



**The Leadership in Energy and Environmental Design (LEED) Green Building Rating System**, developed by the **Green Building Council (USGBC)**

**U.S.**

, provides a suite of standards for the environmentally sustainable design, construction and operation of buildings and neighborhoods. Since its inception in 1998, LEED has grown to encompass more than 14,000 projects in the United States and 30 countries covering 1.062 billion square feet (99 km<sup>2</sup>) of development area.

[\[1\]](#)

The hallmark of LEED is that it is an open and transparent process where the technical criteria proposed by the LEED committees are publicly reviewed for approval by the more than 10,000 membership organizations that currently constitute the USGBC.

Individuals recognized for their knowledge of the LEED rating system are permitted to use the LEED Accredited Professional (AP) acronym after their name, indicating they have passed the accreditation exam given by the Green Building Certification Institute (a third-party organization that handles accreditation for the USGBC).



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## // History

LEED began in 1993 spearheaded by Natural Resources Defense Council (NRDC) senior scientist Robert K. Watson who, as Founding Chairman of the LEED Steering Committee until 2006, led a broad-based consensus process which included non-profit organizations, government agencies, architects, engineers, developers, builders, product manufacturers and other industry leaders. Early LEED committee members also included USGBC co-founder Mike Italiano, architects Bill Reed and Sandy Mendler, builder Gerard Heiber, builder Myron Kibbe and engineer Richard Bourne. As interest in LEED grew, in 1996, engineers Tom Paladino and Lynn Barker co-chaired the newly formed LEED technical committee.

From 1994 to 2006, LEED grew from one standard for new construction to a comprehensive system of six standards covering all aspects of the development and construction process. LEED also has grown from six volunteers on one committee to more than 200 volunteers on nearly 20 committees and over 200 professional staff in Washington, DC.

LEED was created to accomplish the following:

- Define "green building" by establishing a common standard of measurement
- Promote integrated, whole-building design practices
- Recognize environmental leadership in the building industry
- Stimulate green competition
- Raise consumer awareness of green building benefits
- Transform the building market

Green Building Council members, representing every sector of the building industry, developed and continue to refine LEED. The rating systems addresses eight major areas:

- Location and Planning
- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality
- Innovation and Design Process
- Regional Priority

## The Rating System

LEED has evolved since its original inception in 1998 to more accurately represent and incorporate emerging green building technologies. LEED NCv1.0 was a pilot version. These projects helped inform the USGBC of the requirements for such a rating system, and this knowledge was incorporated into LEED NCv2.0. LEED NCv2.2 was released in 2005. Today, LEED consists of a suite of nine rating systems for the design, construction and operation of buildings, homes and neighborhoods. Five overarching categories correspond to the specialties available under the LEED Accredited Professional program. That suite currently consists of:

### Green Building Design & Construction

- LEED for New Construction and Major Renovations
- LEED for Core & Shell Development
- LEED for Schools
- LEED for Retail New Construction (planned 2010)

### Green Interior Design & Construction

- LEED for Commercial Interiors
- LEED for Retail Interiors (planned 2010)

### Green Building Operations & Maintenance

- LEED for Existing Buildings: Operations & Maintenance

### Green Neighborhood Development

- LEED for Neighborhood Development

### Green Home Design and Construction

- LEED for Homes

In 2003, the Canada Green Building Council received permission to create its own version of LEED based upon LEED-NC 2.0, now called LEED Canada-NC v1.0. [\[2\]](#)

LEED also forms the basis for other sustainability rating systems such as the Environmental Protection Agency's Labs21.

After four years of development, aligning credits across all LEED rating systems and weighting credits based on environmental priority, USGBC launched LEEDv3 [\[3\]](#), which consists of a new continuous development process, a new version of LEED Online, a revised third-party certification program and a new suite of rating systems: LEED 2009.

#### **LEED 2009 (v3)**

In LEED 2009 there are 100 possible base points plus an additional 6 points for Innovation in Design and 4 points for Regional Priority. Buildings can qualify for four levels of certification:

- **Certified** - 40 - 49 points
  - **Silver** - 50 - 59 points
  - **Gold** - 60 - 79 points
  - **Platinum** - 80 points and above
- Note that the LEED for Homes rating system is different than LEED v3, with different point categories and thresholds that reward efficient residential design.

#### **Prerequisites and Credits**

Points are distributed across credits seven credit categories. Prerequisites in each category receive no points and are mandatory for all projects. The LEED 2009 Rating System for New Construction and Major Renovations is shown here.

### **Sustainable Sites - 26 Possible Points**

- Prerequisite 1: Construction Activity Pollution Prevention
- Credit 1: Site Selection
- Credit 2: Development Density and Community Connectivity
- Credit 3: Brownfield Redevelopment
- Credit 4.1: Alternative Transportation—Public Transportation Access
- Credit 4.2: Alternative Transportation—Bicycle Storage and Changing Rooms
- Credit 4.3: Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles
- Credit 4.4: Alternative Transportation—Parking Capacity
- Credit 5.1: Site Development—Protect or Restore Habitat
- Credit 5.2: Site Development—Maximize Open Space
- Credit 6.1: Stormwater Design—Quantity Control
- Credit 6.2: Stormwater Design—Quality Control
- Credit 7.1: Heat Island Effect—Nonroof
- Credit 7.2: Heat Island Effect—Roof
- Credit 8: Light Pollution Reduction

### **Water Efficiency - 10 Possible Points**

- Prerequisite 1: Water Use Reduction
- Credit 1: Water Efficient Landscaping
- Credit 2: Innovative Wastewater Technologies
- Credit 3: Water Use Reduction

### **Energy and Atmosphere - 35 Possible Points**

- Prerequisite 1: Fundamental Commissioning of Building Energy Systems
- Prerequisite 2: Minimum Energy Performance
- Prerequisite 3: Fundamental Refrigerant Management
- Credit 1: Optimize Energy Performance
- Credit 2: On-site Renewable Energy
- Credit 3: Enhanced Commissioning
- Credit 4: Enhanced Refrigerant Management
- Credit 5: Measurement and Verification
- Credit 6: Green Power

**Materials and Resources - 14 Possible Points**

- Prerequisite 1: Storage and Collection of Recyclables
- Credit 1.1: Building Reuse—Maintain Existing Walls, Floors and Roof
- Credit 1.2: Building Reuse—Maintain Existing Interior Nonstructural Elements
- Credit 2: Construction Waste Management
- Credit 3: Materials Reuse
- Credit 4: Recycled Content
- Credit 5: Regional Materials
- Credit 6: Rapidly Renewable Materials
- Credit 7: Certified Wood

**Indoor Environmental Quality - 15 Possible Points**

- Prerequisite 1: Minimum Indoor Air Quality Performance
- Prerequisite 2: Environmental Tobacco Smoke (ETS) Control
- Credit 1: Outdoor Air Delivery Monitoring
- Credit 2: Increased Ventilation
- Credit 3.1: Construction Indoor Air Quality Management Plan—During Construction
- Credit 3.2: Construction Indoor Air Quality Management Plan—Before Occupancy
- Credit 4.1: Low-Emitting Materials—Adhesives and Sealants
- Credit 4.2: Low-Emitting Materials—Paints and Coatings
- Credit 4.3: Low-Emitting Materials—Flooring Systems
- Credit 4.4: Low-Emitting Materials—Composite Wood and Agrifiber Products
- Credit 5: Indoor Chemical and Pollutant Source Control
- Credit 6.1: Controllability of Systems—Lighting
- Credit 6.2: Controllability of Systems—Thermal Comfort
- Credit 7.1: Thermal Comfort—Design
- Credit 7.2: Thermal Comfort—Verification
- Credit 8.1: Daylight and Views—Daylight
- Credit 8.2: Daylight and Views—Views

**Innovation in Design - 6 Possible Points**

- Credit 1: Innovation in Design (5 available)
- Credit 2: LEED Accredited Professional

### Regional Priority - 4 Possible Points

- Credit 1: Regional Priority

### LEED NCv2.2

LEED for New Construction and Major Renovations version 2.2 contained the same credits as the new NCv2009, but had fewer points. There are 69 possible points and buildings can qualify for four levels of certification:

- **Certified** - 26-32 points
- **Silver** - 33-38 points
- **Gold** - 39-51 points
- **Platinum** - 52-69 points

### Process

LEED certification is obtained after submitting an application documenting compliance with the requirements of the rating system as well as paying registration and certification fees. Certification is granted solely by the Green Building Certification Institute responsible for the third party verification of project compliance with LEED requirements.

Recently the application process for new construction certification has been streamlined electronically, via a set of active PDFs that automates the process of filing the documentation.

### Directory of LEED-certified projects

The Green Building Council provides an online directory of LEED-certified projects. [\[4\]](#)

### Professional accreditation

Green building professionals can become LEED accredited. This accreditation enables an individual to facilitate the rating of buildings with the various LEED systems. Since January 2008, professional accreditation is administered by the Green Building Certification Institute. Between 2001 and June 2009, LEED accreditation required that candidates only pass one



exam to earn their LEED Accredited Professional designation. After June 2009, LEED accreditation has three tiers and requires candidates to pass a series of LEED exams. The LEED v3 2009 accreditation process changes were made to mirror the various LEED Building Certification Rating Systems. [\[5\]](#) The first tier exam is called LEED Green Associate. The second tier exam is called LEED Accredited Professional with specialty and has five separate exams to allow for individual specialization. The third tier standards have not yet been determined or released [\[6\]](#) . The Green Building Certification Institute has an education provider program that provide seminars and lectures to prepare candidates to take and pass the LEED Exams.

### LEED Green Associate

In order to get a certification to become a LEED Green Associate the requirements are 15 hours in the biennial Credential Maintenance Program with a minimum of 3 hours centered on LEED. The exam you take covers the main aspects and key points of the LEED rating and certification process. This process includes information on: energy credits, tax incentives and complex environmental design ratios. The LEED Green Associate certification is there for people who want to show their dedication to building practices that are in line with green standards, but do not feel obligated to have direct involvement in LEED projects. This title should be more appealing to nontechnical professionals, such as people in marketing for design firms or possibly lawyers who have become a part of real estate development deals. [\[7\]](#)

### Benefits and Disadvantages



LEED certified buildings are supposed to use resources more efficiently when compared to conventional buildings which are simply built to code. LEED certified buildings often provide healthier work and living environments, which contributes to higher productivity and improved employee health and comfort. The USGBC has compiled a long list of benefits of implementing

a LEED strategy which ranges from improving air and water quality to reducing solid waste, benefiting owners, occupiers, and society as a whole.

Often when a LEED rating is pursued, this will increase the cost of initial design and construction. One reason for the higher cost is that sustainable construction principles may not be well understood by the design professionals undertaking the project. This could require time to be spent on research. Some of the finer points of LEED (especially those which demand a higher-than-industry-standard level of service from the construction team) could possibly lead to misunderstandings between the design team, construction team, and client, which could result in delays. Also, there may be a lack of abundant availability of manufactured building components which meet LEED standards. Pursuing LEED certification for a project is an added cost in itself as well. This added cost comes in the form of USGBC correspondence, LEED design-aide consultants, and the hiring of the required Commissioning Authority (CxA) - all of which would not necessarily be included in an environmentally responsible project unless it were also seeking a LEED rating.

However, these higher initial costs can be effectively mitigated by the savings incurred over time due to the lower-than-industry-standard operational costs which are typical of a LEED certified building. Additional economic payback may come in the form of employee productivity gains incurred as a result of working in a healthier environment. Studies have suggested that an initial up-front investment of 2% extra will yield over ten times the initial investment over the life cycle of the building. [\[8\]](#)

Further, the USGBC has stated support for the Architecture 2030, an effort that has set a goal of using no fossil-fuel, greenhouse gas-emitting energy to operate by 2030. [\[9\]](#)

LEED focuses on the end product. For example, because leather does not emit VOCs they are deemed healthy for environments, disregarding the use of extremely harmful chemicals in the process of tanning leather. Other products that do not use harmful chemicals and focus on more sustainable production do not earn any additional points for their attention to environmental concerns.

LEED is a measurement tool and not a design tool. It is also not yet climate-specific, although the newest version hopes to address this weakness partially. Because of this, designers may make materials or design choices that garner a LEED point, even though they may not be the most site or climate-appropriate choice available.

LEED has been innovative in reuse of reclaimed building materials, such as the reusing of asbestos as the insulation in water heaters, and re-casting used copper pipes into copper fittings. This is estimated to have saved close to 5000KW/h's in the United States alone.

LEED is a measurement tool for green building in the United States and it is developed and continuously modified by workers in the green building industry, especially in the ten largest metro areas in the U.S.; however, LEED certified buildings have been slower to penetrate small and mid-major markets. [\[10\]](#) Also, some criticism suggests that the LEED rating system is not sensitive and does not vary enough with regard to local environmental conditions. For instance, a building in Maine would receive the same credit as a building in Arizona for water conservation, though the principle is more important in the latter case. Another complaint is that its certification costs require money that could be used to make the building in question even more sustainable. Many critics have noted that compliance and certification costs have grown faster than staff support from the USGBC.

For existing buildings LEED has developed LEED-EB. Recent research has demonstrated that buildings which can achieve LEED-EB equivalencies can generate a tremendous ROI. In a recent white paper by the Leonardo Academy comparing LEED-EB buildings vs. data from BOMA's Experience Exchange Report 2007 demonstrated LEED-EB certified buildings achieved superior operating cost savings in 63% of the buildings surveyed ranging from \$4.94 to \$15.59 per square foot of floor space, with an average valuation of \$6.68 and a median valuation of \$6.07. [\[11\]](#)

In addition the overall cost of LEED-EB implementation and certification ranged from \$0.00 to \$6.46 per square foot of floor space, with an average of \$2.43 per square foot demonstrating that implementation is not expensive, especially in comparison to cost savings. These costs should be significantly reduced if automation and technology are integrated into the implementation. [\[11\]](#)

### **LEED and carbon trading**

It is expected that LEED-NC 3.0 will include a requirement for a carbon footprint (carbon building print) and a significant reduction of GHG (green-house gases) beyond a baseline level. The reduction in carbon dioxide must be measured based on the direct and indirect carbon dioxide and equivalent reductions. These include emissions related to the consumption of grid delivered electricity, on-site combustion of fossil fuels, and fugitive refrigerant emissions.

The efforts to quantify emission and reductions in emissions will be in an effort to monetize the climate change externality in the same way that a Kyoto Clean Development Project (carbon project) does. ITC Hotel Sonar Bangla Sheraton & Towers in Kolkata, India is the only green building project in the world to monetize the reductions that acts as the main precedent for this type of project.

### **Incentive Programs**

Some areas have implemented or are considering incentives for LEED-certified buildings.

The city of Cincinnati, Ohio adopted a measure providing an automatic 100% real property tax exemption of the assessed property value for newly-constructed or rehabilitated commercial or residential properties that earn a minimum of LEED Certified. [\[12\]](#)

In the state of Nevada construction materials for a qualifying LEED building are exempt from local taxes. Pieces of construction that are deemed "inseparable" parts, such as concrete or Sheetrock, qualify. [\[13\]](#)

The state of Michigan is considering tax-based incentives for LEED buildings. [\[14\]](#)

Many local governments have adopted LEED incentive programs. Program incentives include tax credits, tax breaks, density bonuses, reduced fees, priority or expedited permitting, free or reduced-cost technical assistance, grants and low-interest loans. [\[15\]](#) [\[16\]](#)

### **International initiatives**

With many countries either having, or being in the process of developing domestic assessment methods, international exchanges and coordination have been increasingly evident.

In 1997, for example, the International Organization for Standardization's Technical Committee 59 (ISO TC59) - Building Construction resolved to establish an ad hoc group to investigate the

need for standardized tools within the field of sustainable building. This subsequently evolved and was formalized as Sub-Committee ISO T59/SC17 – Sustainability in building construction – the scope of which includes the issues that should be taken into account within building environmental assessment methods.

In Europe, under European Committee for Standardization's TC350 -Sustainability of Construction Works, a consensus-building process that relates to other standards (ISO) and harmonizes existing approaches was launched. These standards shall enable the exchange of sustainability information related to internationally traded products and services.

### **Facts**

It is estimated that the value of green building construction is projected to increase to \$60 billion by 2010. By 2009, 82% of corporate America is expected to be greening at least 16% of their real estate portfolios; of these corporations, 18% will be greening more than 60% of their real estate portfolios. The green building market is estimated to be worth \$30–\$40 billion annually by the year 2010. By 2010, approximately 10% of commercial construction starts are projected to be green. According to a 2006 McGraw-Hill Smart Market report, every business day, \$464 million worth of construction registers with LEED.

Since 2000, USGBC's membership has more than quadrupled. Currently, there are 19,957 member organizations including corporations, government agencies, non-profits and others from throughout the industry. Over 5 billion square feet of commercial building space is involved with LEED green building certification system. Construction yields an annual output of U.S. \$4.6 trillion, contributing to 8-10% of the global GDP encompassing a workforce of 120 million people and billions of transactions each day. Comprises 13.4% of \$13.2 trillion US GDP. This includes all commercial, residential and infrastructure construction. Commercial and residential building construction constitutes 6.1% of GDP.

Buildings represent 38.9% of US primary energy use. Buildings are one of the heaviest consumers of natural resources and account for a significant portion of the greenhouse gas emissions that effect climate change. In the US, buildings account for 38% of all CO<sub>2</sub> emissions. Buildings represent 72% of US consumption. Buildings use 13.6% of all potable water, or 15 trillion gallons per year. Buildings use 40% of raw materials globally (3 billion tons annually).

EPA estimates that 136 million tons of building related construction and demolition debris was generated in the US in a single year. Compare that to 254 million tons of municipal solid waste generated in the same year. The three largest segments for non-residential green building construction - office, education and healthcare will account for more than 80% of total non-residential construction.

### See also

- Department of Housing and Urban Development (HUD)
- Design for Environment
- Design Impact Measures
- EcoHomes
- Ecological footprint
- Energy conservation
- EnOcean
- Environmental design
- General Services Administration
- Geosolar
- Geothermal heat pump
- Green Globe
- Greensburg, Kansas - the first city to (re)build from scratch to LEED Platinum standards
- High-Performance Green Buildings
- Passive house
- Permaculture
- Renewable energy
- Sustainable architecture
- Trickle vent
- Triple bottom line
- Zero energy building
- Zero carbon city

### Notes

1. <sup>^</sup> ["Green Building By the Numbers"](http://www.usgbc.org/ShowFile.aspx?DocumentID=3340) . USGBC. <http://www.usgbc.org/ShowFile.aspx?DocumentID=3340> . Retrieved 2008-12-01.
2. <sup>^</sup> [Canada Green Building Council: Green Building Rating System](#)
3. <sup>^</sup> ["LEEDv3"](http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1970) . US Green Building Council. <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1970> . Retrieved 20 February 2010.
4. <sup>^</sup> ["LEED Projects Directory - Certified Project Directory"](http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx) . US Green Building Council. <http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx> . Retrieved 20 November 2008.

5. [^ Chicago US Green Building Council, Exam Changes](#)
6. [^ LEED v3 2009 tiered credentialing explanation](#)
7. [^ http://leed--certification.info/](http://leed--certification.info/)
8. [^ Kats, Greg; Leon Alevantis, Adam Berman, Evan Mills, Jeff Perlman \(2003\). "The Costs and Financial Benefits of Green Buildings: A Report to California's Sustainable Building Task Force"](#)  
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11. [^ a b Going Green....Is it the 800lb Elephant in the Room?](#)
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13. [^ "Exemption for LEED Certified Green Buildings" . http://tax.state.nv.us/LEED.htm .](#)
14. [^ "LEED Tax Credits Coming?" . http://blog.mlive.com/squarefootagewm/2008/10/leed\\_tax\\_credits\\_coming.html](#)
15. [^ "Summary of Government LEED Incentives" . http://www.usgbc.org/showfile.aspx?documentid=2021](#)
16. [^ "Public Policy Search" . http://www.usgbc.org/PublicPolicy/SearchPublicPolicies.aspx?PageID=1776](#)

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## External links

- [Information on Glazette, a glass portal \]](#)
- [LEED](#) at the [United States Green Building Council](#)
- [SB Alliance](#)
- [World Green Building Council](#)
- [Canada Green Building Council](#)
- [Sustainable Building Alliance](#)
- [UNEP-SBCI](#)
- [European Committee for Standardization](#)
- [GREENLOGIC Chantier Carbone, Care & Bio \(French\)](#)
- [LEED for roads](#)
- [LEED for Homes News](#)