdoor Water Use Reduction

The goal of this credit is to reduce outdoor water consumption.

There are two options to earn this credit:

- Option 1 (No Irrigation Required): Project Teams need to show that no irrigation is necessary. They can earn 1-2 points through this option.
- Option 2 (Reduced Irrigation): If Project Teams successfully reduce outdoor water consumption by 50%, they are credited one point. If they reduce it by 100%, they receive two points.

Indoor Water Use Reduction: WE Prerequisite

This prerequisite aims to reduce indoor potable water consumption as well as preserve no and low-cost potable water resources.

The requirement is to reduce building water usage by 20% from the baseline (baseline values are shown in the table below).

Table 5: Baseline Water Consumption of Fixtures and Fittings

Commercial Fixtures, Fittings, and Appliances	Current Baseline (IP Units)	Current Baseline (SI Units)
Water closets (toilets)	1.6 gallons per flush	6 liters per flush
Urinal	1.0 gallons per flush	3.8 liters per flush
Public lavatory faucet	0.5 gallons per minute at 60 pounds per square inch	1.9 liters per minute at 415 kilopascals
Private lavatory faucet	2.2 gallons per minute at 60 pounds per square inch	8.3 liters per minute at 415 kilopascals
Kitchen faucet	2.2 gallons per minute at 60 pounds per square inch	8.3 liters per minute at 415 kilopascals

Showerhead	2.5 gallons per minute at 80 pounds per square inch per shower stall	9.5 liters per minute at 550 kilopascals per shower stall
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*Source: USGBC.org

This includes water closets, urinals, private lavatory faucets, public lavatory faucets, kitchen faucets, and showerheads. The Indoor Water Use Reduction prerequisite also deals with installing appliances, equipment that are ENERGY STAR rated, and processes for water use that are energy conscious.

Indoor Water Use Reduction

A minimum of 25% in building water usage must be reduced. The following is a breakdown of reduction percentage and points earned:

- 25% Reduction: 1 point earned
- 30% Reduction: 2 points earned
- 35% Reduction: 3 points earned
- 40% Reduction: 4 points earned
- 45% Reduction: 5 points earned
- 50% Reduction: 6 points earned

To receive this credit, use water saving strategies from WaterSense and consume non-potable water. Strategies for conservation and alternative water sources can be found in the table below:

Table 6: Conservation and Alternative Water Sources

Conservation	Alternative Water Sources
Waterless	Rainwater
Composting	Purple pipe H ₂ O
Dual flush	Dual flush

Building-Level Water Metering: WE Prerequisite

Water consumption is a crucial aspect of any building's resource management plan. To facilitate this, it is required to install permanent water meters that measure the total potable water use for the building and its associated grounds. These meters should compile monthly and annual

summaries of the water consumption data, which can be recorded either manually or automatically.

Moreover, it is mandatory to commit to sharing the resulting whole-project water usage data with USGBC® for a period of five years from the date of project acceptance for LEED certification or typical occupancy, whichever comes first. This commitment must continue for five years or until the building changes ownership. By tracking water consumption, opportunities for additional water savings can be identified and sustainable water management practices can be implemented.

Water Metering

If you are planning to pursue the Water Metering credit, it is required to install meters on two or more sub-systems. Some examples of sub-meters are irrigation, indoor plumbing fixtures and fittings, domestic hot water, certain types of boilers, reclaimed water, and process water.

Cooling Tower Water Use

The aim of the credit is to reduce water consumption in cooling tower operations, while also mitigating the risks of microbial growth, corrosion, and scaling in the condenser water system.

This credit is applicable to projects that utilize cooling towers or evaporative condensers. Cooling towers are responsible for absorbing heat from air-conditioning systems and regulating the temperature of the air within a facility. In many buildings, evaporative cooling towers represent a significant portion of the total water usage.

Optimize Cooling Water Towers

The objective is to attain the desired cycles of concentration without compromising water quality. To proceed, it is advised to have a water treatment expert perform a potable water analysis, or refer to an analysis that was conducted within the last five years. The results of the analysis will be used to calculate the cycles of concentration. The system should be adjusted to function accordingly to determine how many times the water can flow through without causing any operational or performance issues. Teams can earn the first point under this credit by taking these measures. To earn an extra point, teams can either use additional treatment or leverage a non-potable water source to increase the number of cycles, with a minimum of 10 cycles required to qualify. Alternatively, non-potable water sources derived from the site can be used

to reduce the amount of potable water required for makeup water. At least 20% of the water utilized should be offset with this non-potable water. Improving the efficiency of cooling towers has the potential to save thousands of gallons of potable water during peak cooling periods for buildings.

One point is awarded if ten cooling tower cycles are achieved without additional treatment. Two points are awarded if ten cooling tower cycles are achieved and 20% non-potable water is used. Non-potable water sources include air-conditioner condensate, rainwater, steam system condensate, food steamer discharge water, fire pump test water, and ice machine condensate.



5) Energy and Atmosphere

The Energy and Atmosphere (EA) credit category is the most heavily weighted in the rating system, with 33 points available for New Construction projects. This weighting reflects the significant contribution that the built environment makes to global climate change.

There are four prerequisites and seven credits under the EA category. The following is a list of EA prerequisites that you need and credits that you can choose to pursue:

- Fundamental Commissioning and Verification (PR)
- Enhanced Commissioning
- Minimum Energy Performance (PR)
- Optimize Energy Performance
- Building-Level Energy Metering (PR)
- Advanced Energy Metering
- Fundamental Refrigerant Management (PR)
- Enhanced Refrigerant Management
- Demand Response
- Renewable Energy Production
- Green Power and Carbon Offsets

Fundamental Commissioning and Verification: EA Prerequisite

The purpose of Fundamental Commissioning and Verification is to support the design, construction, and operation of a project that meets the owner's project requirements for energy, water, indoor environmental quality, and durability.

For this prerequisite, it is required to engage a third-party Commissioning Authority. This Commissioning Authority (CxA) will review the project's design and develop and implement a comprehensive commissioning plan. A CxA must have Commissioning (Cx) experience on at least two similar building projects. The results and recommendations from the CxA's plan will be reported directly to the owner and other relevant parties throughout the project and will be compiled into a final report for the owner's reference.

The required Cx Process (CxP) involves looking at the following:

- Mechanical (HVAC&R)
- Electrical (lighting and lighting controls)
- Plumbing (domestic hot water)
- Renewable energy systems and assemblies (as they relate to energy, water, indoor environmental quality, and durability)

Before construction, CxAs must do the following:

- Develop preliminary Cx plan
- Review the OPR, BOD, and design documents
- Develop Cx requirements
- Hold kickoff meeting
- Create construction checklists

During and after construction, CxAs must do the following:

- Schedule pre-functional inspections
- Write and develop functional test scripts
- Perform functional testing
- Prepare Cx report
- Prepare current facility requirements and O+M plan

The Operations and Maintenance 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
- 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
- A commissioning program that includes periodic commissioning requirements, ongoing commissioning tasks, and continuous tasks for critical facilities

Enhanced Commissioning

Enhanced Commissioning is a process that further supports the design, construction, and operation of a building project that meets the owner's requirements for energy efficiency, water conservation, indoor environmental quality, and durability.

To achieve this credit, the CxA must play a more comprehensive role than in the prerequisite, and verify that all the requirements developed as part of fundamental commissioning were implemented.

If you want to pursue this credit, the CxA cannot be an employee of the design or construction firm, nor a subcontractor to the construction firm.

There are two options to achieve this credit:

- 1) **Enhanced Systems Commissioning:** This option has two paths, which include:
 - **Enhanced Commissioning (3 points):** It is required to complete the commissioning process (CxP) activities for mechanical, electrical, plumbing, and renewable energy systems and assemblies as per ASHRAE Guideline 0-2005 and ASHRAE Guideline 1.1-2007 for HVAC&R systems. These guidelines relate to energy, water, indoor environmental quality, and durability.
 - The CxA must perform the following tasks (which must be included in the OPR and BOD):
 - Evaluate the contractor submittals
 - Ensure that the construction documents include the requirements for systems manual

- Ensure that the construction documents include the requirements for operator and occupant training
- Confirm the delivery of systems manual updates
- Confirm the delivery and effectiveness of operator and occupant training
- Verify seasonal testing of systems
- Review building operations ten months after substantial completion
- Develop an on-going commissioning plan
- Enhanced and Monitoring-Based Commissioning (4 points): Fulfill the Enhanced Commissioning (first path) requirements. Also, develop monitoring-based procedures and identify points to be measured and evaluated to assess performance of energy- and water-consuming systems.
 - The following procedures and measurement points must be included in the commissioning plan:
 - 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
 - The frequency of analyses in the first year of occupancy (at least quarterly)

Note: Update the systems manual with any modifications or new settings and give the reason for any modifications from the original design.

- 2) Envelope Commissioning (2 points): Ensure that the building's thermal envelope fulfills the requirements outlined in EA Prerequisite Fundamental Commissioning and Verification, in addition to mechanical and electrical systems and assemblies.
- Conduct the CxP for the building's thermal envelope according to ASHRAE Guideline 0-2005 and the National Institute of Building Sciences (NIBS) Guideline 3-2012, Exterior Enclosure Technical Requirements for the Commissioning Process, with regards to energy, water, indoor environmental quality, and durability.
 - The CxA is responsible for the following:
 - Reviewing contractor submittals
 - Verifying that systems manual requirements are included in construction documents
 - Verifying that operator and occupant training requirements are included in construction documents
 - Verifying systems manual updates and delivery
 - Verifying operator and occupant training delivery and effectiveness
 - Verifying seasonal testing
 - Reviewing building operations ten months after substantial completion
 - Developing an ongoing commissioning plan

Minimum Energy Performance: EA Prerequisite

The Minimum Energy Performance prerequisite aims to minimize the environmental and economic impacts of excessive energy use by ensuring that buildings and their systems meet a minimum level of energy efficiency.

To comply with the Minimum Energy Performance prerequisite, teams are required to adhere to the mandatory provisions of ASHRAE 90.1-2010. Projects have three options to choose from for compliance. The first option requires teams to use performance-based metrics to demonstrate compliance, whereas options two and three use prescriptive compliance. The three options for this prerequisite are further outlined below:

- Option 1: Whole-Building Energy Simulation (updated in 2024)
 - This option requires teams to use energy modeling to demonstrate an improvement in the proposed building performance rating in comparison to the

baseline building performance rating, according to ANSI/ASHRAE/IESNA Standard 90.1-2010 Appendix G.

- Teams must include all energy consumption and costs in their proposed design and document the energy modeling input assumptions for unregulated loads.
- The percentage of required improvement varies by project type.
 - New constructions, major renovations, schools, hospitality, as well as warehouses and distribution centers need a minimum of a 10% performance improvement.
 - Core and shell buildings and data centers need a minimum of an 8% performance improvement.
 - Healthcare buildings need a minimum of a 5% performance improvement.
- This option requires the use of a computer model to compare the energy performance of the baseline building versus design building (more expensive) and has flexibility to incorporate cost effective features.
- Option 2: Prescriptive Compliance - ASHRAE 50% Advanced Energy Design Guide
 - This option requires teams to meet the HVAC and service water requirements of the ASHRAE 50% Advanced Energy Design Guide for the appropriate building type, such as office, retail, schools, or hospitals.
- Option 3: Prescriptive Compliance - Advanced Buildings™ Core Performance™ Guide (CPG)
 - This option requires teams to comply with the prescriptive criteria of Sections 1, 2, and part of 3 of the Core Performance Guide.

It is important to note that options two and three are less expensive, less flexible, but are easier to understand.

Optimize Energy Performance

The purpose of this credit is to minimize the negative environmental and financial impacts of excessive energy consumption.

There are two options to earn this credit:

- Option 1: Improve the proposed building performance rating by a greater percentage compared to the baseline building performance rating, according to ASHRAE 90.1-2010, through whole-building energy simulation teams. Points are awarded based on

percentage improvement in energy performance and greenhouse gas emissions according to the following tables:

Table 7: Points for Percentage Improvement in Energy Performance

Points	Major Construction, Major Renovation, Warehouses & Distribution Centers, Hospitality	Schools	Core and Shell, Data Centers	Healthcare
Prerequisite	10%	10%	8%	5%
1	20%	20%	10%	7%
2	25%	25%	15%	10%
3	30%	30%	20%	15%
4	35%	35%	25%	20%
5	40%	40%	30%	25%
6	45%	45%	35%	30%
7	50%	50%	40%	35%
8	55%	60%	45%	40%
9	60%	-	50%	45%
10	-	-	-	50%
Exemplary Performance	100%	100%	100%	100%

*Source: USGBC.org

Table 8: Points for Percentage Improvement in Greenhouse Gas Emissions

Points	Major Construction, Major Renovation, Warehouses & Distribution Centers, Hospitality	Schools	Core and Shell, Data Centers	Healthcare
Prerequisite	10%	10%	8%	5%
1	20%	20%	10%	7%
2	25%	25%	15%	10%
3	30%	30%	20%	15%
4	35%	35%	25%	20%
5	42%	42%	32%	25%
6	50%	50%	40%	30%
7	60%	60%	50%	35%
8	70%	70%	60%	40%
9	85%	-	75%	45%
10	-	-	-	50%
Exemplary Performance	100%	100%	100%	100%

*Source: USGBC.org

- Option 2: Comply with the ASHRAE 50% Advanced Energy Design Guide for Small to Medium Office Buildings through prescriptive measures. Points for the second option are given based on the following:
 - 1 point: Given for building envelope, opaque (roofs, walls, floors, slabs, doors, and continuous air barriers)
 - 1 point: Given for building envelope, glazing (vertical fenestration)
 - 1 point: Given for interior lighting (including daylighting and interior finishes)
 - 1 point: Given for exterior lighting
 - 1 point: Given for plug loads (including equipment and controls)

Building-Level Energy Metering: EA Prerequisite

The Building-Level Energy Metering prerequisite aims to help manage energy and identify opportunities for additional energy savings by tracking the total energy consumption of a building.

This prerequisite requires teams to install or utilize utility-provided building-level energy meters to capture data on the total energy consumption (electricity, natural gas, chilled water, steam, fuel oil, propane, biomass, etc) of the building. The captured data must be shared with USGBC® for at least five years at one-month intervals.

Advanced Energy Metering

The intent of this credit is to support energy management and have individuals identify opportunities for additional energy savings by tracking building-level and system-level energy use.

To qualify for the Advanced Energy Metering credit in BD+C projects, certain requirements must be met. Advanced meters must be installed for all whole-building energy sources, as well as any individual energy end-uses that represent 10% or more of the total annual consumption of the building. Moreover, the meters must meet specific requirements for data collection.

To fulfill the requirements, the following steps must be incorporated:

- Meters must be permanently installed, record at intervals of one hour or less, transmit data to a remote location and be accessible remotely.

- All meters in the system must be capable of reporting hourly, daily, monthly, annual energy use and store all data for at least 36 months.
- Electricity meters must record both consumption and demand.
- Submeters must be installed for every end-use that consumes 10% or more of the total power.
- The data collection system must use a local area network, building automation system, wireless network, or comparable communication infrastructure.

Fundamental Refrigerant Management: EA Prerequisite

The goal of this prerequisite is to help in managing energy and identifying opportunities for additional energy savings by monitoring the energy consumption of the building. Also, it aims to reduce stratospheric ozone depletion.

To comply with the prerequisite, teams must not use chlorofluorocarbon (CFC)-based refrigerants in any HVAC&R equipment. In cases where existing HVAC&R equipment is being used, the project must complete a comprehensive CFC phase-out conversion before project completion. While hydrofluorocarbons (HFCs), hydrochlorofluorocarbons (HCFCs) and CFCs contribute to ozone depletion, only CFCs must be addressed to meet this prerequisite. This is because CFCs have the most impact on the ozone layer. When putting refrigerants in order from the least impact on the ozone to the highest impact, we have: natural refrigerants, HFCs, HCFCs, and CFCs.

Enhanced Refrigerant Management

Enhanced Refrigerant Management aims to reduce ozone depletion and achieve early compliance with the Montreal Protocol. The 1987 Montreal Protocol (International Treaty) states that no new CFCs will be used, CFCs in existing equipment will be phased out, and that CFC removal will be a prerequisite in all rating systems. Units containing less than half a pound of refrigerant (water coolers and window HVAC units) are exempt from the Montreal Protocol. The goal of Enhanced Refrigerant Management is to minimize direct contributions to climate change. Two options are available for this:

- Option 1: No Refrigerants or Low-Impact Refrigerants (1 point) - This option involves not using refrigerants or using only those that have an ozone depletion potential (ODP) of zero and a global warming potential (GWP) of less than 50. These refrigerants can be

either naturally occurring or synthetic. Natural, low-impact refrigerants, such as water, CO₂, and ammonia are recommended.

- Option 2: Calculation of Refrigerant Management (1 point) - With this option, refrigerants are selected based on their impact on the environment. The aim is to minimize or eliminate the emission of compounds that contribute to both ozone depletion and climate change. This is done by choosing equipment that has a low ODP, low GWP, long service life, and small refrigerant charge. It is recommended to select artificial refrigerants with efficient refrigerant charge and minimal leakage.

The best practice for fire suppression is to avoid the use of CFCs, HCFCs, or halons.

Demand Response

The intent of this credit is not only to increase participation in existing programs, facilitating the link between the utility and buildings, but also to increase awareness of the existence of programs and buildings' willingness to participate. By increasing involvement in demand response technologies and programs, grid reliability is increased and greenhouse gas emissions can be reduced.

Demand Response are programs that are designed to respond to increased strain on the electrical grid and adjust accordingly. For example, if the power grid needs 80 megawatts (MWs), but it only has 70 MWs, consumers are paid to reduce 10 MWs to help balance out supply and demand.

There are two different routes one can take to earn this credit.

Case 1- If a demand response program is available, you can earn two points by participating in it and completing the following activities:

- Create a system that has the capability for real-time, fully-automated demand response based on external initiation by a demand response program provider. Semi-automated demand response may be used in practice.
- Sign up for a minimum one-year demand response participation amount contractual commitment with a qualified demand response program provider with the intention of renewing it for multiple years, for at least 10% of the estimated peak electricity demand. Peak demand is determined under EA Prerequisite Minimum Energy Performance.
- Develop a comprehensive plan for meeting the contractual commitment during a demand response event.

- Include the demand response processes in the scope of work for the commissioning authority, and participate in at least one full test of the demand response plan.

Case 2- If a demand response program is not available, you can earn one point by providing infrastructure to take advantage of future demand response programs or dynamic, real-time pricing programs and completing the following activities:

- Install interval recording meters with communications, and make sure the building automation system can accept an external price or control signal.
- Develop a comprehensive plan for shedding at least 10% of the building's estimated peak electricity demand. Peak demand is determined under EA Prerequisite Minimum Energy Performance.
- Include the demand response processes in the scope of work for the CxA, and participate in at least one full test of the demand response plan.
- Contact local utility representatives to discuss participation in future demand response programs.

Renewable Energy Production

The Renewable Energy Production credit tries to decrease the negative environmental and economic impacts of using fossil fuels by allowing for an increase in self-supply of renewable energy. This credit is based on cost. It is important to consider incorporating renewable energy production on site during the early design phase due to its significant design implications.

To achieve this, eligible renewable energy systems should be used to generate energy equivalent to 1% (1 point earned), 5% (2 points earned), or 10% (3 points earned) of the total building energy costs. This will help to reduce the reliance on non-renewable sources of energy and promote the use of sustainable energy alternatives. Eligible sources include solar thermal, solar photovoltaic, wind, geothermal, low-impact hydroelectric, biofuel, and wave/tidal.

On the other hand, ineligible sources of on-site heat or electricity include trash, non-mill residue, treated wood, conventional hydroelectric, geo-exchange systems, and passive solar strategies.

Green Power and Carbon Offsets

The Green Power and Carbon Offsets credit promotes the reduction of greenhouse gas (GHG) emissions by utilizing renewable energy technologies and carbon mitigation projects provided by the grid. This credit is based on energy consumed.

Teams can achieve this credit by signing a contract for a minimum of five years to purchase carbon offsets, green power, or renewable energy certificates (RECs), to be delivered at least annually. RECs can only be used to mitigate the effects of Scope 2 electricity use. Carbon offsets may be used to mitigate Scope 1 or Scope 2 emissions on a metric ton of carbon dioxide–equivalent basis. Teams can earn 1 point if 50% of the total energy is addressed by RECs, green power, or carbon offsets; or 2 points if 100% of the total energy is addressed by RECs, green power, or carbon offsets. It is possible to pursue this credit at any point during the project.

Project teams need to determine the overall energy use (electricity and non-electricity) generated by the grid every year, either by using whole building energy simulation or the Commercial Buildings Energy Consumption Survey (CBECS). Also, they need to calculate the required green power and carbon offsets based on electric energy use and non-electric energy use.

Note that Scope 1 emissions are direct GHG emissions that occur from sources that are controlled or owned by an organization (e.g., emissions associated with fuel combustion in boilers, furnaces, vehicles). Scope 2 emissions are indirect GHG emissions associated with the purchase of electricity, steam, heat, or cooling. Although Scope 2 emissions physically occur at the facility where they are generated, they are accounted for in an organization’s GHG inventory because they are a result of the organization’s energy use. Scope 3 emissions are the result of activities from assets not owned or controlled by the reporting organization, but that the organization indirectly affects in its value chain. An organization’s value chain consists of both its upstream and downstream activities. Scope 3 emissions include all sources not within an organization’s Scope 1 and 2 boundary.



6) Materials and Resources

The Materials and Resources (MR) category is about minimizing embodied energy through the use of a life-cycle approach to building design and construction, while supporting the EPA’s Waste Hierarchy – reduce, reuse, and recycle waste to energy.

There are two prerequisites and five credits under the MR category, as follows:

- Storage and Collection of Recyclables (PR)
- Construction and Demolition Waste Management Planning (PR)
- Construction and Demolition Waste Management
- Building Life-Cycle Impact Reduction
- Building Product Disclosure and Optimization- Environmental Product Declarations
- Building Product Disclosure and Optimization- Sourcing of Raw Materials
- Building Product Disclosure and Optimization- Material Ingredients

Storage and Collection of Recyclables: MR Prerequisite

This prerequisite aims to reduce the amount of waste generated by building occupants, which is often hauled to and disposed of in landfills.

It applies to all projects, even if recycling services are currently unavailable in the area. By providing storage for recyclables, the building can participate in potential future recycling services.

To meet this prerequisite, the following requirements must be met:

1. Provide collection and storage space for different types of recyclable materials, including mixed paper, corrugated cardboard, glass, plastics, and metals.
2. Provide safe collection, storage, and disposal for at least two hazardous materials, such as batteries, mercury-containing lamps, and electronic waste.

Note that the waste can be collected separately or combined.

Construction and Demolition Waste Management Planning: MR Prerequisite

This prerequisite aims to minimize the amount of waste generated from construction and demolition projects that are typically disposed of in landfills or incinerated. The goal is to recover, reuse, and recycle materials to reduce the environmental impact of these activities.

To achieve this, a construction and demolition waste management (CWM) plan should be developed and implemented. The plan should include the following:

- 1) Identification of at least five materials (structural/non-structural) that can be diverted from disposal. The plan should also indicate the approximate percentage of overall project waste that these materials represent.

- 2) Specification of the diversion strategies that will be employed. For example, the plan should indicate whether the materials will be separated or commingled and where they will be taken for processing.
- 3) Provision of a final report that details all major waste streams generated during the project, including the disposal and diversion rates.

The calculation should exclude alternative daily cover, hazardous waste, land clearing debris, soil and landscaping materials.

Construction and Demolition Waste Management

The goal of this credit is to reduce the amount of waste generated by construction and demolition activities that end up in landfills or incineration facilities. This can be achieved by recovering, reusing, and recycling materials.

Once the CWM plan has been created as a prerequisite, teams have the option to pursue the corresponding credit, which requires meeting diversion thresholds. Although the prerequisite does not specify a threshold for the overall waste diversion goal, teams that are also pursuing the credit should keep those requirements in mind when setting their goals.

There are two options on how to receive this credit:

- 1) Waste Diversion (there are two possible paths for this option)
 - a. Path 1: Divert 50% of the total construction and demolition material. Diverted materials must include at least three material streams (metal, masonry, and plastic)
 - b. Path 2: Divert 75% of the total construction and demolition material. Diverted materials must include at least four material streams (metal, masonry, plastic, and wood)
- 2) Waste Reduction: Avoid generating more than 2.5 pounds of construction waste per square foot (12.2 kilograms per square meter) of the building's floor area.
 - a. To calculate waste generated per square foot of the building's floor area, divide the total construction and demolition waste generated by the gross floor area.
 - b. The materials included in the total construction and demolition waste generated are recycled, donated, reused offsite, sent to a landfill, or incinerated.

Building Life-Cycle Impact Reduction

This credit aims to promote the adaptive reuse of buildings and optimize the environmental performance of products and materials. It rewards teams that adopt a life-cycle thinking approach to green building and prioritize reuse whenever possible.

There are four options for achieving this credit:

- Option 1: Historic Building Reuse (5 points) - This involves maintaining the existing structure, envelope, and interior non-structural elements of a historic building or contributing building in a historic district.
 - Points are also awarded under Location Transportation for historic buildings.
- Option 2: Renovation of Abandoned or Blighted Building (5 points)- This option requires maintaining at least 50% of the existing building structure, enclosure, and interior structural elements.
 - Points are also awarded under Location Transportation for blighted buildings.
- Option 3: Building and Material Reuse (2-4 points) - This option involves reusing or salvaging building materials from on/off-site as a percentage of the surface area.
 - Structural elements, enclosure materials, and permanently installed interior elements are included, while window assemblies and hazardous materials to be remediated are excluded.
 - Points are awarded based on the percentage of surface area reused or salvaged (25%= 2 points, 50%= 3 points, 75%= 4 points).
- Option 4: Whole-Building Life-Cycle Assessment (3 points) – For new construction, a life-cycle assessment of the project’s structure and enclosure must demonstrate at least a 10% reduction, compared to a baseline building, in at least three of the six impact categories listed below:
 - Global warming (this must be selected)
 - Eutrophication
 - Ozone depletion
 - Smog formation
 - Acidification
 - Depletion of nonrenewable energy sources

Building Product Disclosure and Optimization (BPDO) - Environmental Product Declarations

The aim of the Environmental Product Declarations credit is to promote the use of products and materials for which life-cycle information is available, and which have environmentally, economically, and socially preferable life-cycle impacts. It incentivizes project teams to select products from manufacturers who have verified improved environmental life-cycle impacts, which will increase the use of eco-friendly products and materials.

There are two options (each are worth one point) to receive this credit:

- 1) Environmental Product Declaration (EPD): Project teams must use at least 20 different qualifying products from at least five different manufacturers. It includes Product-Specific Type III EPD, Industry Wide (Generic) EPD, and Product Life-Cycle Assessment (LCA), which are further described below:
 - a. Industry-Wide (Generic) EPD: It includes products with third-party certification. It must conform to ISO 14025 and EN 15804 or ISO 21930.
 - b. Product-Specific Type III EPD: It is like Industry Wide EPD, but for a specific product. It must conform to ISO 14025 and EN 15804 or ISO 21930.
 - c. Product LCA: Assessment of a partial product life-cycle from extraction to the factory before it is transported to the consumer. It must conform to ISO 14044.
- 2) Multi-Attribute Optimization: Products and materials that are extracted, manufactured, and purchased within 100 miles of the project are valued at 200% of their cost.
Note: For a material to receive credit (100% of cost), it must have third party certified demonstration of reduction in at least three categories (global warming potential, eutrophication, ozone depletion, smog formation, acidification, and depletion of nonrenewable energy sources).

Building Product Disclosure and Optimization (BPDO) - Sourcing of Raw Materials

The objective of this credit is to promote the use of products and materials that have a positive impact on the environment, economy and society throughout their life cycle. The project teams who select materials from manufacturers that have improved environmental life-cycle impacts will be rewarded.

There are two options to receive this credit:

- 1) Raw Material Source and Extraction Reporting (1 point): The teams are required to use a minimum of 20 compliant products from at least five different manufacturers. There are different weights that the different criteria are given in the credit.

- 2) Leadership Extraction Practices (1 point): Purchase at least 25% cost value of permanently installed products which meet extraction criteria. Refer to the table below for more information.

Table 9: Leadership Extraction Practices

Responsible Extraction Criteria	Value Related to the Product Cost
Products from a manufacturer that participates in an extended producer responsibility program	50%
Bio-based materials excluding hide products	100%
Wood products certified by the Forest Stewardship Council	100%
Materials re-use including salvaged, refurbished or re-used products	100%
Recycled content (post/pre-consumer)	100%/50%
Other USGBC® programs	Dependent on stringency

Building Product Disclosure and Optimization (BPDO) - Material Ingredients

The aim of the credit is to encourage the selection of products that have been verified to minimize the use and generation of harmful substances and have improved life-cycle impacts. Project teams that choose these products will be rewarded.

There are three options:

- 1) Material Ingredient Reporting (1 point): Use at least 20 different permanently installed products from at least five different manufacturers to demonstrate the chemical inventory of the product to at least 0.1% (1000 ppm).
 - Involves using the Health Product Declaration (HPD), which offers a standardized way of reporting the material contents of building products and provides information on the associated health effects. It was developed according to the directions set forth by the Health Product Declaration Collaborative and can often be sourced directly from manufacturers' websites. In addition, it is considered to be complimentary to life-cycle documentation such as LCA and EPD.
- 2) Material Ingredient Optimization (1 point): Use products that document their material ingredient optimization for at least 25%, by cost, of the total value of permanently installed products in the project.

- Involves optimizing the products and materials used in building projects to ensure they have minimal negative environmental and social impacts throughout their life-cycle.
- 3) Product Manufacturer Supply Chain Optimization (1 point): Use building products for at least 25%, by cost, of the total value of permanently installed products in the project.
- Focuses on rewarding raw material manufacturers who produce products that have been verified to have improved life-cycle impacts.

The following table compares and contrasts the different options for this credit.

Table 10: -BPDO Material Ingredients Options

Material Ingredient Reporting (1 point)	Material Ingredient Optimization (1 point)	Product Manufacturer Supply Chain Optimization (1 point)
Purchase at least 20 permanently installed products that meet the criteria from five different manufacturers	25% compliance by cost	25% compliance by cost
USGBC® Approved Program	USGBC® Approved Program	Manufacturer documents at least 99% of ingredients for material and supply chain processes
Uses the HPD	Products and materials that are extracted, manufactured, and purchased within 100 miles of the project are valued at 200% of their cost.	Products and materials that are extracted, manufactured, and purchased within 100 miles of the project are valued at 200% of their cost.

7) Indoor Environmental Quality



The Indoor Environmental Quality (EQ) category focuses on indoor air and lighting quality and thermal, visual, and acoustic comfort. Good indoor environmental quality (IEQ) has many benefits; good IEQ protects the health and comfort of occupants.

There are two prerequisites and nine credits under the EQ category, as follows:

- Minimum Indoor Air Quality Performance (PR)
- Enhanced Indoor Air Quality Strategies
- Environmental Tobacco Smoke Control (PR)
- Low-Emitting Materials

- Construction Indoor Air Quality Management Plan
- Indoor Air Quality Assessment
- Thermal Comfort
- Interior Lighting
- Daylight
- Quality Views
- Acoustic Performance

Minimum Indoor Air Quality Performance: EQ Prerequisite

This prerequisite strives to establish minimum standards for indoor air quality (IAQ) to ensure the comfort and well-being of building occupants. To meet this requirement, teams must comply with specific ventilation standards and monitor outdoor airflow. The requirements may vary depending on the type of ventilation the project uses, be it mechanical, natural, or mixed mode.

There are two options to meet this prerequisite for mechanically ventilated spaces:

- 1) ASHRAE Standard 62.1-2010: This procedure determines, separately for each ventilation system, the minimum amount of outdoor air that the ventilation system must provide.
- 2) CEN Standard EN 15251-2007 and EN 13779-2007: These calculations determine the minimum amount of outdoor air that each ventilation system must supply.

When determining the minimum outdoor air opening and space configuration requirements for naturally ventilated spaces, follow ASHRAE Standard 62.1-2010.

For mechanically ventilated (active systems), there is a concern whether enough fresh air enters the building. On the other hand, for naturally ventilated (passive systems), there is a concern whether enough CO₂ exits the building. CO₂ concentrations must be monitored. Monitors must be positioned between three feet and six feet on the wall (breathing zone).

Enhanced Indoor Air Quality Strategies

The Enhanced Indoor Air Quality (IAQ) Strategies credit aims to improve occupants' comfort, well-being and productivity by enhancing indoor air quality. This credit focuses on incorporating design features that will help maintain indoor air quality long after the building's construction is completed. The strategies include using entryway systems to prevent pollutants from being

tracked into the building, enhancing filtration media, increasing outside air delivery, and monitoring ventilation.

There are two options for this credit:

1) Enhanced IAQ Strategies (1 point)

- Entryway Systems: Install permanent entryway systems at least ten feet (three meters) long in the primary direction of travel to capture dirt and particulates entering the building at regularly used exterior entrances, such as grates, grilles, or rollout mats).
- Interior Cross-Contamination Prevention: Make sure to properly ventilate all areas where hazardous gases or chemicals may be present or used (such as garages, housekeeping and laundry areas, copying and printing rooms). The exhaust rates should be determined in accordance with the EQ Prerequisite Minimum Indoor Air Quality Performance or at least 0.50 cubic feet per minute (cfm). This will create negative pressure in the room with respect to adjacent areas when the doors are closed.
- Filtration: Use an air filter with a Minimum Efficiency Reporting Value (MERV) of 13 or higher, in accordance with ASHRAE Standard 52.2–2017.
- Natural ventilation design calculations: Employ 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.
- Mixed-mode design calculations: Comply with CIBSE Applications Manual 13–2000, Mixed Mode Ventilation.

2) Additional Enhanced IAQ Strategies (1 point)

- Exterior Contamination Prevention: Minimize and control the entry of pollutants into the building.
- Increased Ventilation: Increase outdoor air ventilation rates to 95% of all occupied spaces by at least 30% above minimum rates.
- Carbon Dioxide Monitoring: Monitor carbon dioxide concentrations within all densely occupied spaces. CO₂ monitors must be between three and six feet (900 and 1,800 millimeters) above the floor, and they must have an audible or visual indicator or alert the building automation system in case the sensed CO₂ concentration exceeds the setpoint by more than 10% (based on ASHRAE 62.1–2010).

- Additional Source Control and Monitoring: If in a space where air pollutants are expected, assess potential sources of additional air pollutants apart from carbon dioxide. To minimize the possibility of contaminant release, develop and execute a materials-handling strategy. Additionally, install monitoring systems equipped with sensors designed to identify specific pollutants. An alarm should go off if any abnormal or hazardous conditions are identified.
- Natural Ventilation Room-by-Room Calculations: Comply with CIBSE AM10, Section 4.

Environmental Tobacco Smoke Control: EQ Prerequisite

This prerequisite strives to protect building occupants from the harmful effects of tobacco smoke through strict control measures.

LEED, a certification program for green building, no longer permits designated interior smoking rooms except for private residences. This change is based on overwhelming evidence and broad consensus that exposure to tobacco smoke has negative impacts on human health. As a result, LEED projects now require increased levels of indoor air quality performance.

With this prerequisite, smoking is prohibited inside buildings. Smoking areas must be designated outside the building, at a distance of 25 feet from windows, entries, and air intakes. Signage must also be provided within ten feet of entrances to ensure that the rules are clear to everyone.

For residential buildings to meet this prerequisite, they must meet the above requirements. Or, smoking areas must be compartmentalized by doing the following:

- Prohibit smoking inside common areas.
- Seal penetrations in the walls, ceilings, and floors between units.
- Seal vertical chases next to the units.
- Use weather-stripped doors.
- Keep halls under positive pressure to prevent tobacco smoke from entering other units.

Low-Emitting Materials

This credit aims to reduce the concentration of chemical contaminants that can harm air quality, human health, productivity, and the environment. There are two options to achieve this credit:

- 1) Product Category Calculations (1-3 points): Refer to the following table for thresholds of compliance with emissions and content standards, separated by category of material.

Table 11: Thresholds of Compliance with Emissions and Content Standards for 7 Categories of Materials

Category	Threshold	Emissions and Content Requirements
Interior paints and coatings applied on site	At least 90%, by volume, for emissions; 100% for VOC content	<ul style="list-style-type: none"> • General Emissions Evaluation for paints and coatings applied to walls, floors, and ceilings • VOC content requirements for wet applied products
Interior adhesives and sealants applied on site (including flooring adhesive)	At least 90%, by volume, for emissions; 100% for VOC content	<ul style="list-style-type: none"> • General Emissions Evaluation • VOC content requirements for wet applied products
Flooring	100%	General Emissions Evaluation
Composite wood	100% not covered by other categories	Composite Wood Evaluation
Ceilings, walls, thermal, and acoustic insulation	100%	<ul style="list-style-type: none"> • General Emissions Evaluation • Healthcare, Schools only Additional insulation requirements
Furniture (include in calculations if part of scope of work)	At least 90%, by cost	Furniture Evaluation
Healthcare and School Projects only: Exterior applied products	At least 90%, by volume	Exterior Applied Products

*Source: USGBC.org

- 2) Budget Calculation Method: The Budget Method is a technique that categorizes the interior of a building into five assemblies: flooring, ceilings, walls, thermal/acoustic insulation, and furniture. It allows project teams to achieve the credit, even if not all the items meet the compliance requirements. Walls, ceilings, and flooring are defined as building interior products. Each layer of the assembly, including paints, coatings, adhesives, and sealants, must be evaluated for compliance. Insulation is tracked separately. The assembled product must be over 50% compliant. Compliance level is categorized as follows: 50-69% (1 point), 70-89% (2 points), 90+% (3 points).

Additional emissions and content requirements can be found on the USGBC® website.

The Construction Indoor Air Quality Management Plan credit aims to ensure the well-being of construction workers and building occupants by minimizing indoor air quality problems associated with construction and renovation. The plan is comprised of the following requirements:

- During construction, the project must comply with the control measures set by the ‘Sheet Metal and Air-Conditioning Contractors’ National Association’ (SMACNA).
- On-site absorptive materials must be protected from moisture damage (Source Control), and their installation should be scheduled appropriately.
- If Air Handler is used, MERV 8 filters must be installed on return grilles according to ASHRAE 52.2 (HVAC Protection).
- The use of tobacco products inside the building and within 25 feet of the building entrance during construction is prohibited (Source Control).

Indoor Air Quality Assessment

The purpose of this credit is to improve the quality of indoor air in a building during construction and occupancy. To earn the Indoor Air Quality Assessment credit, teams need to either complete a building flush-out or perform air testing to measure various contaminant levels.

- 1) Flush-out (1 point): Involves the installation of new filters after construction and completing a building air flush-out between a maintained temperature of 60-80°F. There are two paths for a flush-out:
 - a. Path 1 (Before Occupancy): Flush-out 14,000 cubic feet of air per square foot.
 - b. Path 2 (During Occupancy): The building should be flushed out at least 3,500 cubic feet of air per square foot three hours before occupancy. This process should continue during occupancy until reaching 14,000 cubic feet of air per square foot.
- 2) Air Testing (2 points): Teams can submit air test laboratory results to meet the Indoor Air Quality Assessment credit.

Thermal Comfort

The Thermal Comfort credit promotes occupants’ productivity, comfort, and well-being by providing quality thermal comfort. It ensures that buildings maintain acceptable thermal

comfort levels by providing thermal comfort control, allowing occupants to adjust the temperature to their preference.

Project Teams must meet the requirements for both thermal comfort design and thermal comfort control. There are two options for thermal comfort design:

- Option 1: Design heating, ventilating, and HVAC systems to meet the requirements of ASHRAE Standard 55-2010, which specifies comfort controls for individual occupants in a building and comfort controllability for multi-occupant spaces, ensuring that everyone has access to the right temperature settings.
- Option 2: Design HVAC systems and the building envelope to meet the requirements of ISO 7730:2005 and CEN Standard EN 15251:2007.

For thermal comfort control, it is required to provide individual thermal comfort controls for at least 50% of individual occupant spaces, for all shared multi-occupant spaces, and for any individual occupant spaces without individual controls. These controls allow adjustments in at least one of the following: air temperature, radiant temperature, air speed, and humidity.

Interior Lighting

Interior lighting is an important aspect of any building's design. It plays a crucial role in promoting occupants' productivity, comfort, and well-being. This credit awards teams for meeting specific lighting control and quality requirements.

The unit of measure for determining light levels on a project is foot-candles (fc), which measures the amount of light that falls on a surface.

There are two options to earn this credit:

- 1) Lighting Control (1 point): Requires that the lighting system provide 90% individual controllability, which means that occupants can turn the lights on or off, or adjust them to mid-level (between 30-70% of the maximum output). Additionally, all multi-occupant spaces must have 100% lighting control.
- 2) Lighting Quality (1 point): Requires teams to select four of the following eight strategies: light fixture luminance, color rendering index (CRI), lamp life, direct overhead lighting, surface reflectance (for ceilings, walls, and floors), surface reflectance (for furnishings), surface illuminance ratio (for walls to work surface), and surface illuminance ratio (for ceiling to work surface).

Daylight

The Daylight credit intends to enhance the connection between building occupants and the outdoors, promote healthy circadian rhythms, and reduce the use of electrical lighting by introducing daylight into the space. To achieve the daylight credit, teams must do one of the following three options:

- 1) Simulation: Spatial Daylight Autonomy (1-3 points)- Project Teams must show through annual computer simulations that spatial daylight autonomy of at least 55%, 75%, or 90% is achieved. Also, they must show that annual sunlight exposure of no more than 10% is achieved.
- 2) Simulation: Illuminance Calculations (1-2 points): Demonstrate through computer modeling that illuminance levels will be between 300 lux and 3,000 lux for 9 a.m. and 3 p.m. on a clear-sky day.
 - Illuminance intensity must be calculated for sun and sky.
 - One day must be selected within 15 days of September 21st and one day must be selected within 15 days of March 21st that represent clear-sky conditions. Average the value of the two selected days.
- 3) Measurement (1-3 points): Measure illuminance levels between 9 a.m. and 3 p.m. on a selected day in two different months (4-8 months apart). Levels must be between 300 lux and 3,000 lux for the floor area.

Quality Views

This credit serves to provide building occupants with a connection to the natural outdoor environment by offering quality views. Seventy-five percent of all regularly occupied floor area must have at least two of the four kinds of views mentioned below:

- Multiple lines of sight that allow for vision glazing
- Two out of three of the following:
 - Flora, fauna, or sky
 - Movement
 - Objects located at a minimum distance from the exterior of the glazing area
- Unobstructed views that are located within the distance of three times the head height of the vision glazing

- Views with a factor of 3 or greater as outlined in the “Windows and Offices: A Study of Office Worker Performance and the Indoor Environment” report
 - The View Factor is a measure of the amount and quality of views within a 90-degree cone of vision from an individual work station. It is rated from 0 (poor quality) to 5 (high quality).

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.

Acoustic Performance

The Acoustic Performance credit’s purpose is to provide workspaces and classrooms that promote occupants’ well-being, productivity, and communications through effective acoustic design.

It addresses the acoustic performance of buildings by laying out requirements for the following elements:

- HVAC background noise
- Sound isolation
- Reverberation time
- Sound reinforcement and masking

Acoustic Performance was a prerequisite for schools’ projects in v2009. Now, it is offered as a credit in LEED v4 for all BD+C projects. It is worth one point (two points for Healthcare).

Project Surroundings and Public Outreach

Project Surroundings and Public Outreach is a knowledge domain that includes topics such as impacts of a built environment, codes, values of sustainable design, as well as regional design. Some of the content for this knowledge domain is from the bonus credit categories (Innovation and Regional Priority), which are described in the next section.

Impacts of the Built Environment

In the United States, conventional buildings are responsible for:

- 14-16% of potable water consumption
- 30% of waste output
- 38% of CO₂ emissions
- 40% of raw materials usage
- 24-50% of energy usage

LEED Accredited Buildings (green buildings) should be used whenever possible. There are several benefits of using green buildings:

- Reduced operating costs, reduced greenhouse gas emissions, and less waste
- Energy and water conservation
- Healthy and productive indoor environments
- Qualification for incentives
- Lower maintenance costs

Market Adaptation

LEED is used in more than 145 countries. It has the following goals for market adaptation:

- 1) Reduce contribution to global climate change
- 2) Improve human health
- 3) Protect water resources and biodiversity
- 4) Promote sustainable material cycles
- 5) Develop a green economy
- 6) Enhance community quality of life

Environmental Externalities

An externality is an event that occurs as a byproduct of another event occurring. More specifically, an environmental externality is a cost or benefit that is caused by one party but incurred or received by another party financially. Environmental externalities can be positive or negative.

A negative environmental externality is an indirect imposition of cost by one party on another party. Most environmental externalities are negative. For instance, pollution caused by commuting to work or chemical spill caused by improperly stored wastes are examples of negative environmental externalities. Similarly, when corporations cut costs by implementing new operations that are more harmful to the environment, it leads to negative environmental externality. In all these examples, social costs outweigh private costs.

On the other hand, a positive environmental externality is when one party receives indirect benefits due to actions taken by another party. One positive environmental externality is research and development conducted by a company, which increases private profits and the general level of knowledge within a society. Another positive environmental externality is investment in education, which leads to a smarter and more intelligent workforce. In both examples, there is a positive gain on both the private and social level.

Externalities are generated either in production (production externality) or consumption (consumer externality) of a good or service. Production externalities occur when industrial operations have side effects, such as improper storage of chemicals. Consumer externalities might occur, depending on how consumers utilize resources, such as choosing to drive their own car instead of taking public transit. In these externalities, costs and benefits can be both private to an individual or an organization, or social, meaning it can affect society as a whole.

Governments and companies can address externalities through financial and social measures. The government can impose taxes on goods causing externalities. Additionally, the government can provide subsidies to encourage the consumption of positive externalities. Lastly, governments can implement regulations to offset the effects of externalities.

Triple Bottom Line

The USGBC® encourages Project Teams to use a Triple Bottom Line (financial, social, and environmental) benefit-cost analysis (BCA) on at least six LEED credits. This includes analyzing financial/economic, environmental, and social costs and benefits associated with the selected credits. The analysis can be done internally, or by using an outside service such as a consulting

firm or a software product. Also, of the credits selected, the following three credits should be included, if possible:

- 1) Indoor Water Use Reduction
- 2) Outdoor Water Use Reduction
- 3) Optimized Energy Performance

Note: The mentioned credits are required if they are being achieved in the LEED submission. The remaining credits can be selected at the discretion of the submitter.

The concept integrates the three resources of people (social), planet (natural), and profit (economic capital) into a longer-term view of sustainability best practices where the built environment does not have a negative value on any one group of stakeholders.

LEED Codes

LEED codes play a vital role in setting sustainable building standards. They provide a comprehensive guide that outlines specific requirements and best practices that projects must meet to earn LEED certification. By following these codes, builders and designers can ensure that their projects are environmentally responsible and meet the highest standards of sustainability. However, it is important to note that LEED practices should not take precedence over building code design practices.

Life-Cycle Approach

Green building involves using a life-cycle approach to consider the entire life of a project, material or service. This approach helps project teams design for longevity and use systems thinking to consider the upstream and downstream impacts of buildings. For instance, evaluating the water pollution that can result from the manufacturing of a building product or the hazards from the disposal of a hazardous building material in an unlined landfill. The Materials and Resources section of green building also offers credits that encourage teams to do life-cycle analysis of products and entire buildings.

Life-Cycle Costing helps teams determine the payback period for first costs. This information is critical in understanding the implications of selecting a product or system, especially when the first costs may be higher but can help reduce operating costs over time.

LEED Bonus Credit Categories



1) Innovation

The Innovation (IN) credit category is where innovation and evolution are measured along with exemplary performance and both are rewarded for going above and beyond credit thresholds.

There are two credits under the IN category, as follows:

- Innovation
- LEED Accredited Professional

Innovation

The purpose of this credit is to encourage projects to go beyond the minimum requirements. It rewards projects for exceptional or innovative performance.

There are three options to achieve this credit:

- Option 1: Innovation (1 point per instance, up to 2)
This option requires a plan or a document that can be shown to USGBC® as to what additional sustainability measures have been taken beyond the requirements of LEED. The submitted plan should indicate the following:
 - Intent
 - Proposed requirements
 - Proposed submittals
 - Design approach and strategies
 - Significant, measurable environmental benefit
 - Should not be addressed elsewhere in the LEED green building rating system being pursued
- Option 2: Pilot (1 point per instance, up to 4)
 - Achieve credit from USGBC®'s LEED Pilot Credit Library
 - There is a Public Outreach opportunity here. It is entitled Community Outreach and Involvement. Project Teams can earn a point for leading and engaging the community in the following ways:

- Before starting the design, meet with adjacent property owners, residents, business owners, workers, local planning and community development officials, and current residents or workers at the project site to obtain their input and document it.
 - During the preliminary design phase, host at least one open community meeting, other than an official public hearing or recurring citizen advisory meeting, to receive comments on the preliminary project design concept. Work with community associations and/or local government to advertise the meeting(s). Summarize and collect comments generated at the meeting(s).
 - Modify the project's preliminary design based on community input. If modifications are not made, explain why community input did not generate design modifications.
 - Establish an ongoing means of communication between the developer and the community throughout the design and construction phases and, in cases where the developer maintains any control, after construction.
- Option 3: Exemplary Performance (1 point per instance, up to 2)
 - Double the minimum requirement on any of the other credit requirements.
 - Reach the next incremental threshold.

Note: The maximum total point combination is five. To earn all five, projects must earn at least one pilot and one innovation credit.

LEED Accredited Professional

The aim of this credit is to encourage team integration on LEED projects to aid in the application and certification process.

This credit rewards teams for having at least one LEED Accredited Professional (AP) on the team.

2) Regional Priority



The Regional Priority (RP) credit category rewards teams for focusing on issues that are most important in their region.



Regional Priority is the only credit name under the RP category. It rewards projects for addressing specific environmental, social equity, and public health priorities in a particular region. For example, Project Teams should consider the surrounding environment as part of their design of a parking lot. They should not install a large parking lot (that will develop a lot of rainfall runoff) near wetlands.

Project Teams can achieve additional credits based on the geographic location of the project. Since Regional Priority is specific to region, the credits change based on project location. Credits can be found by looking up the project here: <https://www.usgbc.org/regional-priority-credits>.

There are six credits available, and a maximum of four points can be earned for achieving Regional Priority credits.

A database of Regional Priority credits and their geographic applicability is available on the USGBC® website at <http://www.usgbc.org/rpc>.