




Introduction to LEED V4 Building Design & Construction

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Overview

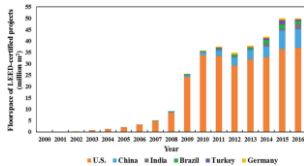
- LEED Variants
- LEED V4 Structure and Processes
- LEED V4-New Construction Categories & Credits
- LEED-shortcomings
- Future directions of the movement

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LEED- Leadership in Energy & Environmental Design

- Has been applied to projects in 167 countries and territories.
- Almost 100,000 total commercial LEED ND projects
- More than 1.6 million residential units registered or certified.
- More than 4,000 K-12 projects registered or certified.
- More than 8,100 higher education projects registered or certified.
- Long, collaborative, consensus-based development process (1995-1998) by US Green Building Council.

Version	Years Applicable
1.0 (Beta Version)	1998-2000
2.0	2000-2002
2.1	2002-2005
2.2	2005-2009
3 (LEED 2009)	2009-2016
4	2013-...



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LEED buildings command rents as much as **10%** above market value.

Lease up rates as much as **20%** above average.

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30-40% savings on energy and water

2-10% increase in employee productivity

35% less absenteeism

AS COMPARED TO CONVENTIONAL CONSTRUCTION

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Average cost paid to USGBC for LEED certification: \$5,000

Average cost for LEED implementation 1-3% of project's total budget cost

Average return on investment: 1-3 years

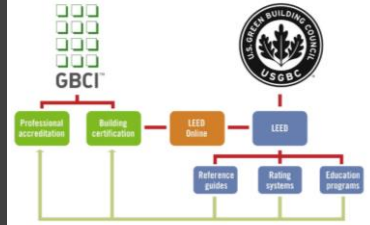
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How it All Fits Together

- Third-Party Verification helps guarantee that each project saves energy, water and other resources, reducing the overall environmental impact.
- It means transparency!



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Structures of the LEED Suite of Buildings Rating Systems

Phase	Type of Project		
	Schools	Retail	Commercial
Construction	LEED BD+C: Schools	LEED BD+C: Retail	LEED BD+C: New Construction
Fit-Out	-	LEED ID+C: Retail	LEED ID+C: Commercial Interiors
Operations	LEED O+M: Schools	LEED O+M: Retail	LEED O+M: Existing Buildings

BD+C
DESIGN + CONSTRUCTION
Cost & Cost
Retail
Healthcare
Data Centers
Hospitality
Warehouses & Distribution

ID+C
INTERIOR DESIGN + CONSTRUCTION
Commercial Interiors
Retail
Hospitality

O+M
OPERATIONS + MAINTENANCE
Existing Buildings
Data Centers
Warehouses & Distribution
Hospitality
Retail

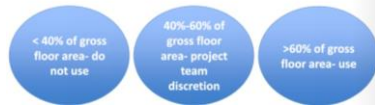
ND
NEIGHBORHOOD DEVELOPMENT
Low-Cost Affordable Housing
Land Reclamation
Greenfield
Planned Urban Commercial
Industrial

HOMES
HOUSING
Single Family
Low-Rise Multi-Unit
Mid-Rise Multi-Unit

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Which Rating System Do I use?

- 40/60 Rule when unsure about rating system selection
- Assign a rating system to each area of the project (in square feet or meters)



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Which HOMES Rating System Do I use?



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LEED Credentials

Exam:	2 hours/100 Q	Member \$ 200	Non-Member \$ 250
Exam:	2 hours/100 Q	Member \$ 250	Non-Member \$ 350
Exam:	4 hours/200 Q (Combo)	Member \$ 400	Non-Member \$ 550

- LEED GAs must possess:
 - basic knowledge of the LEED rating systems,
 - LEED documentations process,
 - sustainable design principles,
 - standard terminology,
 - and LEED resources that are available for identifying green strategies.

-LEED APs must be Professionals in the Industry

- The LEED AP Fellow Nominee is evaluated based on four of five mastery elements:
 - Technical Proficiency
 - Education and mentoring
 - Leadership
 - Commitment and service
 - Advocacy

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- Three minimum program requirements (MPRs)
- Maximum of 110 points divided into 10 categories

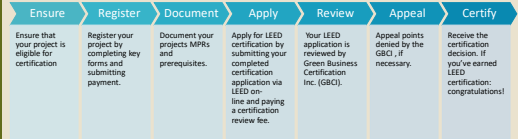


SIZE Requirements:
LEED BD+C and EB:O&M Rating Systems
 a minimum of 93 square meters of gross floor area.
LEED ID+C Rating Systems
 a minimum of 22 square meters of gross floor area.
LEED Neighborhood Development Rating Systems
 Contain at least two habitable buildings and be no larger than 1500 acres.

LEED V4 Structure & process

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LEED Certification Process



◆ Split Review Option: Separate Design & Construction review

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LEED V4- Building Design & Construction

Category or Credit Name	Points Assigned		
	New Construction (NC)	Core and Shell (CS)	School (S)
Integrated project Planning & Design	1	1	1
Location & Transportation (LT)	16	20	15
Sustainable Sites (SS)	10	11	12
Water Efficiency (WE)	11	11	12
Energy & Atmosphere (EA)	33	33	31
Materials and Resources (MR)	13	14	13
Indoor Environmental Quality (IEQ)	16	10	16
Innovation and Design (ID)	6	6	6
Regional Priority (RP)	4	4	4
Total Points Available	110	110	110

Certified 40-49
 Silver 50-59
 Gold 60-79
 Platinum >80

<https://www.usgbc.org/credits/new-construction/v4>

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Quiz Time!

- Which of the following is not covered by LEED minimum program requirements?
- A Project's LEED boundary
 - A Project's size
 - A Project's energy efficiency
 - A Project's location on existing land

Correct Answer: (c)- The Minimum Program Requirements (MPRs) are the minimum characteristics or conditions that make a project appropriate to pursue LEED certification. There is no LEED MPR regarding a project's energy efficiency.

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Quiz Time!

- Which organization is responsible for reviewing a project's documentation for credit compliance?
- U.S. Green Building Council
 - Green Building Certification Institute
 - American Institute of Architects
 - American Society of Heating, Refrigeration and Air-Conditioning Engineers

Correct Answer: (B)- Green Building Certification Institute is in charge of reviewing a project's documentation for credit compliance while U.S. Green Building Council is in charge of developing the Assessment System.

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Quiz Time!

A project team is planning a 14 story, 200 unit apartment building in New York City. The project team wants to attempt LEED certification. Which rating system should the project use?

- LEED for Retail
- LEED for Homes
- LEED for New Construction
- LEED for Neighborhood Development
- LEED Multifamily

Correct Answer: (c)

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Quiz Time!

An 85 square meter LEED v4 BD+C New Construction project is attempting to earn 80 points. What LEED Certification level will it earn?

- a) Platinum
- b) Gold
- c) Silver
- d) Certified
- e) None of the above

Correct Answer: (e)
A 750 square foot LEED v4 BD+C New Construction project is attempting to earn 80 points. What LEED Certification level will it earn?

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Quiz Time!

Each version of the rating system is open and available for how many years?

- a) 5 years after the rating system lunch date
- b) 10 years after the rating system lunch date
- c) 5 years after the date that next rating system is published?
- d) 10 years after the date that the next rating system is published?
- e) 10 years after the project is registered under that rating system

Correct Answer: (b)

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Integrative project Planning & Design

Intent:
Maximize opportunities for integrated, cost-effective adoption of green design and construction strategies, while emphasizing on human-health issues.

Requirements:
Use cross-discipline design and decision making, beginning in the programming and pre-design phase, ensuring the followings:

Owner's Project Requirements Document.
Incorporated with health mission statement and strategies.

Preliminary Rating Goals
Conduct a preliminary LEED meeting, determining certification level, credits, and responsible parties for each credit.

Integrated Project Team
Including as many professionals as possible (minimum of 4)

Design Charrette- minimum of 4 hour

	New Construction	Core & Shell	Schools
Integrative project planning & design	1	1	1

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Location & Transportation

* Addresses issues of building location relative to ecologically sensitive land and access to transportation.

Category or Credit Name	New Construction	Core and Shell	Schools
Location & Transportation (LT)	16	20	15
LEED for Neighborhood Development	16	20	15
Sensitive Land Protection	1	2	1
High-Priority Site	2	3	2
Surrounding Density and Diverse Uses	5	6	5
Access to Quality Transit	5	6	4
Bicycle Facilities	1	1	1
Reduced Parking Footprint	1	1	1
Green Vehicles	1	1	1

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Intent:

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

Certification level	Points BDC	Points BDC (of Points BDC)	Points BDC (of Points BDC)	Points BDC (of Points BDC)	Points BDC (of Points BDC)
Certified	8	8	8	8	8
Silver	10	12	10	6	10
Gold	12	16	12	7	12
Platinum	16	20	15	9	16

LT credit: LEED for Neighborhood Development Location

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LT credit- Sensitive Land Protection

Option 1:
Choose a brownfield.

Option 2:
Avoid building on the following sites:

- Prime farmland
- Floodplains
- Habitat for endangered and threatened species
- Close proximity (30 meters) to wetlands and water bodies

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LT Credit: High Priority Site EP

Intent: To encourage project location in areas with development constraints and promote the health of the surrounding area.

- Option 1: Historic District
- Option 2: Priority Designation (listed by the Environmental Protection Agency-EPA)
- Option 3: Brown Field Remediation

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LT Credit- Surrounding Density and Diverse Uses

Intent:

- To Conserve land and protect farmland & wildlife habitat by encouraging development in areas with existing infrastructure.
- To promote walkability, and transportation efficiency and reduce vehicle distance traveled.
- To improve public health by encouraging daily physical activity.

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Surrounding Density and Diverse Uses- Option 1

Residential Density (Dwelling units/acre)		
Units	Acre	DU
10	1	10
22	1	22
3	.75	4
18	2	9
	4.75	45

✓ Residential Density = Dwelling units (DU)/acre
45 DU/4.75 Acres = 9.47 Res. Density

Option 1- (Surrounding Density) Locate on a site whose surrounding existing density within a 1/4 mile (400-meter) radius of the project boundary is at least 7 DU/acre for 2 pts or 12 DU/acre for 3 pts.

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LT Credit- Surrounding Density and Diverse Uses- Option 1

OR
Achieve a Nonresidential Density (FAR) of at least 0.5 for 2 pts or 0.8 for 3 pts.

Nonresidential Density (floor-area ratio)			
Building Area (ft ²)	Buildable Land (acres)	Buildable Land (ft ²)	FAR
50,000	1	43560	
70,000	2	87120	
20,000	1.5	65340	
25,000	1	43560	
165,000	5.5	239,580	.69

✓ Floor Area Ratio (FAR) is the density, excluding parking, measured as:
 $\frac{\text{the total building floor area (165,000)}}{\text{the total buildable land area available (239,580)}}$

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LT Credit- Surrounding Density and Diverse Uses- Option 2

• the building's main entrance must be within a 800-meter walking distance of the main entrance of four to seven (1 point) or eight or more (2 points) existing and publicly available diverse uses.

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LT Credit- Access to Quality Transit EP

Intent: To encourage development in locations with multimodal transportation choices to reduce greenhouse gas emissions, air pollution, and other environmental and public health harms associated with motor vehicle use.

Requirement: Locate any functional entry of the project within a 400-meter walking distance of existing or planned bus, streetcar, or informal transit stops, or within a 800-meter walking distance of existing or planned bus rapid transit stops, light or heavy rail stations, commuter rail stations or ferry terminals. The transit service at those stops and stations in aggregate must meet the minimums listed in Tables 1 and 2.

Weekday Stops	Weekend Stops	Points (B&C (except Low Rise) transit)	Points (B&C (Low Rise) and street)	Points (D&C)
72	40	1	1	2
144	108	3	3	5
360	216	5	6	7

Weekday stops	Weekend stops	Points (all projects)
24	6	1
48	6	2
10	3	3


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LT Credit- Bicycle Facilities

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

Requirements:

- Bicycle network (within 180 meter distance)
- Bicycle storage and shower rooms




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LT Credit- Reduced Parking Footprint

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

Requirements:

- Leave Building frontages facing the circulation network free of surface parking lots.
- Use no more than 20% of the total development footprint area for all new off-street surface parking facilities.
- No individual surface parking lot larger than 2 acres.
- Exemptions: garages under habitable building space, underground or multistory parking facilities, On-street parking spaces.
- Provide carpool or shared-use vehicle parking spaces equivalent to at least 10% of the total off-street parking spaces, within 200 feet walking distance of entrances to the building.



EP

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LT Credit- Green Vehicles

Intent:
To reduce pollution by promoting alternatives to conventionally fueled automobiles

Requirements:
Designate 5% of all parking spaces used by the project as preferred parking for green vehicles.

Option 1. Electric Vehicle Charging (EVSE for 2% of parking spaces)

Option 2. Liquid, gas, or battery facilities (alternative fuel fueling facilities for 2% of parking spaces)



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Quiz Time!

• A BD+C project may earn up to 20 points for locating in a LEED ND location where the ND project is:

- Registered under LEED v4
- Certified Plan or Project under LEEDv4
- Under plan review with the local planning department
- At least 90% complete

Correct Answer: (B)- A BD+C Core and Shell project can earn 20 points for locating within the boundaries of a Platinum certified LEEDv4 for Neighborhood Development Plan or Project adaptation.

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Quiz Time!

• An owner would like to build a LEED certified building on a suburban site that has not previously developed. In order to earn the Sensitive Land Protection credit which of the following is the best pathway?

- Check the NatureServe database to ensure that the site is not habitat for any listed species.
- Ask local experts about what species live in the area.
- Ensure that the project is located 15 m above the 100 year flood level
- Locate the building at least 10 meter away from the pond on the site.

Correct Answer: (A)- In order to earn the credit the owner must avoid habitat for listed species or ecological communities classified by NatureServe as GH (possibly extinct), G1 (critically imperiled), or G2 (imperiled). The project must also be at least 30 m from a water body and cannot locate in a floodplain to earn the credit.

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Quiz Time!

• Developing a site that meets the requirements for high-priority site credit may have the following benefits (select two):

- A contaminated site will be less expensive to purchase
- Help to revitalize the neighborhood
- Help to increase the local tax base so that property taxes go up
- Achieve savings by connecting to existing infrastructure.

Correct Answer: (B)&(D)

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Quiz Time!

Which of the following LEED credits are eligible for exemplary performance?

- High priority site
- Site assessment
- Light pollution reduction
- Sensitive land protection

Correct answer: (a).
High priority site is eligible for exemplary performance by pursuing option 2 or 3 in addition to option 1.

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Sustainable Sites (SS)

- Addresses issues of construction/ Building impact on the surrounding environment.
- It focuses on restoring project site elements and preserving the biodiversity

Credit or Category Name	New Construction	Core and Shell	Schools
Sustainable Sites (SS)	10	11	12
Construction Activity Pollution Prevention	P	P	P
Environmental Site Assessment	n/a	n/a	P
Site Assessment	1	1	1
Site Development- Protect or Restore Habitat	2	2	2
Open Space	1	1	1
Rainwater Management	3	3	3
Heat Island Reduction	2	2	2
Light Pollution Reduction	1	1	1
Site Master Plan	n/a	n/a	1
Tenant design and Construction Guidelines	n/a	1	n/a
Joint use of Facilities	n/a	n/a	1

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SS Prerequisite- Construction Activity Pollution Prevention

Intent:
To reduce pollution from construction activities by controlling soil erosion, waterway sedimentation, and airborne dust.

Requirements:
Create and implement an erosion and sedimentation control plan for all construction activities associated with the project (According to the 2003 EPA Construction General Permit/ local equivalent)

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SS Prerequisite 1- Construction Activity Pollution Prevention

- Strategies:
- Seeding
- Mulching
- Earth dikes
- Silt fencing
- Sediment traps & basins

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SS Pre-requisite- Environmental Site Assessment (schools only)

Intent:
To ensure that the site is assessed for environmental contamination and if contaminated, that the environmental contamination has been remediated to protect children's health.

Requirements:
Schools sites that are contaminated by past use as a landfill are ineligible for LEED certification. If a site is otherwise contaminated, it must be remediated to meet local, state, or federal EPA region residential (unrestricted) standards, whichever is most stringent

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SS Credit- Site Assessment

Intent:
To assess site conditions before design to evaluate sustainable options and inform related decisions about site design.

Requirement:
Complete & Document a site survey or assessment that includes the following information:

- Topography
- Hydrology
- Climate
- Vegetation
- Soils
- Human use
- Human health effects


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Site Development- Protect or Restore Habitat

EP

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

Requirements:
Preserve and protect from all development and construction activity 40% of the greenfield area on the site (if such areas exist).
AND
Option 1. on-site restoration- 30% (2 points)
OR
Option 2. Financial Support (\$4 per square meter to a locally recognized land trust)




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SS Credit- Open Space

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

Requirements
Provide outdoor space greater than or equal to 30% of the total site area. A minimum of 25% of that outdoor space must be vegetated (turf grass does not count as vegetation) or have overhead vegetated canopy.



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SS credit- Rainwater management

EP

Intent
To reduce runoff volume and improve water quality by replicating the natural hydrology and water balance of the site, based on historical conditions and undeveloped ecosystems in the region.

Requirements
Option 1. Percentile of rainfall events
Path 1. 95th percentile (2 points)
Or
Path 2. 98th percentile (3 points)
Or
Path 3. Zero lot line projects only- 85th percentile
Option 2. Natural land cover conditions (3 points)

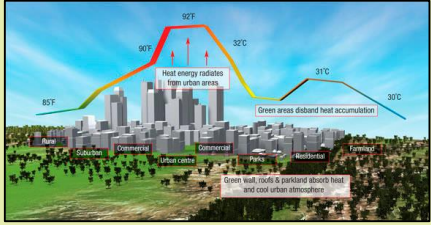
Integrated Rainwater Management



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SS Credit- Heat Island Reduction

Intent
To minimize effects on microclimates and human and wildlife habitats by reducing heat islands. "Albedo Effect"



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Heat Island Reduction

EP

Requirements:
Option 1: nonroof and roof (2 points)

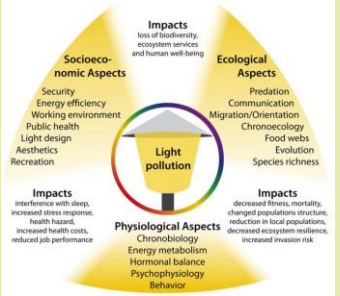
Area of Nonroof Measures	+	Area of High-Reflectance Roof	+	Area of Vegetated Roof	≥	Total Site Paving Area	+	Total Roof Area
0.5		0.75		0.75				

Option 2: parking under cover (1point)
(75% of parking spaces)

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SS Credit- Light Pollution Reduction

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



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SS Credit- Light Pollution Reduction

Requirements
Meet uplight and light trespass requirements, using either the backlight-uplight-glare (BUG) method (Option 1) or the calculation method (Option 2).

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Model Lighting Ordinance (MLO) lighting zone	User Vision adaptation	Lighting used for human activity	Lighting behavior	Luminaire up light rating (option 1)	Maximum allowed percentage of total luminaire lumens emitted above horizontal (option 2)
LZ0	Adapted to the darkness	Human activity subordinate in importance to nature	When not needed, should be extinguished	U0	0%
LZ1	Adapted to low light	Lighting is seldom used for safety and convenience but is not uniform or continuous	After curfew, most lighting should be extinguished or reduced as activity level decline.	U1	0%
LZ2	Adapted to moderate lighting	Lighting is sometimes used for safety and convenience but is not uniform or continuous	After curfew, most lighting should be extinguished or reduced as activity level decline.	U2	1.5%
LZ3	Adapted to moderately high light level	Lighting is generally desired for safety, security, and/or	After curfew, most lighting should be extinguished or reduced as activity level decline.	U3	3%
LZ4	Adapted to high light levels	Lighting is generally considered necessary for safety, security, and/or convenience and it is mostly uniform/continuous	After curfew, lighting may be extinguished or reduced in some areas as activity levels decline.	U4	6%

Illuminating Engineering Society and International Dark Sky Association (IES/IDA)

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SS Credit- Site Master Plan (Schools Only)

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

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

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

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SS Credit- Tenant Design and Construction Guidelines

Intent:
Provide tenants with a descriptive tool that both educates and helps them implement sustainable design and construction features in their tenant improvement build-out

Requirements:
An illustrated document of the following:

- A description of the sustainable design and construction features incorporated in the project and the project's sustainability goals and objectives.
- Information on LEED for Commercial Interiors and how the core and shell building contributes to achieving these credits.
- Information that enables a tenant to coordinate space design and construction with the core and shell's building systems.

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SS Credit- Joint Use of Facilities

Intent:
To integrate the school with the community by sharing the building and its playing fields for non-school events and functions.

Requirements:

- Option 1.** make building space open to general public

OR

- Option 2.** Contract with specific organizations to share at least two building space

OR

- Option 3.** Use at least two shared space owned by other organizations

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Quiz Time!

• What is "Albedo"?

- A reference to a type of formaldehyde in a building material
- A measure of photosynthesis
- The reflectivity of a material
- The emissivity of a material
- The sustainability quotient of a material

Correct Answer: (C)
Albedo is the measure of the diffuse reflection of solar radiation out of the total solar radiation received by an astronomical body. It is dimensionless and measured on a scale from 0 to 1.

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Quiz Time!

• A property whose use may be complicated by the presence or possible presence of a hazardous substance, pollutant or contaminant is called a ____.

- a) Playground
- b) Greenfield
- c) Brownfield
- d) Blackfield

Correct Answer: (C)

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Quiz Time!

Providing open space on LEED project site is encouraged for which of the following reasons (Check all that applies)?

- a) Foster social interaction
- b) Link habitat corridors in urban areas
- c) Increase impervious surfaces
- d) Reduce visual interest

Correct Answer: (a)& (b)

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Water Efficiency (WE)

Credit or Category Name	New Construction	Core and Shell	Schools
Water Efficiency (WE)	11	11	12
Outdoor Water Use Reduction	P	P	P
Indoor Water Use Reduction	P	P	P
Building-Level Water Metering	P	P	P
Outdoor Water Use Reduction	2	2	2
Indoor Water Use Reduction	6	6	7
Cooling Tower Water Use	2	2	2
Water Metering	1	1	1

- Drought Conditions persist around the world.
- Indoor and outdoor water efficiency becomes increasingly important.
- Water Consumption Metering has gained importance.



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WE Prerequisite: Outdoor Water Use Reduction

Requirements:

- Option 1: No irrigation required
- Option 2: Reduced Irrigation (at least 30% for the site's peak watering month)

Athletic fields and playgrounds (if vegetated) and food gardens may be included or excluded at the project team's discretion.



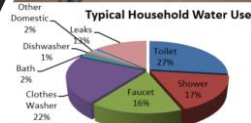
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WE Prerequisite: Indoor water use reduction

Requirements:

- Option 1- Building water use: Reduce aggregate water consumption by 20% from the baseline by:
 - Using graywater
 - Fixtures, Fittings, and appliances



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Standard Water Use Baseline in Buildings in United States

Commercial Fixtures, Fittings, and Appliances	Current Baseline
Commercial toilets	1.6 gallons per flush (gpf)** Except slow-out fixtures: 3.5 gpf†
Commercial urinals	1.0 gpf†
Commercial lavatory (restroom) faucets	2.2 gallons per minute (gpm) at 60 pounds per square inch (psi), private applications only (hotel or motel guest rooms, hospital patient rooms) 0.5 gpm) at 60 (psi)** all others except private applications 0.25 gallons per cycle for metering faucets
Commercial premise spray valves (for food service applications)	Flow rate < 1.6 gpm) (no pressure specified, no performance requirement)
Residential Fixtures, Fittings, and Appliances	Current Baseline
Residential toilets	1.6 gpf***
Residential lavatory (bathroom) faucets	2.2 gpm) at 60 psi
Residential kitchen faucet	2.2 gpm) at 60 psi
Residential showerheads	2.5 gpm) at 80 (psi) per shower stall****

The baseline is to help compare the water efficiency after employing sustainable strategies, per USEPA (version 2002).³⁰

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Option 2- Appliance & process water use:

Install appliances, equipment and processes that meet the requirements

Table 2. Standards for appliances

Appliance	Requirement
Residential Clothes Washer	ENERGY STAR or performance equivalent
Commercial Clothes Washer	CEE Tier 3A
Residential Dishwasher (standard and compact)	ENERGY STAR or performance equivalent
Premise spray valve	≤ 1.3 gpm
Ice machine	ENERGY STAR or performance equivalent and use either air-cooled or closed-loop cooling, such as chilled or condenser water system

Table 3. Standards for processes

Process	Requirement
Heat rejection and cooling	No once-through cooling with potable water for any equipment or appliances that reject heat Faucet with <ul style="list-style-type: none"> • makeup water meters • conductivity controllers and overflow alarms • efficient drain eliminators that reduce drift to maximum of 0.002% of recirculated water volume for counterflow towers and 0.005% of recirculated water flow for cross flow towers
Cooling towers and evaporative condensers	

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WE prerequisite: Building level Water Metering

Intent

To support water management and identify opportunities for additional water savings by tracking water consumption.

Requirements

Install permanent water meters that measure the total potable water use for the building and associated grounds. Meter data must be compiled into monthly and annual summaries.




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WE Credit: Outdoor Water Use Reduction Design Credit

Requirements:

- Option 1. No irrigation required
- Or
- Option 2. Reduced irrigation
 - Nonvegetated surfaces, such as permeable or impermeable pavement, should be excluded from landscape area calculations.




Percentage reduction from baseline	Points (Except Healthcare)	Points (Healthcare)
50%	1	1
100%	2	-

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WE Credit- Indoor Water Use Reduction

Requirements:

- Further reduce fixture and fitting water use from the calculated baseline in WE prerequisite.



Percentage Reduction	Points (BD&C)	Points (Schools, Retail, Hospitality, Healthcare)	Points (ID&C)	Points (CI Retail)	Points (CI Hospitality)
25%	1	1	2	2	2
30%	2	2	4	4	4
35%	3	3	6	6	6
40%	4	4	8	8	8
45%	5	5	10	10	10
50%	6	-	12	-	11

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WE Credit- Cooling Tower Water Use

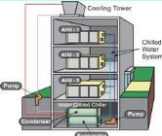
Intent:

To conserve water used for cooling tower makeup while controlling microbes, corrosion, and scale in the condenser water system.

Requirements:

Conduct a one-time potable water analysis to optimize cooling tower cycles. Measure the five control parameters listed:

Parameter	Maximum level
Ca (as CaCO3)	1000 ppm
Total alkalinity	1000 ppm
SiO2	100 ppm
Cl	250 ppm
Conductivity	2000 µS/cm



65

WE Credit- Cooling Tower Water Use-Requirements

Parameter	Points
Maximum number of cycles achieved without exceeding any filtration levels or affecting operation of condenser water system (up to maximum of 10 cycles)	1
Achieve a minimum 10 cycles by increasing the level of treatment in condenser or make-up water OR Meet the minimum number of cycles to earn 1 point and use a minimum 20% recycled nonpotable water	2


66

WE Credit: Water Metering

Intent:
To support water management and identify opportunities for additional water savings by tracking water consumption.

Requirements:
Install permanent water meters for at least two water subsystems:

- Irrigation
- Indoor plumbing fixtures and fittings
- Domestic hot water
- Boiler
- Reclaimed water
- Humidification systems, dishwashers, clothes washers, pools,....



67

Quiz Time!

Which of the following is not a benefit of maintaining native vegetation instead of using nonnative vegetation on a project?

- A) Reduced fertilizer application
- B) Reduced pesticide application
- C) Reduced heat island impacts
- D) Reduced irrigation requirements

Correct Answer: (C)- There are no heat island impacts from native versus nonnative vegetation on a project.

68

Quiz Time!

"Graywater" can be reused for which of the following purposes?

- a) Cooling towers and irrigation
- b) Toilet flushing, cooling towers and irrigation
- c) Irrigation only
- d) Graywater should not be reused

Correct Answer: (b)
Graywater is defined as "untreated household waste water which has not come into contact with toilet waste". Graywater includes used water from bathtubs, showers, bathroom wash basins, and water from clothes-washers and laundry tubs. It must not include waste water from kitchen sinks or dishwashers.

69

Quiz Time!

___ is a critical step to reporting how much water is being used by systems and fixtures and identifying leaks or other inefficiencies.

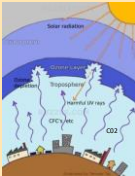
- a) Installing submeters
- b) Hiring a commissioner
- c) Reviewing water end use reports
- d) Using the water sense waterbudget tool

Correct Answer: (a)

70

Energy & Atmosphere (EA)

Covers issues of energy and issues that connect buildings systems to environmental impacts on air and the atmosphere.



Credit or Category Name	New Construction	Core and Shell	Schools
Energy & Atmosphere	33	33	31
Fundamental Commissioning & verification	P	P	P
Minimum energy performance	P	P	P
Building-level energy metering	P	P	P
Fundamental Refrigerant management	P	P	P
Enhanced Commissioning	6	6	6
Optimize Energy performance	18	18	16
Advanced Energy metering	1	1	1
Demand response	2	2	2
Renewable energy production	3	3	3
Enhanced refrigerant management	1	1	1
Green power and carbon offsets	2	2	2


71

EA Prerequisite- Fundamental Commissioning and Verification

Commissioning Process scope:

- The commissioning authority (CxA) must do the following in accordance with ASHRAE Guideline 0-2005 and ASHRAE Guideline 1.1-2007 for HVAC&R Systems:
 - Review the OPR, BOD, and project design.
 - Develop and implement a Cx plan.
 - Confirm incorporation of Cx requirements into the construction documents.
 - Develop construction checklists.
 - Develop a system test procedure.
 - Verify system test execution.
 - Maintain an issues log throughout the Cx process.
 - Prepare a final Cx process report.
 - Document all findings and recommendations and report directly to the owner throughout the process

+Commissioning Authority Qualifications
+Current Facilities Requirements & Operations & Maintenance Plan



72

EA Pre-requisite- Minimum Energy Performance

Intent:
To reduce the environmental and economic harms of excessive energy use.

- Option 1- Whole-building energy simulation

according to ANSI/ASHRAE/IESNA Standard 90.1-2010, Appendix G

- Option 2- Prescriptive compliance: ASHRAE 50% Advanced Energy Design Guide

Comply with the mandatory and prescriptive provisions

- Option 3- Prescriptive Compliance: Advanced Buildings™ Core Performance™ Guide

LEED Type	Improvement
New Construction	5%
Major Renovation	3%
Core and Shell	2%


Comply with Section 1: Design Process Strategies, Section 2: Core Performance Requirements, and the three strategies from Section 3: Enhanced Performance Strategies, as applicable

73

EA prerequisite-Building-level Energy Metering

Intent:
To support energy management and identify opportunities for additional energy savings by tracking building-level energy use.

Requirements:
Use energy meters to provide building-level data representing total building energy consumption.
Commit to sharing with USGBC the resulting data for a five-year period.

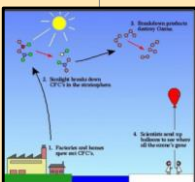


74

EA Pre-requisite-Fundamental Refrigerant Management

Intent:
To reduce stratospheric ozone depletion.

- Do not use chlorofluorocarbon (CFC)-based refrigerants in new HVAC&R systems




75

Refrigerant	GWP (Montreal Protocol)	GWP	Building Application
CFC-11	1.00	4680	Chillers
CFC-12	1.00	10720	Chillers
CFC-113	0.80	6030	Chillers
CFC-114	1.00	7900	Chillers
CFC-115	0.60	7250	Chillers
HCFC-22	0.06	1780	Air Conditioning/Chillers
HCFC-123	0.02	76	CFC-11 Replacement
HFC-23	0.00	12240	Low Temp Refrigeration
HFC-134a	0.00	1320	CFC-12/HCFC-22 Replacement
HFC-245a	0.00	1020	Chillers
HFC-404A	0.00	3900	Low Temp Refrigeration
HFC-407C	0.00	1700	HCFC-22 Replacement
HFC-410A	0.00	1890	Air Conditioning
HFC-507A	0.00	3900	Low Temp Refrigeration
Carbon Dioxide	0.00	1	
Air	0.00	0	
Water	0.00	—	Not calculated
Hydrocarbons	0.00	3	GWP for Propane
Ammonia (NH3)	0.00	0	

GWP = Global Warming Potential

1 lb of HFC-23 does as much global warming as 12,240 lbs of CO₂




76

EA Credit-Enhanced Commissioning

Complete the following commissioning process activities for:

- mechanical,
- electrical,
- plumbing,
- renewable energy systems and assemblies (4 points)

AND/OR
For building's thermal envelope (2 points)



- Review contractor submittals.
- Verify
 - inclusion of systems manual requirements in construction documents.
 - inclusion of operator and occupant training requirements in construction documents.
 - systems manual updates and delivery.
 - operator and occupant training delivery and effectiveness.
 - seasonal testing.
- Review building operations 10 months after substantial completion.
- Develop an on-going commissioning plan.

In accordance with ASHRAE Guideline 0-2005 and ASHRAE Guideline 1.1-2007

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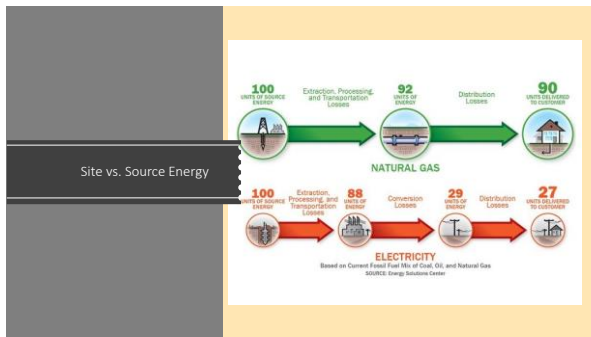
EA credit-Optimize Energy Performance

Option 1- Whole-building energy simulation

Establish an energy performance target no later than the schematic design phase. The target must be established as kBtu per square foot-year (kW per square meter-year) of source energy use.

New Construction	Major Renovation	Core & Shell	Points (except Schools, Healthcare)	Points Healthcare	Points School
6%	4%	3%	1	3	1
8%	6%	5%	2	4	2
10%	8%	7%	3	5	3
12%	10%	9%	4	6	4
14%	12%	11%	5	7	5
16%	14%	13%	6	8	6
18%	16%	15%	7	9	7
20%	18%	17%	8	10	8
22%	20%	19%	9	11	9
24%	22%	21%	10	12	10
26%	24%	23%	11	13	11
29%	27%	26%	12	14	12
32%	30%	29%	13	15	13
35%	33%	32%	14	16	14
38%	36%	35%	15	17	15
42%	40%	39%	16	18	16
46%	44%	43%	17	19	-
50%	48%	47%	18	20	-

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79

EA credit- Optimize Energy Performance

Option 2- Prescriptive Compliance: ASHRAE Advanced Energy Design Guide (1-6 points)

To be eligible for Option 2, projects must use Option 2 in EA Prerequisite Minimum Energy Performance.

ASHRAE 50% ADVANCED ENERGY DESIGN GUIDE FOR SMALL TO MEDIUM OFFICE BUILDINGS	
Building envelope, opaque: roofs, walls, floors, slabs, doors, and continuous air barriers	1 point
Building envelope, glazing: vertical fenestration	1 point
Interior lighting, including daylighting and interior finishes	1 point
Exterior lighting	1 point
Plug loads, including equipment and controls	1 point

80

EA Credit- Advanced Energy Metering

Intent
To support energy management and identify opportunities for additional energy savings by tracking building-level and system-level energy use

Requirements
Install advanced energy metering for the following:

- all whole-building energy sources used by the building; and
- any individual energy end uses that represent 10% or more of the total annual consumption of the building

With submetering technology, energy managers may track main load energy usage, real-time consumption at the asset level (e.g. HVAC, lighting, refrigeration, etc.), and production efficacy (e.g. renewables and energy storage) (Figure 3).

Real-time consumption data

81

EA Credit- Demand Response

Intent:

- To increase participation in demand response technologies and programs that make energy generation and distribution systems more efficient, increase grid reliability, and reduce greenhouse gas emissions.

Case 1. Demand response program available (2 points)

- Participate in an existing demand response (DR) program

Case 2. Demand response program not available (1 point)

Provide infrastructure to take advantage of future demand response programs or dynamic, real-time pricing programs

82

EA Credit- Renewable Energy Production EP

Intent
To reduce the environmental and economic harms associated with fossil fuel energy by increasing self-supply of renewable energy.

Percentage Renewable Energy	Points (Except CS)	Points (CS)
1%	1	1
3%	-	2
5%	2	3
10%	3	-

% renewable energy = $\frac{\text{Equivalent cost of usable energy produced by the renewable energy system}}{\text{Total building annual energy cost}}$

83


Renewable Energy Sources

84

EA Credit- Enhanced Refrigerant Management

Intent
To reduce ozone depletion and support early compliance with the Montreal Protocol while minimizing direct contributions to climate change.

Requirements
Option 1. No refrigerants or low-impact refrigerants (ODP=0; GWP<50)(1 point)
OR
Option 2. Calculation of Refrigerant impact



SI units

LCOWP + LCOOP * 10³ * 13

85

EA Credit- Green power and carbon offsets

Intent:
To encourage the reduction of greenhouse gas emissions through the use of grid-source, renewable energy technologies and carbon mitigation projects.

Requirements:
Engage in a contract for qualified resources that have come online since January 1, 2005, for a minimum of five years, to be delivered at least annually.

PATHS TO OFFSET ENERGY USE			Percentage of total energy addressed	Points
TYPE	MEASUREMENT	VERIFICATION		
REC's	MWh		50%	1
carbon offsets	metric tons of CO ₂ equivalent	certified by appropriate Green-e program	100%	2
green power	MWh			

86

Quiz Time!

• A green (vegetated) roof can contribute to which 3 credits? (check all that applies)

a) Heat island reduction
b) Optimize energy performance
c) Rainwater management
d) Outdoor water use reduction
e) Material ingredients

Correct Answer: (a&b&c)

87

Quiz Time!

• A building automation system will assist with collecting data about which of the following:

a) Energy spikes that occur every morning
b) Cleanliness of restrooms
c) Maintenance schedule for replacing air filters
d) Complaints from occupants about a loud fan noise in a conference room

Correct Answer: (a)

88

Quiz Time!

Ozone depletion potential is based on:

a) Carbon dioxide
b) Carbon monoxide
c) CFC-11
d) HCFC-123

Correct Answer: (c)

89

Quiz Time!

• What statement is true regarding HydroFluoroCarbons (HFCs)?

a) Many HFCs have a significant global warming potential
b) The HFC refrigerant group includes NH₃, CO₂, and propane C.
c) HFCs have high ozone depletion potential
d) FCs are scheduled to be banned under the Montreal Protocol

Correct Answer: (a)

Many HFCs have a significant global warming potential
HFCs typically have a low ozone depletion potential but a high global warming potential.

90

Quiz Time!

Which credits use a baseline to perform calculations? (check all that applies)

- a) Water use reduction
- b) Optimize energy performance
- c) Bicycle facilities
- d) Indoor water use reduction
- e) Demand response
- f) Heat island reduction

Correct Answer: (a), (b), & (d)

91

Quiz Time!

What does a carbon offset represent?

- a) The energy consumption divided by the number of square feet in a building
- b) A unit of carbon dioxide equivalent that is reduced, avoided, or sequestered to compensate for emissions occurring elsewhere.
- c) A tradable commodity representing proof that a unit of electricity was generated from a renewable resource
- d) The primary measure of energy consumption associated with buildings

Correct Answer: (b)
A unit of carbon dioxide equivalent that is reduced, avoided, or sequestered to compensate for emissions occurring elsewhere.

92


Quiz Time!

A project team is reviewing strategies to increase energy efficiency. Which of the following will help reduce plug-load demands?

- A. Installing appliances that meet or exceed ENERGY STAR requirements
- B. Efficient street lighting
- C. Computer modeling
- D. High-performance glazing


Correct Answer: (a)

93

 **Material and Resources**

The Materials and Resources (MR) credit category focuses on minimizing the embodied energy and other impacts associated with the extraction, processing, transportation, maintenance, and disposal of building materials.

Credit or Category Name	New Construction	Core and Shell	Schools
Materials & Resources	13	14	13
Storage & collection of recyclables	P	P	P
Construction & demolition waste management planning	P	P	P
Building life cycle impact reduction	5	6	5
Building product disclosure & optimization- environmental product declarations	2	2	2
Building product disclosure & optimization- sourcing of raw materials		2	2
Building product disclosure & optimization- material ingredients	2	2	2
Construction & demolition waste management	2	2	2



94

MR Pre-requisite: Storage & Collection of recyclables

Intent:
To reduce the waste that is generated by building occupants and hauled to and disposed of in landfills.

Requirements:
Provide dedicated areas accessible to waste haulers and building occupants for the collection and storage of recyclable materials for the entire building.



95

MR Prerequisite: Construction & Demolition Waste Management Planning

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

Requirements:
Develop and implement a construction and demolition waste management plan:

- Establish waste diversion goals for the project by identifying at least five materials.
- Describe where the materials will be taken and how the recycling facility will process the material.
- Provide a final report detailing all major waste streams generated, including disposal and diversion rates.



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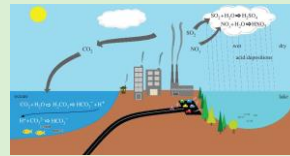
MR Credit: Building Life Cycle Impact Reduction ★ EP

Intent:
To encourage adaptive reuse and optimize the environmental performance of products and materials.



Requirements:
Demonstrate reduced environmental effects during initial project decision-making by achieving one of the followings:
Option 1. historic building reuse (5 points)
Option 2. Renovation of abandoned or blighted building (50% of surface area)(5 points)
Option 3. building and material reuse(25%-50%-75%) (2-4 points)
Option 4. whole-building life-cycle assessment (10%)(3 points)

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- ◆ global warming potential (greenhouse gases), in CO₂e;
- depletion of the stratospheric ozone layer, in kg CFC-11;
- acidification of land and water sources, in moles H+ or kg SO₂;
- eutrophication, in kg nitrogen or kg phosphate;
- formation of tropospheric ozone, in kg NO_x, kg O₃ eq, or kg ethene; and
- depletion of nonrenewable energy resources, in MJ.

Building Life Cycle Impact Criteria

98

MR Credit: Building product disclosure and optimization - environmental product declarations ★ EP

Intent:
To encourage the use of products and materials for which life-cycle information is available and that have environmentally, economically, and socially preferable life-cycle impacts. To reward project teams for selecting products from manufacturers who have verified improved environmental life-cycle impacts.

Requirements:
Option 1. environmental product declaration (EPD) (1 point)
And/Or
Option 2. Multi-attribute optimisation (1 point)



Option 1. Environmental Product Declaration (EPD)

- Use at least 20 different permanently installed products sourced from at least five different manufacturers that meet one of the disclosure criteria below.
- Environmental product declarations which conform to ISO 14025 and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
- Product-specific declaration.
- USGBC approved program – Products that comply with other USGBC approved environmental product declaration frameworks.

QUALITY CATEGORY	CRADLE TO CRADLE CERTIFIED™ PRODUCT SCORECARD			
	BASIC	BETTER	BEST	REVEALING
ENVIRONMENTAL HEALTH			✓	
WATER EFFICIENCY		✓		
ENERGY EFFICIENCY		✓		
SOCIAL PRACTICES			✓	
OVERALL CERTIFICATION LEVEL	✓			

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100



Option 2. Multi-attribute optimization

- Use products that comply with one of the criteria below for 50% *by cost* of the total value of permanently installed products in the project. Products will be valued as below.
- Third party certified products that demonstrate impact reduction below industry average in at least three of the mentioned categories are valued at 100% of their cost for credit achievement calculations.
 - USGBC approved program – Products that comply with other USGBC approved multi-attribute frameworks.
 - For credit achievement calculation, products sourced (extracted, manufactured, purchased) within 100 miles (160 km) of the project site are valued at 200% of their base contributing cost

101

MR Credit- Building product disclosure & optimization- sourcing of raw materials ★ EP

Intent:
To encourage the use of products and materials for which life cycle information is available and that have environmentally, economically, and socially preferable life cycle impacts. To reward project teams for selecting products verified to have been extracted or sourced in a responsible manner.

Requirements:
Option 1: Raw material source and extraction reporting (1point)
And/or
Option 2. Leadership extraction practices (1 point)



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Option 1. Raw material source and extraction reporting

- Use at least 20 different permanently installed products from at least five different manufacturers that have publicly released a report from their raw material suppliers which include:
 - raw material supplier extraction locations,
 - a commitment to long-term ecologically responsible land use,
 - a commitment to reducing environmental harms from extraction and/or manufacturing processes,
 - and a commitment to meeting applicable standards or programs voluntarily that address responsible sourcing criteria.
- Acceptable CSR frameworks include the following:
 - Global Reporting Initiative (GRI) Sustainability Report
 - Organization for Economic Co-operation and Development (OECD) Guidelines for Multinational Enterprises
 - U.N. Global Compact: Communication of Progress
 - ISO 26000: 2010 Guidance on Social Responsibility
 - USGBC approved program: Other USGBC approved programs meeting the CSR criteria



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Option 2. Leadership extraction practices

Use products that meet at least one of the responsible extraction criteria below for at least 25%, by cost, of the total value of permanently installed building products in the project.

- Extended producer responsibility (valued 50%).
- Bio-based materials (based on Sustainable Agriculture Standard).
- Wood products (the Forest Stewardship Council).
- Materials reuse.
- Recycled content.
- meeting leadership extraction criteria (USGBC approved programs).



104

EP MR Credit- Building product disclosure & optimization- material ingredients

Intent:

- To encourage the use of products that have:
 - Life-cycle information available
 - Environmentally, economically, socially preferable life-cycle impacts.
- To reward teams for selecting products with
 - chemical ingredients inventories using accepted methodologies
 - verified to minimize the use and generation of harmful substances
- To reward raw material manufacturers who produce products verified to have improved life-cycle impact

Requirements: (2 points available from 3 options)

Option 1. Material ingredient reporting (1 point)

And/or

Option 2. Material ingredient optimization (1point)

And/or

Option 3. Product Manufacturer Supply Chain Optimization (1 point)


105

MR Credit- Construction & Demolition waste management

Intent:

To reduce construction and demolition waste disposed of in landfills and incineration facilities by:

- recovering,
- reusing,
- and recycling materials.



Requirements:

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

Option1 . Diversion

- Path 1. Divert 50% and three material streams (1 point)
- Path 2. Divert 75% and four material streams (2points)

OR

Option 2. Reduction of total waste material (2 points)

- do not generate more than 12.2 kilograms of waste per square meter of the building's floor area.

106

Quiz Time!

In its solid waste management hierarchy, the U.S. EPA ranks ____ as the four preferred strategies for reducing waste.

Correct Answer: (c)

- Reduce, reuse, recycle, & waste to landfill
- Source depletion, reclaim, renew, and waste to water
- Source reduction, reuse, recycle, & waste to energy
- Recycle, relaine, use renewable & burn

107

Quiz Time!

When a whole building energy analysis is conducted for the building life cycle impact reduction credit, which impact measure(s) must be reduced by 10% or more?

Correct Answer: (a) This is a question of deep knowledge! While all the answers are on the list of impact measures that should be reduced, GWP is the only one that is REQUIRED to be reduced (by 10%).

- Global warming potential
- Ozone depletion potential
- Acidification
- Eutrophication
- All of the above

108

Quiz Time!

The calculation for recycled content in a building material is based on:

- a) Cost
- b) Weight
- c) Surface area
- d) Replacement cost
- e) Harvest cycle

Correct Answer: (b)
The calculation for recycled content in a building material is based on weight or volume.

109

Quiz Time!

Which credits can achieve exemplary performance point (check all that applies)?

- a) Building Life Cycle Impact Reduction
- b) Building Product Disclosure and Optimization - Environmental Product Declarations
- c) Building Product Disclosure and Optimization - Sourcing of Raw Materials
- d) Building Product Disclosure and Optimization - Material Ingredients
- e) Construction and Demolition Waste Management


Correct Answer: all choices!

110

Indoor Environmental Quality

rewards decisions made by project teams about indoor air quality and thermal, visual, and acoustic comfort.

Credit or Category Name	New Construction	Core and Shell	Schools
Indoor Environmental Quality	16	10	16
Minimum indoor air quality performance	P	P	P
Environmental tobacco smoke control	P	P	P
Minimum acoustic performance	-	-	P
Enhanced indoor air quality	2	2	2
Low-emitting materials	3	3	3
Construction indoor air quality management plan	1	1	1
Indoor air quality assessment	2	-	2
Thermal comfort	1	-	1
Interior lighting	2	-	2
Daylight	3	3	3
Quality views	1	1	1
Acoustic performance	1	-	1



111


IAQ Pre-requisite: Minimum Indoor Air Quality Performance

Intent
To contribute to the comfort and well-being of building occupants by establishing minimum standards for indoor air quality (IAQ)

Requirements
Meet the requirements for both ventilation and monitoring.

Ventilation
Mechanically ventilated spaces (Meet the minimum air intake requirements)
Option 1. ASHRAE Standard 62.1-2010
Option 2. CEN Standards EN 15251-2007 and EN 13779-2007 (projects outside the US)
Naturally ventilated spaces (Meet the minimum outdoor air opening and space configuration requirements) ASHRAE Standard 62.1-2010, or a local equivalent

Monitoring
Mechanically ventilated spaces
Naturally ventilated spaces



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IAQ Credit: Minimum Indoor Air Quality Performance-Monitoring

Monitoring

Mechanically ventilated spaces


- For variable air volume systems, the device must measure the minimum outdoor air intake flow with an accuracy of +/-10% of the design minimum outdoor airflow rate. An alarm must indicate when the outdoor airflow value varies by 15% or more from the outdoor airflow setpoint.

Naturally ventilated spaces

Option 1. Provide a direct exhaust airflow measurement device capable of measuring the exhaust airflow+ alarm.

Option 2. Provide automatic indication devices on all natural ventilation openings intended to meet the minimum opening requirements + alarm.

Option 3. Monitor carbon dioxide (CO2) concentrations within each thermal zone. CO2 monitors must be between 90 and 180 centimeters above the floor and within the thermal zone. + visual indicator/ alarm for more than 10% CO2 concentration.



113

IAQ Credit: Minimum Indoor Air Quality Performance-Monitoring

Residential Projects

In addition, if the project building contains residential units, each dwelling unit must meet all of the followings:

- Unvented combustion appliances are not allowed.
- Carbon monoxide monitors must be installed on each floor of each unit.
- All indoor fireplaces and woodstoves must have solid glass enclosures or doors that seal when closed.
- Any indoor fireplaces and woodstoves that are not closed combustion or power-vented must pass a backdraft potential test.
- Space- and water-heating equipment that involves combustion must be designed and installed with closed combustion, or with power-vented exhaust, or located in a detached utility building or open-air facility.

For projects in high-risk areas for radon, EPA Radon Zone 1 (or local equivalent for project outside the U.S.), design and construct any dwelling unit on levels one through four above grade with radon-resistant construction techniques.



114

Environmental tobacco smoke control

Intent
To prevent or minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to environmental tobacco smoke.

Requirements
Option 1. No smoking

- Prohibit smoking inside the building.
- Prohibit smoking outside the building except in designated smoking areas located at least 7.5 meters from all entries, outdoor air intakes, and operable windows. Also prohibit smoking outside the property line in spaces used for business purposes.
- Signage must be posted within 3 meters of all building entrances indicating the no-smoking policy.

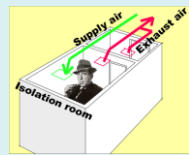


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Environmental tobacco smoke control- Residential only

Option 2- Compartmentalization of Smoking Area

- Prohibit smoking inside all common areas/ Communicate the prohibition/ Make provisions for enforcement
- Prohibit smoking outside the building except in designated smoking areas located at least 7.5 m from all entries, outdoor air intakes, and operable windows.
- No smoking signage must be posted within 3 m of all building entrances.
- Each unit must be compartmentalized to prevent excessive leakage between units:
 - Demonstrate a maximum leakage of 1.17 liters per second per square meter at 50 Pa of enclosure.

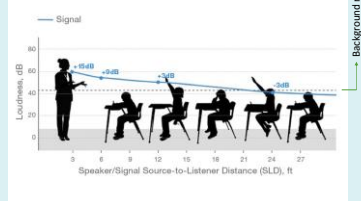


116

Minimum Acoustic Performance (required for schools)

Intent

- To provide classrooms that facilitate teacher-to-student and student-to-student communication through effective acoustic design.



117

Minimum Acoustic Performance (required for schools)

Requirements:

- HVAC background noise**
Achieve a maximum background noise level of 40 dBA from heating, ventilating, and air-conditioning (HVAC) systems in classrooms and other core learning spaces ([ANSI Standard S12.60-2010](#))
- Exterior noise**
For high-noise sites (peak-hour Leq above 60 dBA during school hours), implement treatment measures
- Reverberation time:** Adhere to the following time requirements:
 - Classroom & core learning spaces<566 cubic meters:** sufficient sound-absorptive finishes ([ANSI Standard S12.60-2010, Part 1](#))
 - Classroom & core learning spaces>566 cubic meters:** Meet the recommended reverberation times ([NRC-CNRC Construction Technology Update No. 51, Acoustical Design of Rooms for Speech](#) (2002))

118

Enhanced indoor air quality strategies

Option 1. Enhanced IAQ strategies (1point)

- Comply with the following requirements:
 - Mechanically ventilated spaces:**
 - entryway systems;
 - interior cross-contamination prevention (negative pressure, self closing doors, deck to deck partitions, or a hard-lid ceiling)
 - filtration (minimum efficiency ASHRAE Standard 52.2-2007)
 - Naturally ventilated spaces:**
 - entryway systems; and
 - natural ventilation design calculations (Chartered Institution of Building Services Engineers (CIBSE) Applications Manual AM10, March 2005)
 - Mixed-mode systems:**
 - entryway systems;
 - interior cross-contamination prevention;
 - filtration;
 - natural ventilation design calculations; and
 - mixed-mode design calculations.



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Option 2. Additional enhanced IAQ strategies (1 point)

Comply with the followings:

- Mechanically ventilated spaces (select one):**
 - exterior contamination prevention (Demonstrate that outdoor air contaminant concentrations at outdoor air intakes are below the thresholds)
 - increased ventilation (Increase outdoor air ventilation rates to all occupied spaces by at least 30%)
 - carbon dioxide monitoring; or
 - additional source control and monitoring (detect contaminants/ alarm)
- Naturally ventilated spaces (select one):**
 - exterior contamination prevention;
 - additional source control and monitoring; or
 - natural ventilation room by room calculations.
- Mixed-mode systems (select one):**
 - exterior contamination prevention;
 - increased ventilation;
 - additional source control and monitoring; or
 - natural ventilation room-by-room calculations

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Low Emitting materials

Intent

- To reduce concentrations of chemical contaminants that can damage air quality, human health, productivity, and the environment.

Option 1. Product Category Calculations
Achieve the threshold level of compliance with emissions and content standards for the number of product categories listed in Table 2.

Table 1. 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 80%, 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 80%, 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 80%, by cost	Furniture Evaluation
Healthcare and Schools Projects only: Exterior applied products	At least 80%, by volume	Exterior Applied Products

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Low-Emitting materials

Option 2. Budget Calculation Method
If some products in a category do not meet the criteria, project teams may use the budget calculation method (Table 3).

Table 3. Points for percentage compliance, under budget calculation method

Percentage of total	Points
≥ 50% and < 70%	1
≥ 70% and < 80%	2
≥ 80%	3

The budget method organizes the building interior into six assemblies:

- flooring;
- ceilings;
- walls;
- thermal and acoustic insulation;
- furniture; and
- Healthcare, Schools only: exterior applied products.

Equation 1. Total percentage compliance

Total % compliant for projects without furniture =	(% compliant walls + % compliant ceilings + % compliant flooring + % compliant insulation)	4
Total % compliant for projects with furniture =	(% compliant walls + % compliant ceilings + % compliant flooring + % compliant insulation + (% compliant furniture))	5

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Construction Indoor Air Quality management plan

Intent

To promote the well-being of construction workers and building occupants by minimizing indoor air quality problems associated with construction and renovation.

Requirements:

- Meet all applicable control measures of SMACNA IAQ Guidelines for occupied buildings under construction.
- Protect absorbent materials stored on-site and installed from moisture damage.
- Do not operate permanently installed air-handling equipment during construction unless filtration media with a minimum efficiency reporting value (MERV) of 8, as determined by ASHRAE 52.2-2007
- Prohibit the use of tobacco products




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Quiz Time!

What does ANSI Standard S12.60 relate to?

- Thermal comfort
- Energy efficiency
- Acoustical performance
- Indoor air quality
- Indoor Quality management

Correct answer: (c)
ASHRAE 52.2 relates to Indoor Air Quality and MERV filtration levels for achieving low levels of indoor air particulates

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Quiz Time!

Which of the followings are a common source of indoor air contaminants (Check all that applies)

- Cleaning materials
- Mold resulting from moisture in materials
- Pollutants tracked in on occupants shoes
- Indoor fireplaces with solid enclosures

Correct Answer: (a), (b), & (C)

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Quiz Time!

What is the name for the procedure used to clear buildings of contaminants before they are occupied?

- Flush-out
- Infiltration
- Ventilation
- Ex-filtration

Correct Answer: (A)
After construction is completed, a building must be flushed with outside air-either via the HVAC system in place or with windows-before it may be occupied. This process is called flush-out.

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Quiz Time!

What does ASHRAE Standard 52.2 relate to?

- a) Thermal comfort
- b) Energy efficiency
- c) Daylight
- d) Indoor air quality
- e) Renewable energy credits

Correct answer: (d)
ASHRAE 52.2 relates to Indoor Air Quality and MERV filtration levels for achieving low levels of indoor air particulates

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Quiz Time!

• What rate of fresh air distribution per occupant should be enough to prevent "sick building syndrome"?

- a) 100 parts per million
- b) 100 to 200 cubic feet per hour
- c) 900 to 1200 cubic feet per hour
- d) 3000 to 4000 cubic feet per hour

Correct Answer: (C)
The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) recommend that fresh air pumps at a rate between 900 to 1200 cubic feet per hour per occupant in order to keep occupants productive and healthy.

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 **Innovation**

Sustainable design strategies and measures are constantly evolving and improving. New technologies are continually introduced to the marketplace, and up-to-date scientific research influences building design strategies. The purpose of this LEED category is to recognize projects for innovative building features and sustainable building practices and strategies

	New Construction	Core & Shell	Schools
Innovation (Category)	6	6	6
Innovation	5	5	5
LEED Accredited Professional	1	1	1

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Innovation

Intent
To encourage projects to achieve exceptional or innovative performance.

Requirements
To achieve all five innovation points, a project team must achieve:
At least one pilot credit,
At least one innovation credit,
No more than two exemplary performance credits. 


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LEED Accredited Professional



- **Intent**
- To encourage the team integration required by a LEED project and to streamline the application and certification process .
- **Requirements**
- At least one principal participant of the project team must be a LEED Accredited Professional (AP) with a specialty appropriate for the project.

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 **Regional Priority**

- Because some environmental issues are particular to a locale, volunteers from USGBC chapters and the LEED International Roundtable have identified distinct environmental priorities within their areas and the credits that address those issues. These Regional Priority credits encourage project teams to focus on their local environmental priorities.
- Data base: www.usgbc.org/rpc

	New Construction	Core & Shell	Schools
Regional Priority	4	4	4

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Quiz Time!

Which of the following is NOT required for a project to become LEED certified?

Correct answer: (C)

- a) Fundamental commissioning of the building's energy systems
- b) The use of a reasonable site boundary
- c) On-site visit from a GBCI representative prior to certification
- d) Commitment to sharing whole building energy and water data

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Quiz Time!

• MERV (Minimum Efficiency Reporting Value) is relevant to which ASHRAE standards in LEED v4?(Choose 2)

Correct answer: (a) & (c)

ASHRAE Standard 52.2-2007 is relevant to the supply of outdoor air to occupied interior spaces and references a MERV rating of 13 or higher. ASHRAE Standard 62.1-2010 is relevant to minimum indoor air quality performance and references a MERV rating of 11 or higher.

- a) 52.2-2007B.
- b) 55-2010C.
- c) 62.1-2010D.
- d) 90.1-2010E.
- e) 189.1

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Quiz Time!

Roof-mounted solar photovoltaic panels on the project site can contribute to which credits in LEED v4? (Check all that applies)

Correct answer: (b&d)

Green Power is a credit that is related to leveraging off-site sources of renewable energy.

- a) Demand Response
- b) Renewable Energy
- c) Green Power
- d) Heat Island Reduction
- e) Daylight

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Quiz Time!

To achieve exemplary performance for an innovation credit, a project team must ____.

Correct answer: (a).

- a) Achieve double the credit requirements or the next incremental percentage threshold of an existing credit.
- b) Achieve all of the credits in a single category
- c) Achieve all of the credits in the five categories: SS, WE, EA, MR, & EQ.
- d) Conceive an idea for an innovative credit

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Quiz Time!

Installing underground parking can achieve synergies across multiple credits by reducing the environmental impacts of ____.

Correct answer: (c).

- a) Ozon depletion and rainwater runoff
- b) Light pollution and soil erosion
- c) Heat island effect and rainwater runoff
- d) Soil erosion and ozon depletion

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What is missing from the LEED system?

Social & cultural aspects
Beauty aspects
Property appraisal
Reductive as opposed to holistic
Product-based as opposed to process based
Building-based as opposed to place-based

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Emerging Directions/ New Strategies

- Shift in emphasis from individual buildings toward the built environment.
- Rapidly increasing activity of government in the green building arena
- Increasing need for a focus on the greening of existing buildings
- Addressing lack of capacity in the building trades to meet the demand for green building
- Gathering data on green building performance
- Need for educating about how to manage, operate, and inhabit green buildings.
- Increasing interest in and need for green building expertise internationally.

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Emerging Directions/ Obstacles: Liability Issues

- Failing to Achieve a promised level of green building certification
- Failing to live up to expectations:
 - lower operational performance
 - Different ideas about what green building is

=> Need for IDP

- No single entity controls the green building process, which makes the issue of responsibility and risk allocation critical
- Construction is a management-intensive business, and green initiatives add another layer of complexity

=>Need for IPD


"There's one sure way to kill an idea: Sue it to death."

Hidden Liability Issues May Writ Green Building, July 14, 2008 ENR article

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Emerging Directions/Obstacles:

- Perceived increase in initial costs
- Convenience of working with known procedures
- Spectacular Landmarks : The desire for increased tourism, & fostering local pride



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LEED Resources

LEED Green Associate Candidate Handbook
LEED Credit Library, LEED Addenda Database,
Sample Credit Forms, Regional Priority Credits,
Pilot Credit Library, Innovation Catalog, Guide
to LEED Certification, Foundations of LEED



www.usgbc.org/resources/leed-v4-user-guide

ever

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