

# Quantifying Sustainable Design: Introduction to LEED™

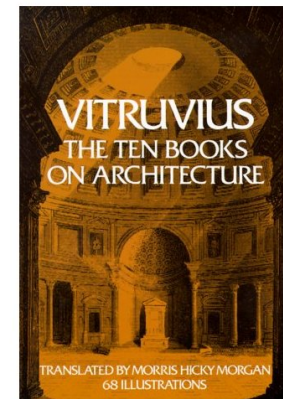


From the Beginning to 2014

# A short history on rating systems:

Architects have been attempting to arrive at a no-fail formula for “good design” for more than 2000 years:

- Vitruvius, The Ten Books of Architecture, 80 CE
- Palladio, The Four Books of Architecture, c. 1400
- Serlio, The Five Books of Architecture, c. 1500
- Rondelet, Dictionary of Architecture and Construction, c. 1790
- Durand, Precis de Lecons, c. 1800
- etc.



## The need to “quantify” sustainable design...

- Architects are becoming increasingly aware of the need for concern about the negative impact that buildings have on our environment.
- The broad question (1987-1999) was: “What is sustainable design?”
- The more refined question (2000 - ) is: “How green is it?”
- When working to both create and *market* sustainable design, it is increasingly important to be able to make definitive assessments so that proposals may be *quantified* and *compared*.
- And in 2013, “How much is your CO<sub>2</sub> impact?”

Different tools have been developed to assist with the ability to “quantify” and “compare” the greenness of buildings:

**Assessment tools that address the WHOLE building:**

**BREEAM: Building Research Establishment Environmental Assessment Method from British Research Establishment in the UK**



BREEAM/Green Leaf: variation on tool

**Green Globes: BREEAM developed “on-line” tool that provides for an inexpensive (\$250) assessment (rules similar to LEED)**



**GBTool: Developed in Canada by Green Building Challenge (GBC) very comprehensive, most detailed, but complicated to use**



**LEED™: Assessment tool developed by the USGBC**

**Others - more specialized, less widely used**





## Assessment tools that address embodied energy:

Athena: Canadian developed embodied energy assessment

<http://www.athenasmi.ca/>

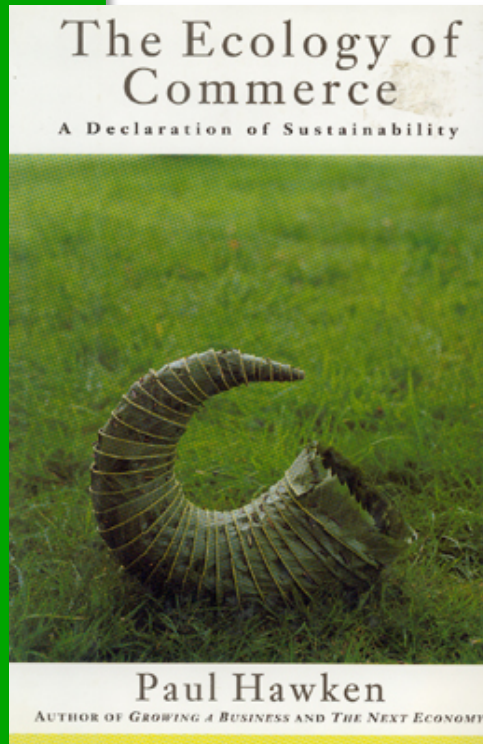


ENvest: UK developed embodied energy assessment

<http://envestv2.bre.co.uk/>



*Embodied energy is the energy used to mine, manufacture and transport products – take them from their “raw state” and bring them to the building site.*




Paul Hawken's influential book, "*The Ecology of Commerce: A Declaration of Sustainability*" was published in 1993, where he unequivocally states that:

*"Business people must either dedicate themselves to transforming commerce to a restorative undertaking, or march society to the undertaker...Quite simply, our business practices are destroying life on earth."*

## Therefore the Major Objectives last year *were*:

- energy efficient building
  - think use of power to heat, cool and light the building
  - think embodied energy which is the energy needed to produce the materials, transport them to the site and install them
- minimize use of non-renewable materials
- make buildings durable so that their parts last a long time to limit replacement costs (both \$ and environmental)
- minimize CO<sup>2</sup> and other noxious emissions (Kyoto)
- minimize the negative impact on the site and environment

## And the new objectives 2014 ARE:

- Design to be **CARBON NEUTRAL**
  -  website of [www.architecture2030.org](http://www.architecture2030.org)
- Design for **ZERO WASTE** (looking at Cradle 2 Cradle concept)
  - Waste = Food
- **Design for DISASSEMBLY** (Dfd)
  - Everything should come apart for easy reuse at end of “life”
  - We have to keep moving if we are going to keep up....



## Therefore the Primary Objectives are:



1

### Energy

Reduce the energy needed for the activities of the building(s) and make the highest possible use of renewable forms of energy.



2

### Indoor Environmental Quality

Reduce (eliminate if possible) harmful substances in indoor air, introduce natural views, light and fresh air for every activity and provide adequate control of artificial light, temperature and humidity



3

### Materials

Make the highest possible use of materials made locally from renewable or recycled resources, whenever possible re-use buildings and building components, and reduce waste during construction and afterwards.



# Therefore the Primary Objectives are:



## Water

Reduce the amount of water needed for the activities of our projects and the surrounding landscape, and make the most efficient use of the water required.



## Site Issues

Locate the building such that the energy and the pollution caused by travel to the building is reduced. Position and shape the building on the site so that soil disturbance is minimized. Manage storm water to avoid erosion.



## Implementation

Implement measures to ensure successful execution of the design and optimum long-term operation of the building systems.

## Economic Benefits - The Soft Numbers

- Reduce liability
  - Improve risk management
- Increase retail sales with daylighting
  - Studies have shown ~40% improvement<sup>2</sup>
- Impact on Schools and Education
- Improve productivity
  - Estimated \$29 –168 billion in national productivity losses per year
- Reduce absenteeism and turnover
  - Providing a healthy workplace improves employee satisfaction

# Productivity Benefits

## Improve occupant performance

- **Estimated \$29 –168 billion in national productivity losses per year <sup>1</sup>**
- **Student performance is better in daylit schools**

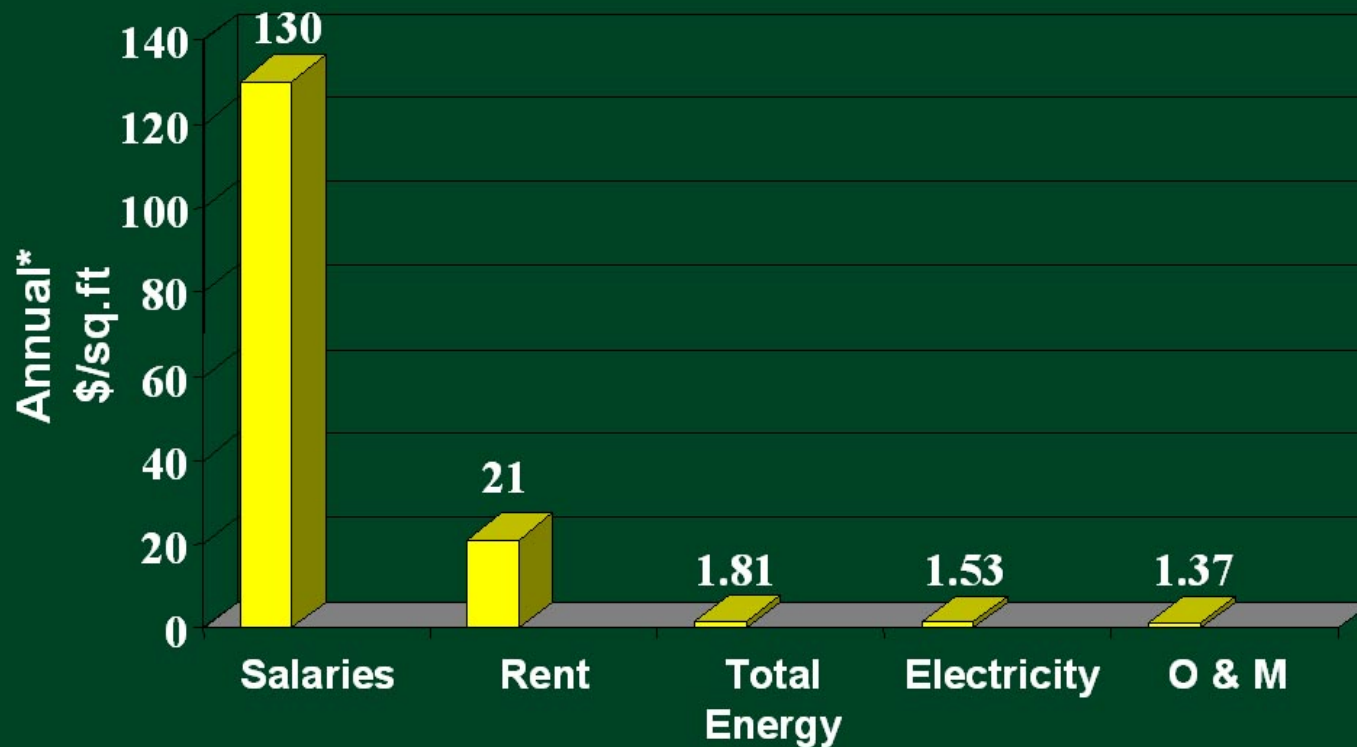
## Reduce absenteeism and turnover

- **Providing a healthy workplace improves employee satisfaction**

## Increase retail sales with daylighting

- **Studies have shown ~40% improvement**

# Green Buildings & Occupants



1991 Source: BOMA, EPRI, Statistical Abstract in RMI "Greening the Building and the Bottom Line, 1994

# Leadership in Energy and Environmental Design:



**Leadership in Energy &  
Environmental Design**

A leading-edge system for designing,  
constructing, operating and certifying the  
world's greenest buildings.



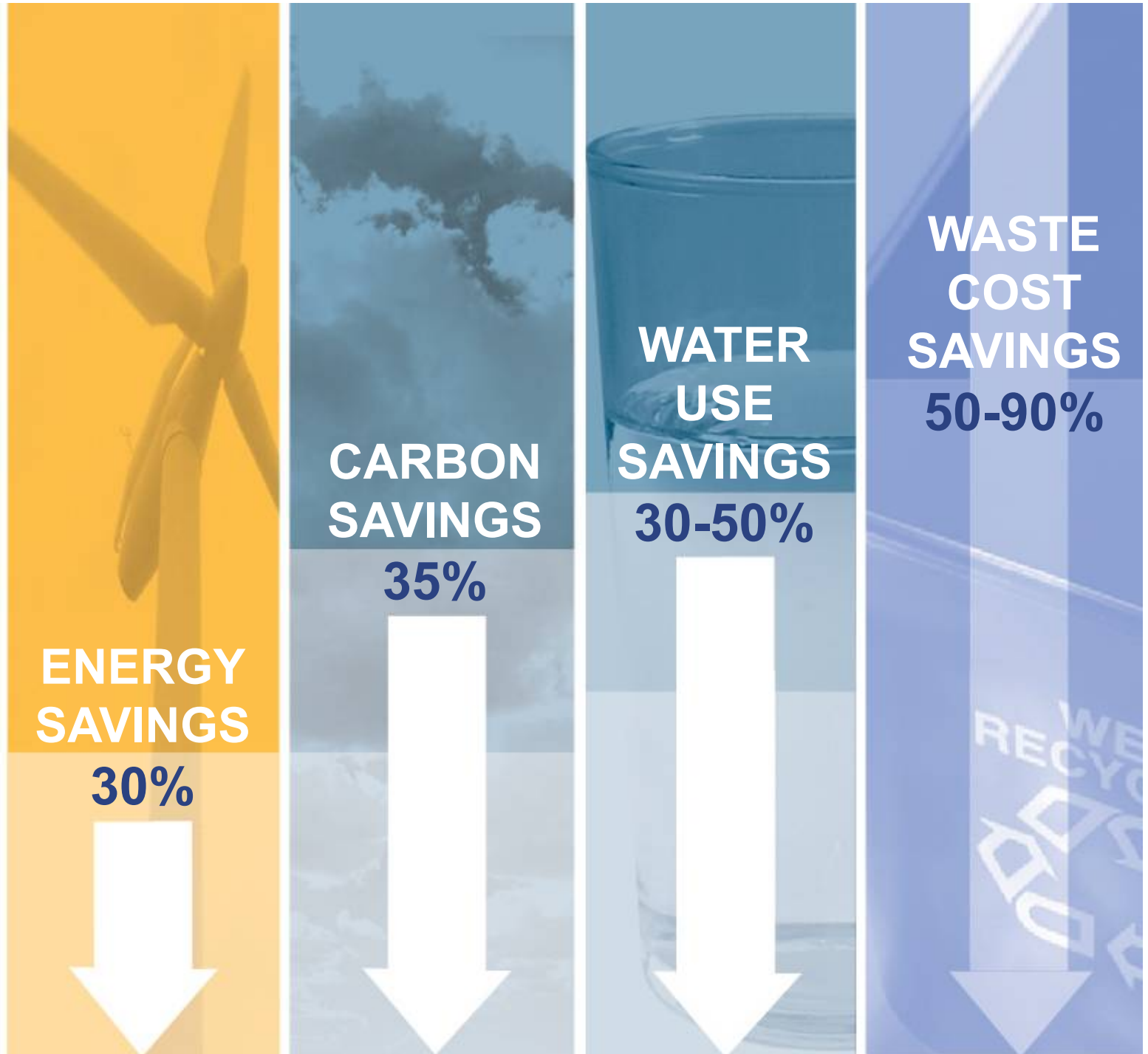
# What is LEED?

- The **L**eadership in **E**nergy and **E**nvironmental **D**esign (LEED™) Green Building Rating System is an assessment tool that is currently being promoted throughout North America for the evaluation and promotion of sustainable design.
- The goal of LEED™ is to initiate and promote practices, which limit the negative impact of buildings on the environment and occupants. The design guideline is intended to prevent exaggerated or false claims of sustainability and to provide a standard of measurement of and between buildings. In addition to creating a working definition of “green building”, LEED promotes integrated, whole-building integrated design practices (IDP).

# Why Was LEED® Created?

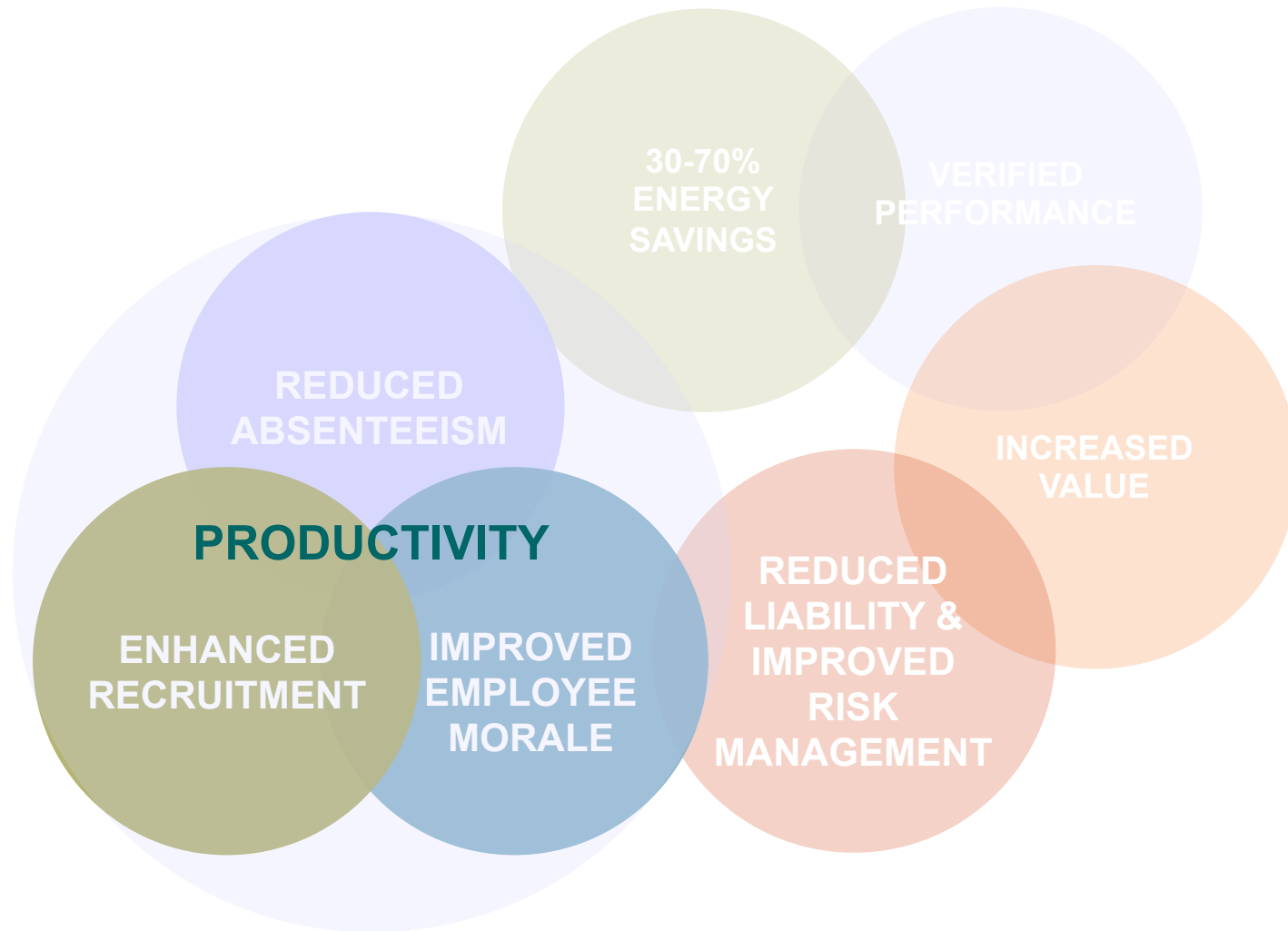
- Facilitate positive results for the environment, occupant health and financial return
- Define “green” by providing a standard for measurement
- Prevent “greenwashing” (false or exaggerated claims)
- Promote whole-building, integrated design processes
  - Use as a design guideline
  - Recognize leaders
  - Stimulate green competition
  - Establish market value with recognizable national “brand”
  - Raise consumer awareness
  - [Transform the marketplace!](#)

# Average Savings of Green Buildings

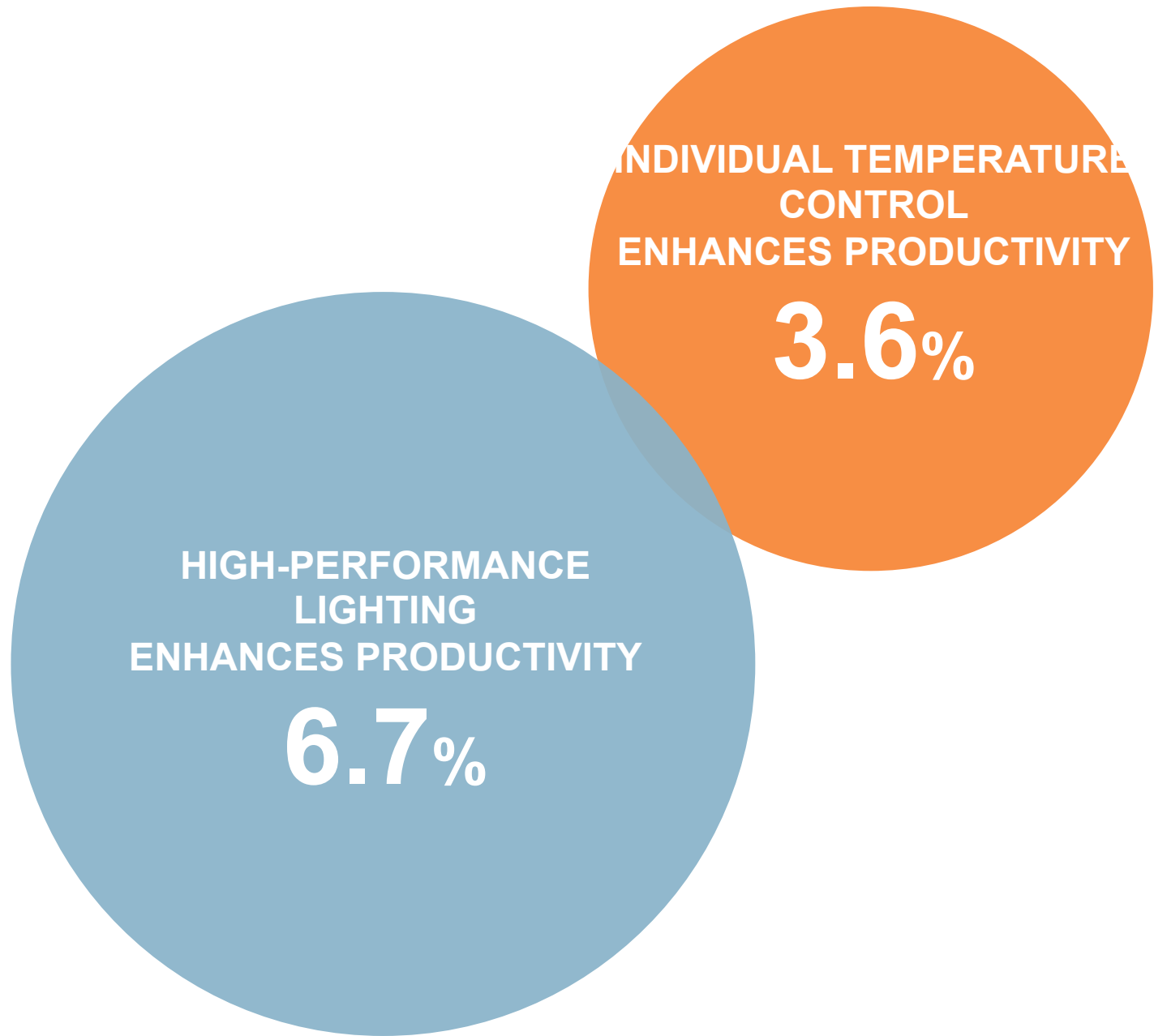


Source:  
Capital E

# Improved Bottom Line.

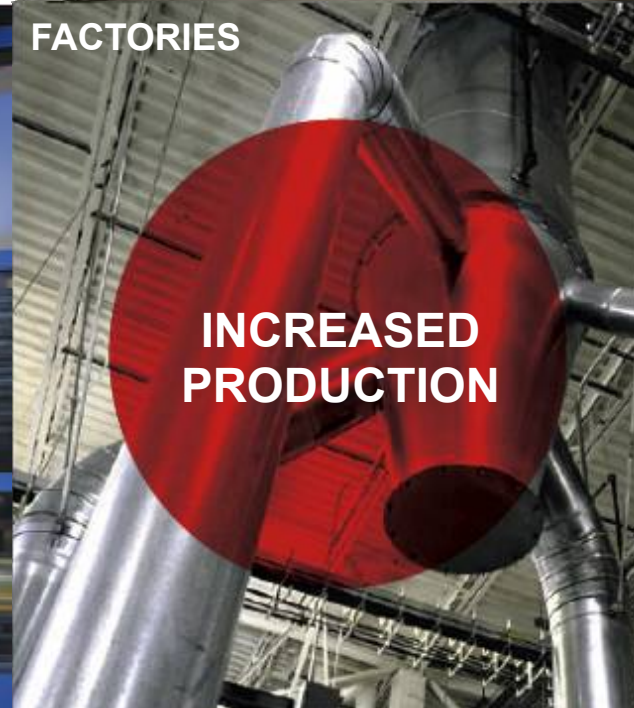
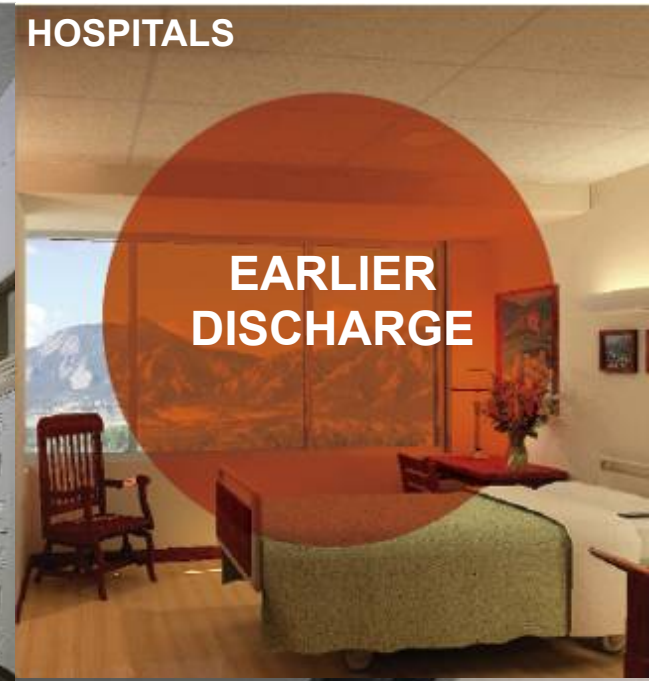
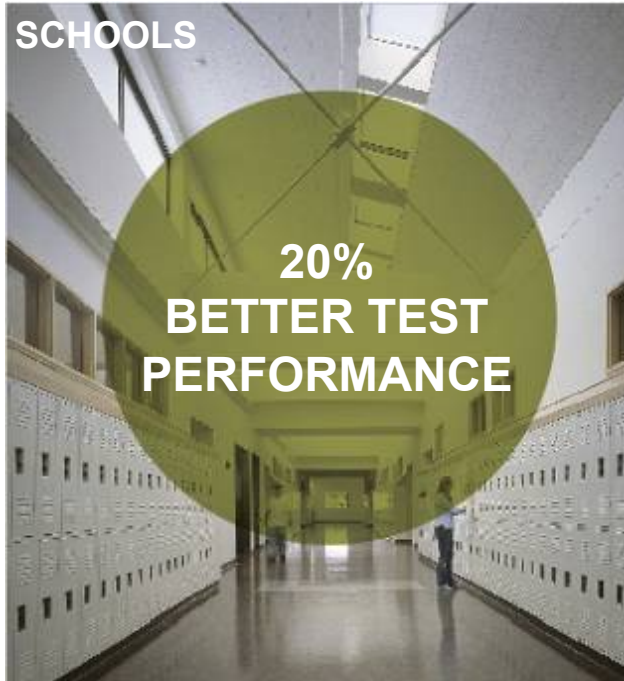


**Average  
Productivity  
Gains**

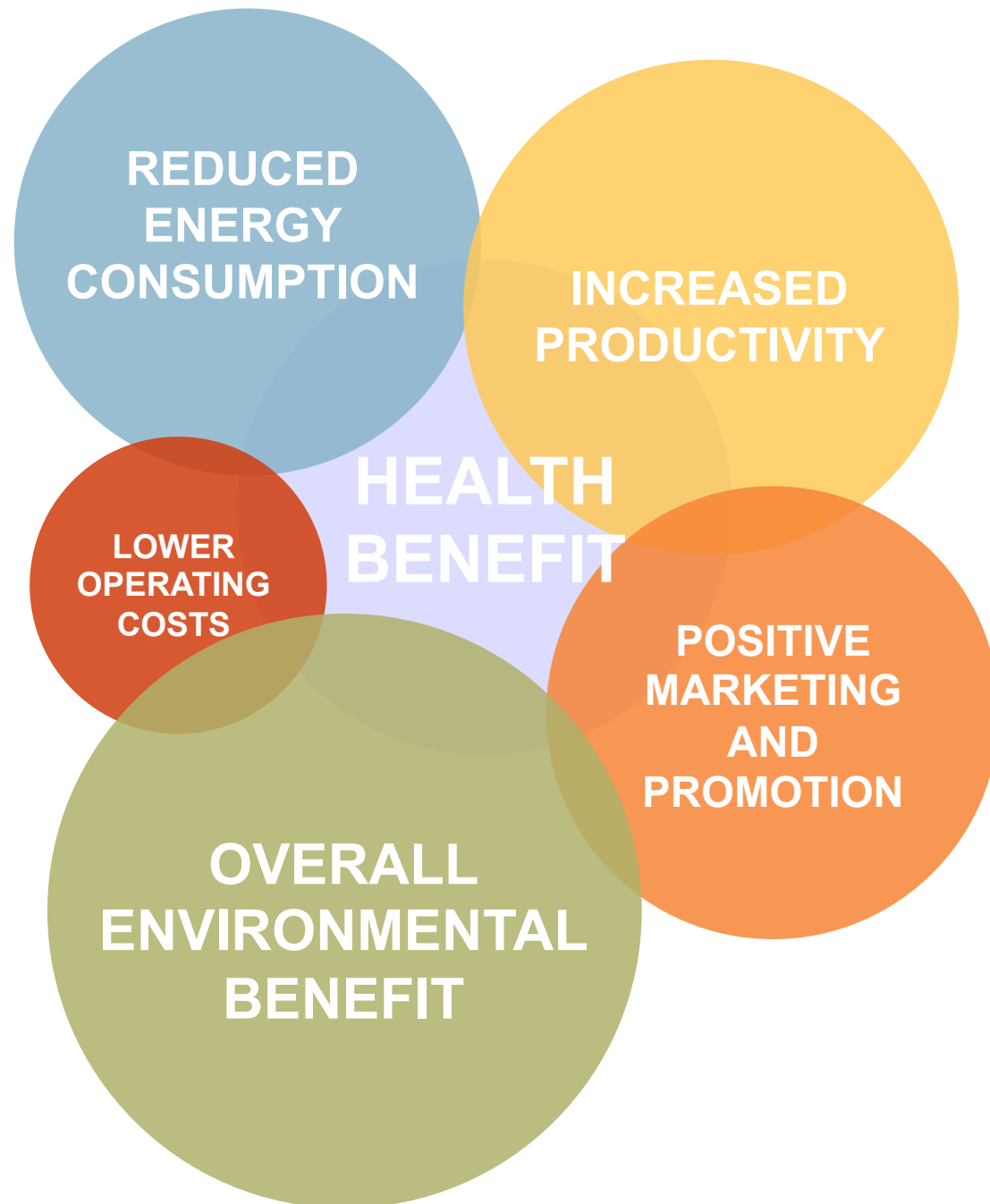




**Increased  
Productivity.**



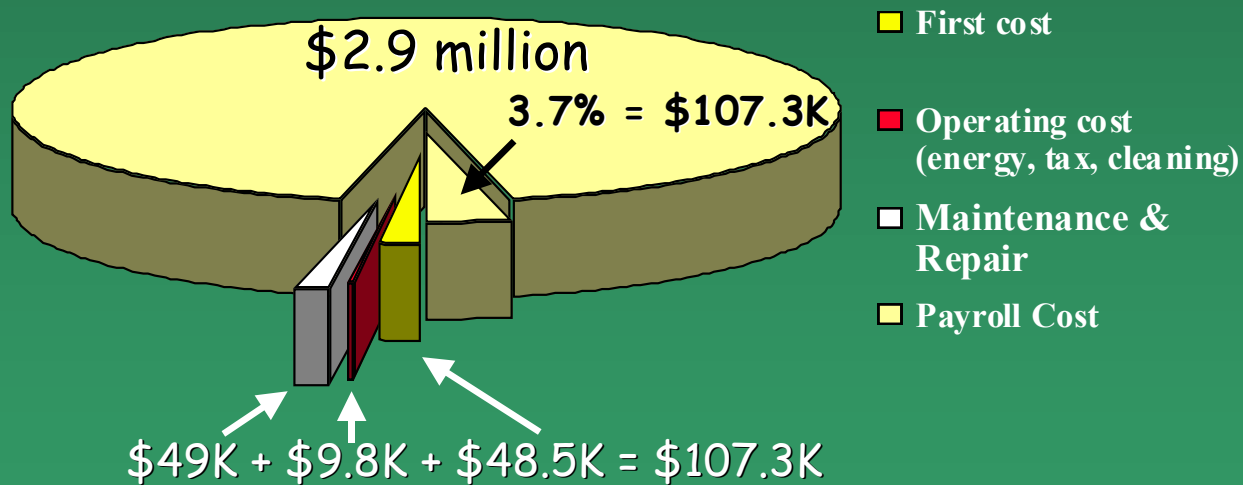
**Occupants and tenants perceive value of working in a green building to be:**



# BUILDING PERFORMANCE: Relative costs of life cycle elements

*Productivity gains of only 3.7% can pay for all facility costs over a 30 year period.*

\$/work space after 30 years



Source: U.S. Secretary of Defense

ATHENA™ Institute



The LEED Assessment system will be explored in detail in this course because it is an accessible, checklist based system that looks at all aspects of sustainable design.

The goal of this exploration of LEED will be do be able to “design to LEED”.

# What is the LEED System?

## LEADERSHIP in ENERGY and ENVIRONMENTAL DESIGN

A leading-edge system for certifying DESIGN, CONSTRUCTION, & OPERATIONS of the greenest buildings in the world

Scores are tallied for different aspects of efficiency and design in appropriate categories.

For instance, LEED assesses in detail:

1. Site Planning
2. Water Management
3. Energy Management
4. Material Use
5. Indoor Environmental Air Quality
6. Innovation & Design Process



A photograph of a modern, multi-story building with a glass facade and a brick base, identified as the John M. Langston High School Continuation & Langston-Brown Community Center in Arlington, Virginia.

Green Facts	
John M. Langston High School Continuation & Langston-Brown Community Center Arlington, Virginia	
LEED-NC rating out of	69
<b>Silver</b>	<b>35</b>
Sustainable Site	8
Water Efficiency	3
Energy & Atmosphere	4
Materials & Resources	6
Indoor Environmental Quality	11
Innovation & Design	3

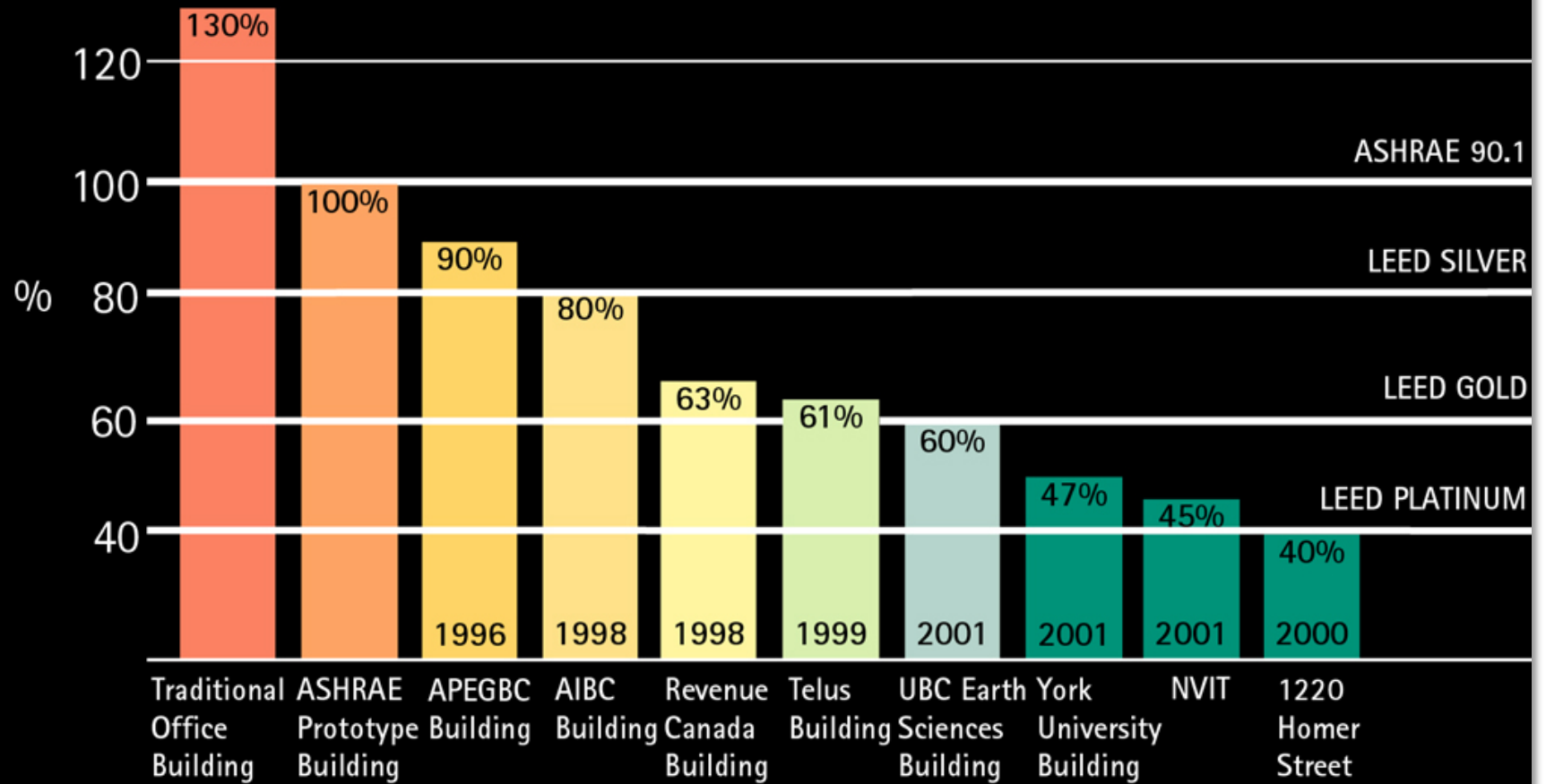
USGBC LEED-NC rated Sept. 3, 2003.



## The reason architects should *(AT LEAST)* design to LEED:

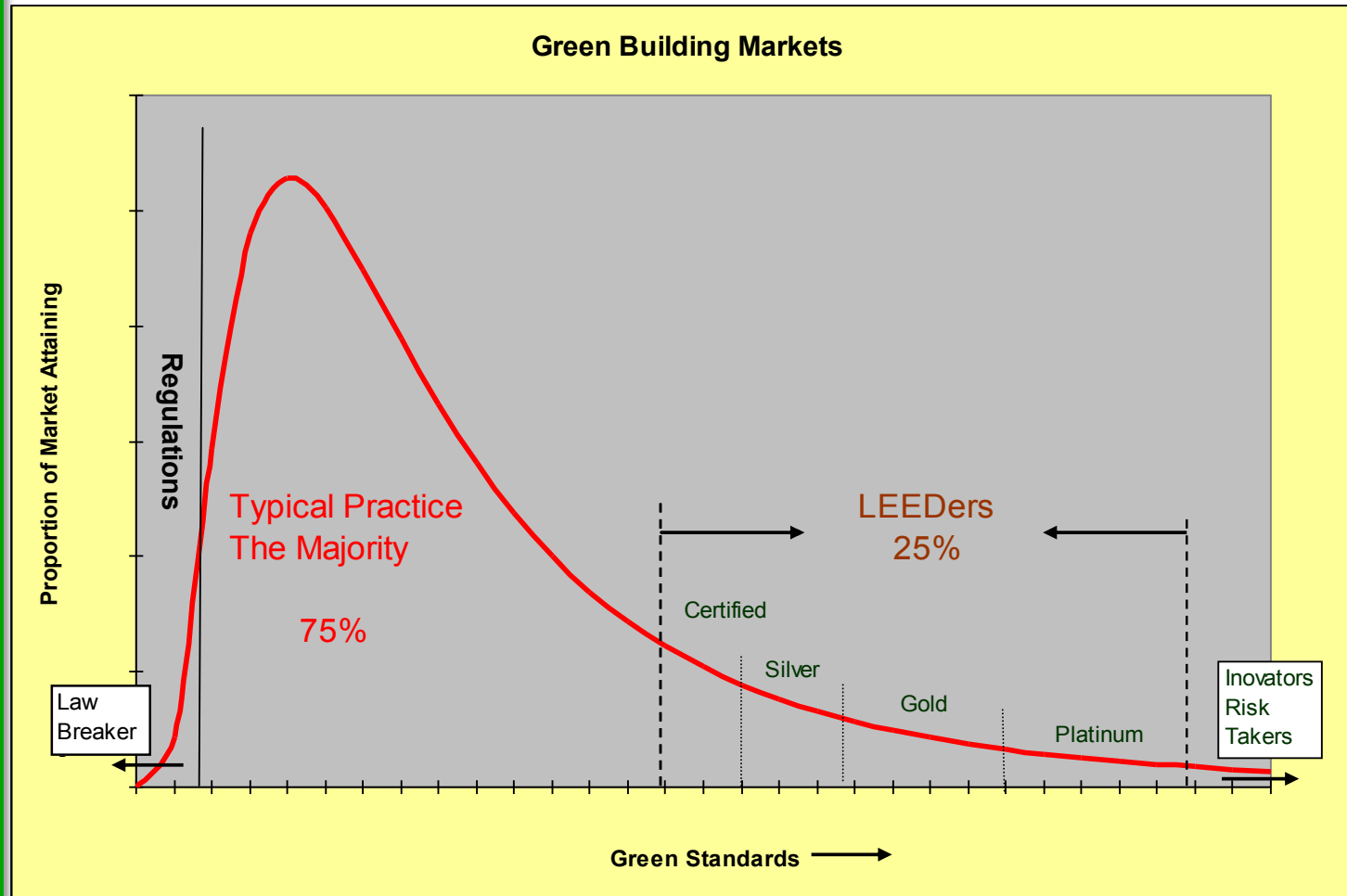
- If we can't quantify, we can't compare.
- If we don't know how green it is, we can't really sell the idea convincingly to clients or the public.
- If we don't know how much environmental saving results, then we are just producing "soft" products that may or may not have any real value. If we don't understand and use sustainable design with authority, then we really don't know if what we have produced is correct or will work effectively.
- Some "green" buildings that have been designed pre-LEED have been studied and proven to be very low in LEED ratings

## Comparative Energy Consumption



Comparisons are the key to understanding the relative effectiveness of certain design strategies.

# Positioning of LEED® in the Market

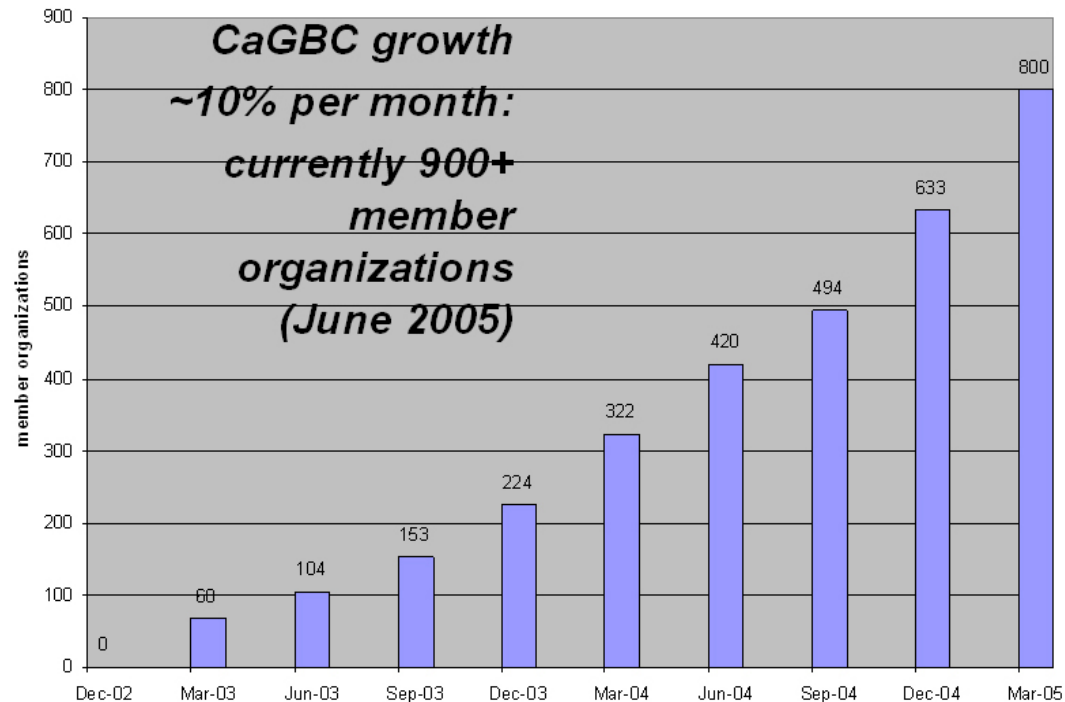


# What are the Advantages of LEED® ?

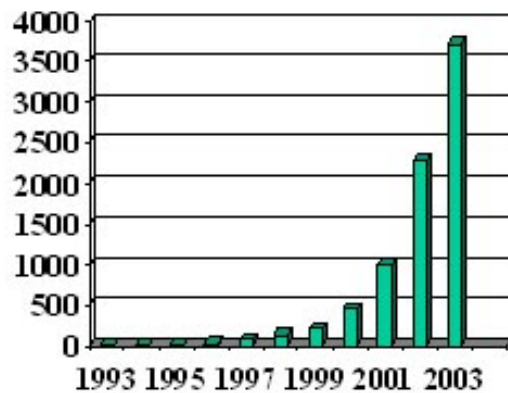
- Relatively simple to implement
- Not overly prescriptive
- Can be modified for local climate and standards (LEED™ BC and LEED™ Canada)
- It has legitimacy and consistency
- Credibility of third party verification

# LEED® Uptake – USGBC & CaGBC Membership

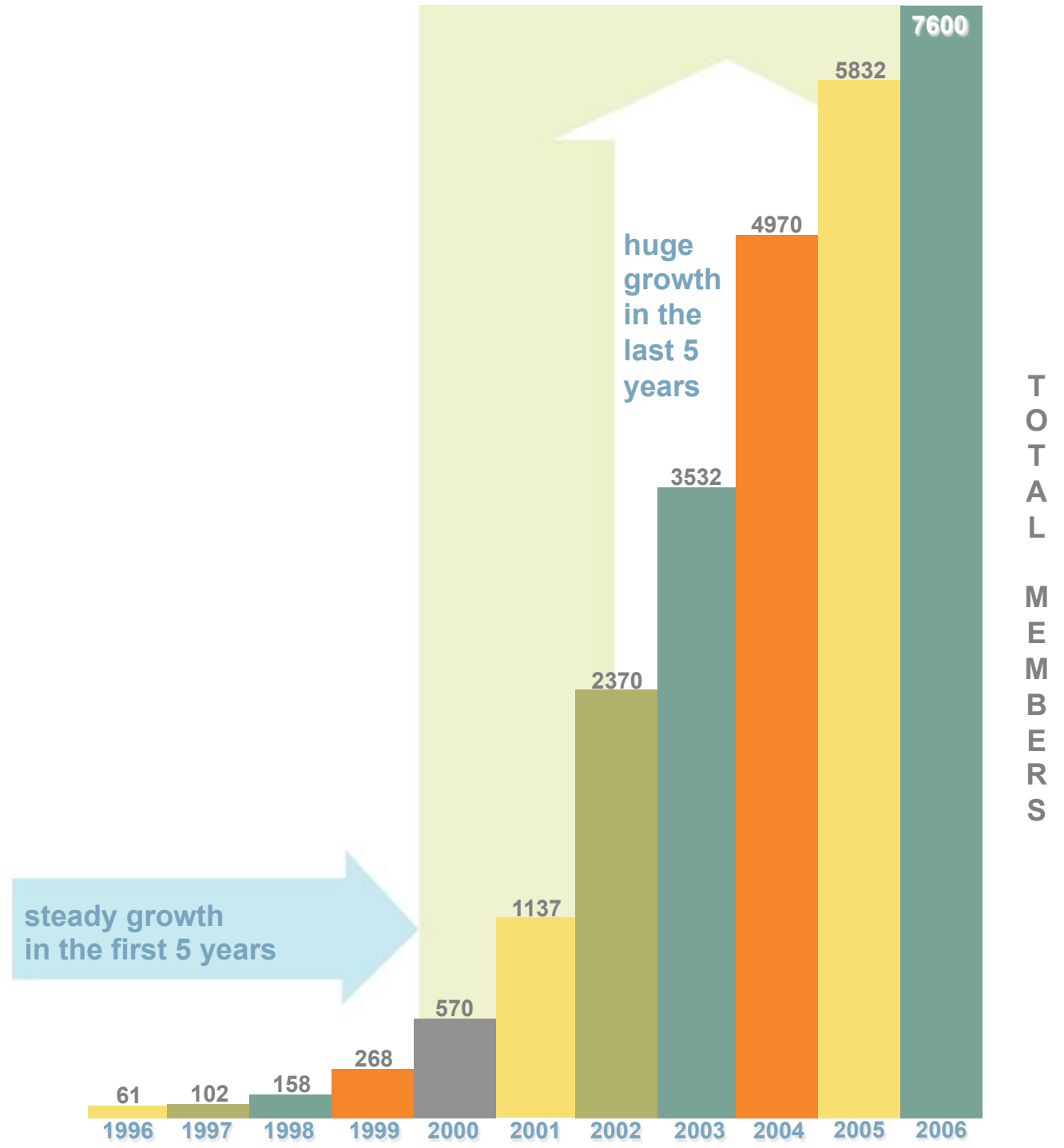
CaGBC Membership Trend



USGBC: Dec. 2003



**USGBC  
membership  
growth reflects  
the expansion  
of green  
buildings in  
the market**



**Increase  
in LEED  
Projects  
in three  
years.**

**2002:**  
More than  
80 million  
square feet.

**2003:**  
More than  
141 million  
square feet.

**2004:**  
More than  
180 million  
square feet.

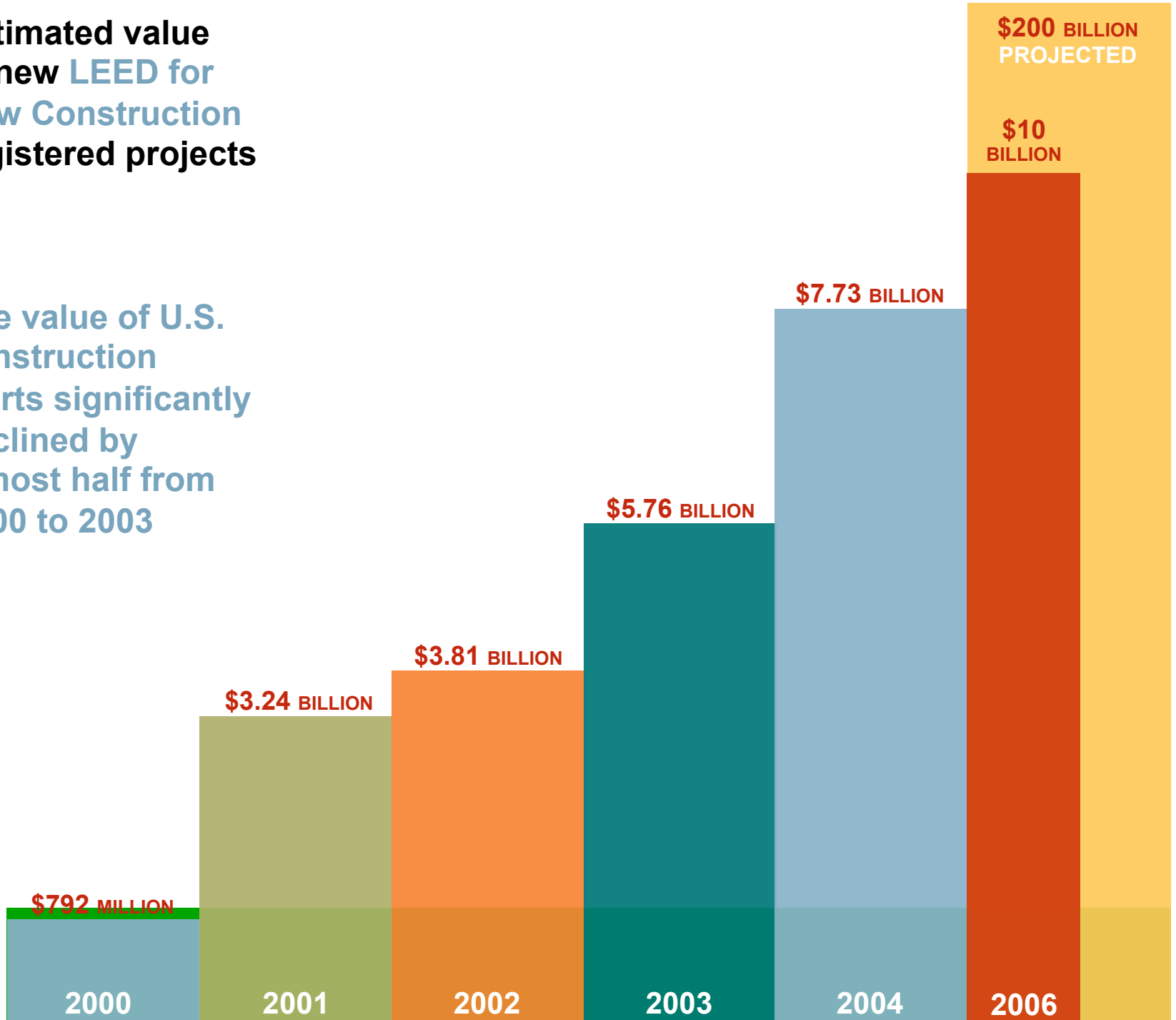
**2005:**  
500 million  
square feet.

**2006:**  
642 million  
square feet.



# Estimated value of new LEED for New Construction registered projects

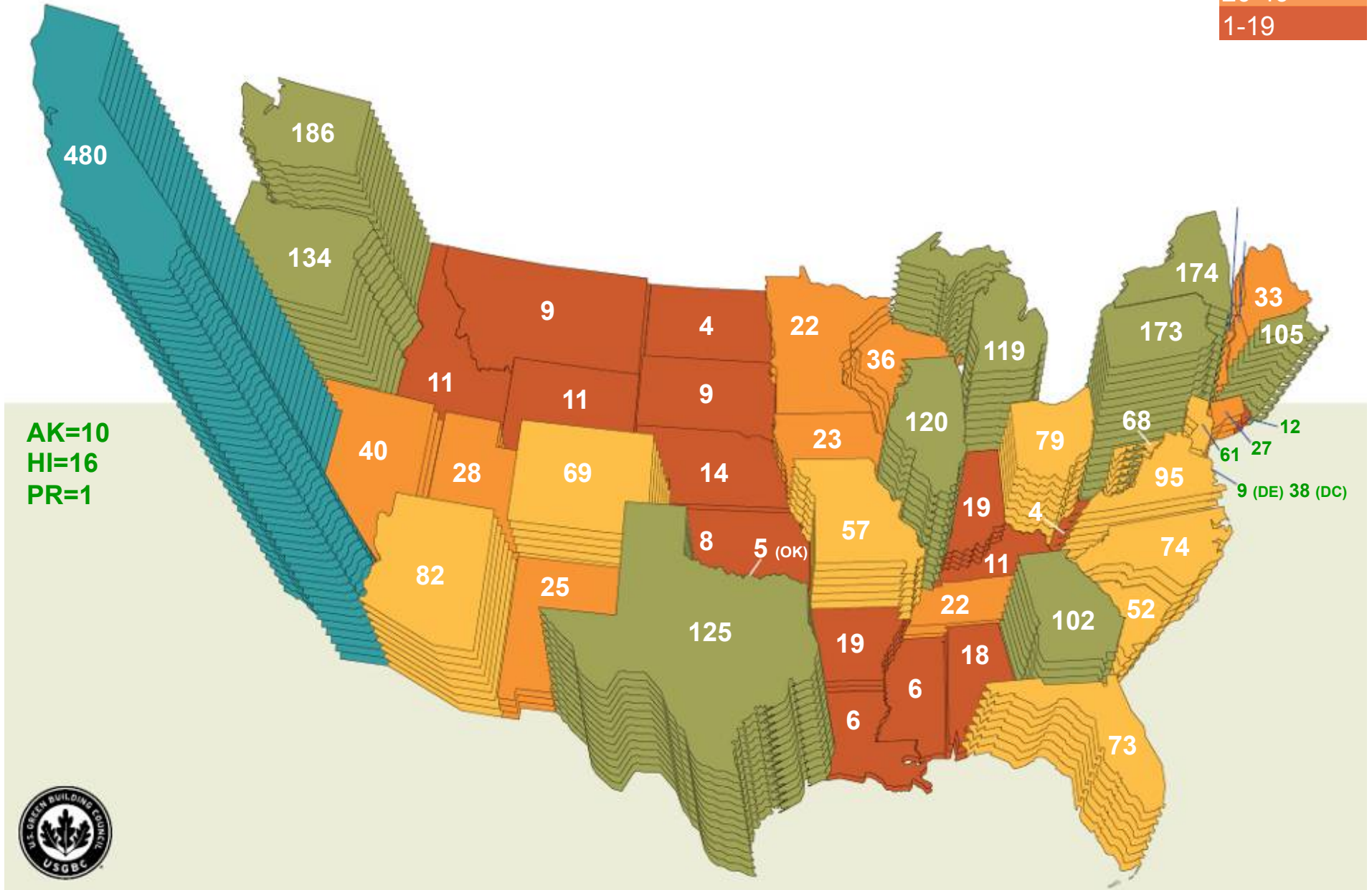
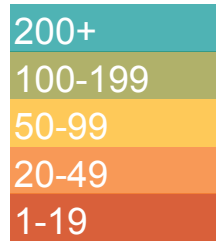
The value of U.S. construction starts significantly declined by almost half from 2000 to 2003

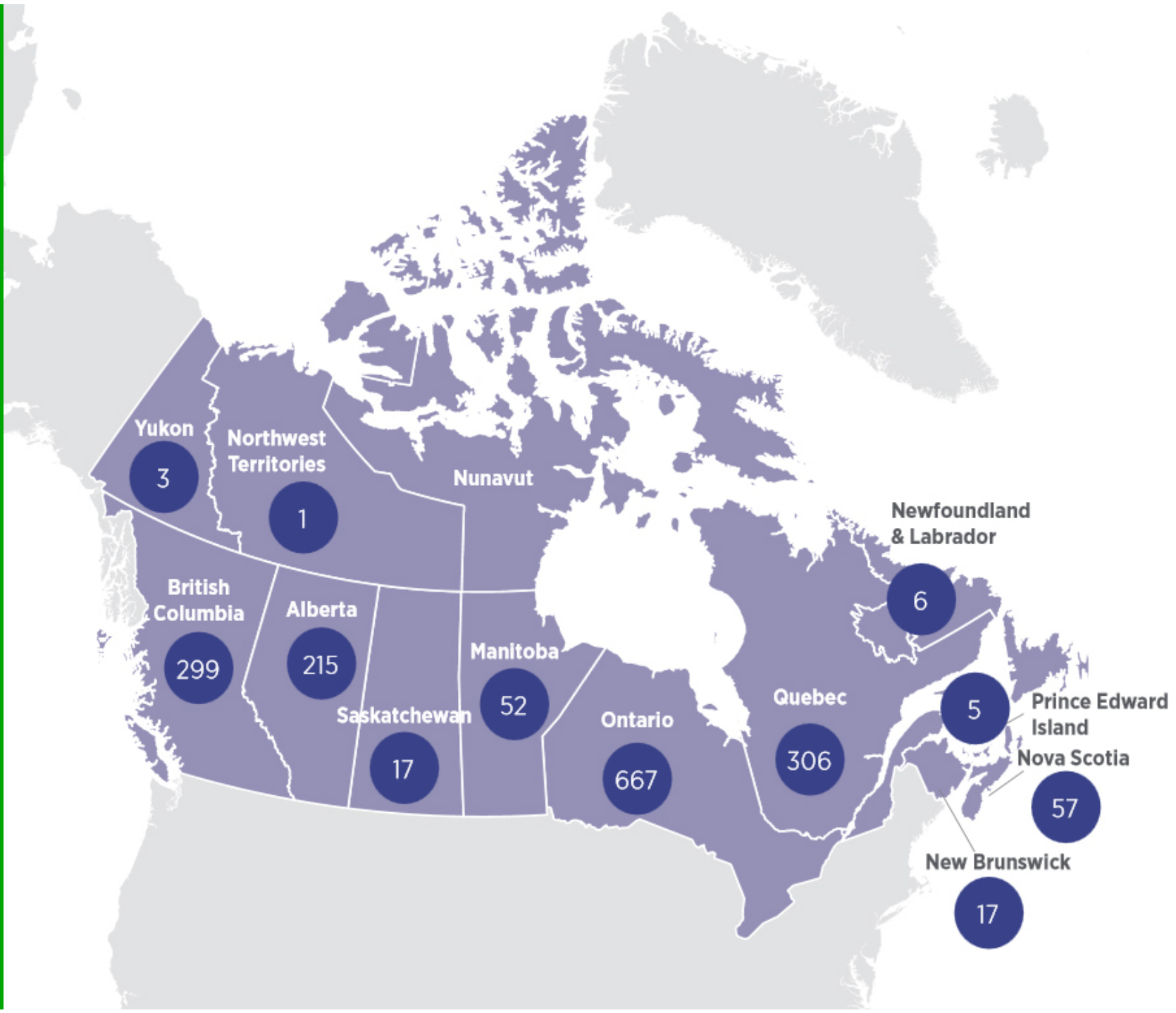




# LEED for new construction buildings as of 07/06

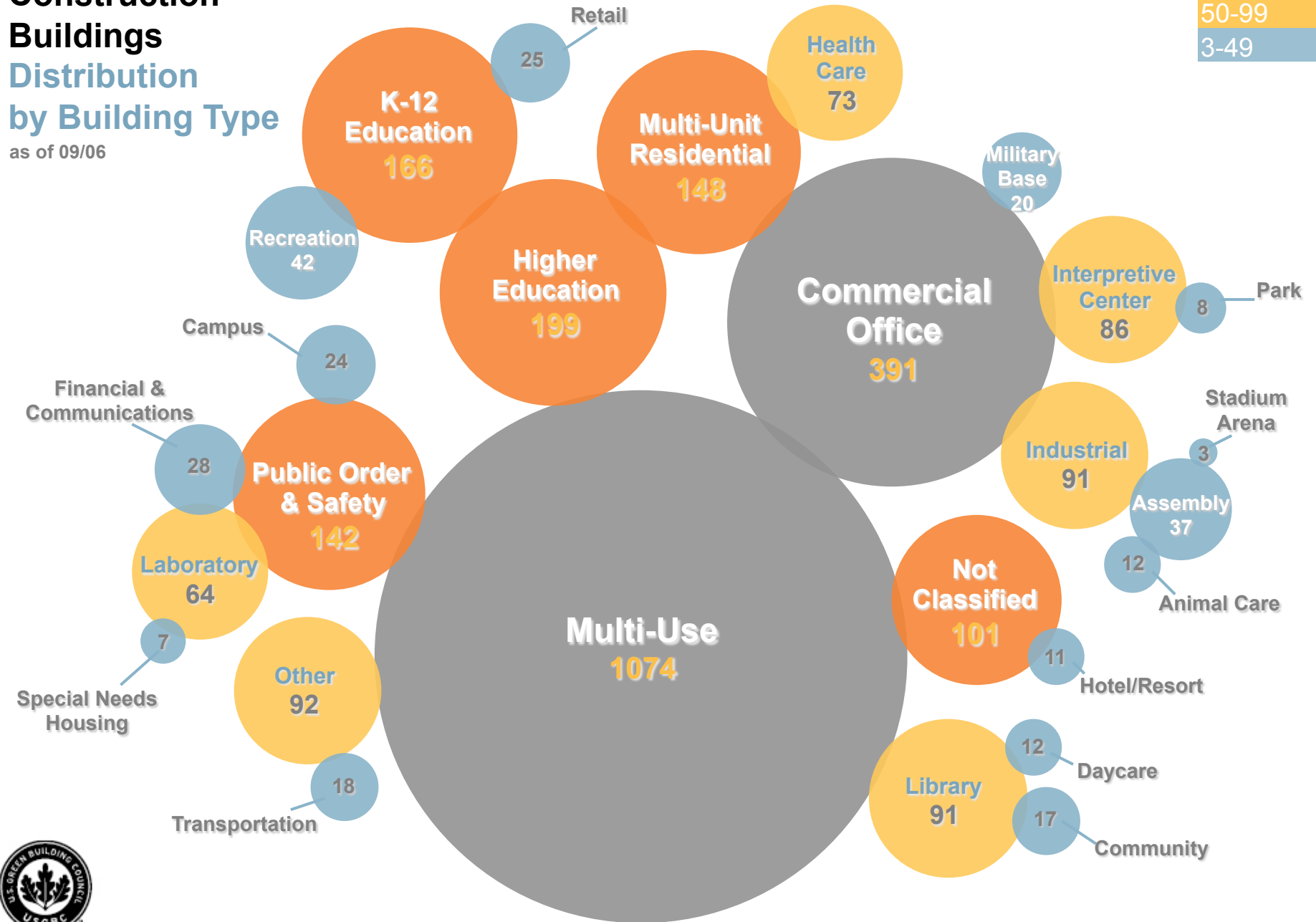
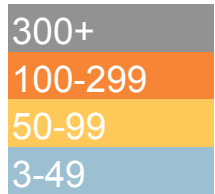
## Distribution by geography





# LEED for New Construction Buildings Distribution by Building Type

as of 09/06



## Reasons for LEED Momentum

- Works well for institutional & commercial buildings
- Capital Cost effective (LEED Silver 0-2% premium) if IDP used
- Very rapid paybacks
- Third party credibility and independent verification process
- Key to meeting Kyoto and Copenhagen commitments

# LEED Endorsement in Canada

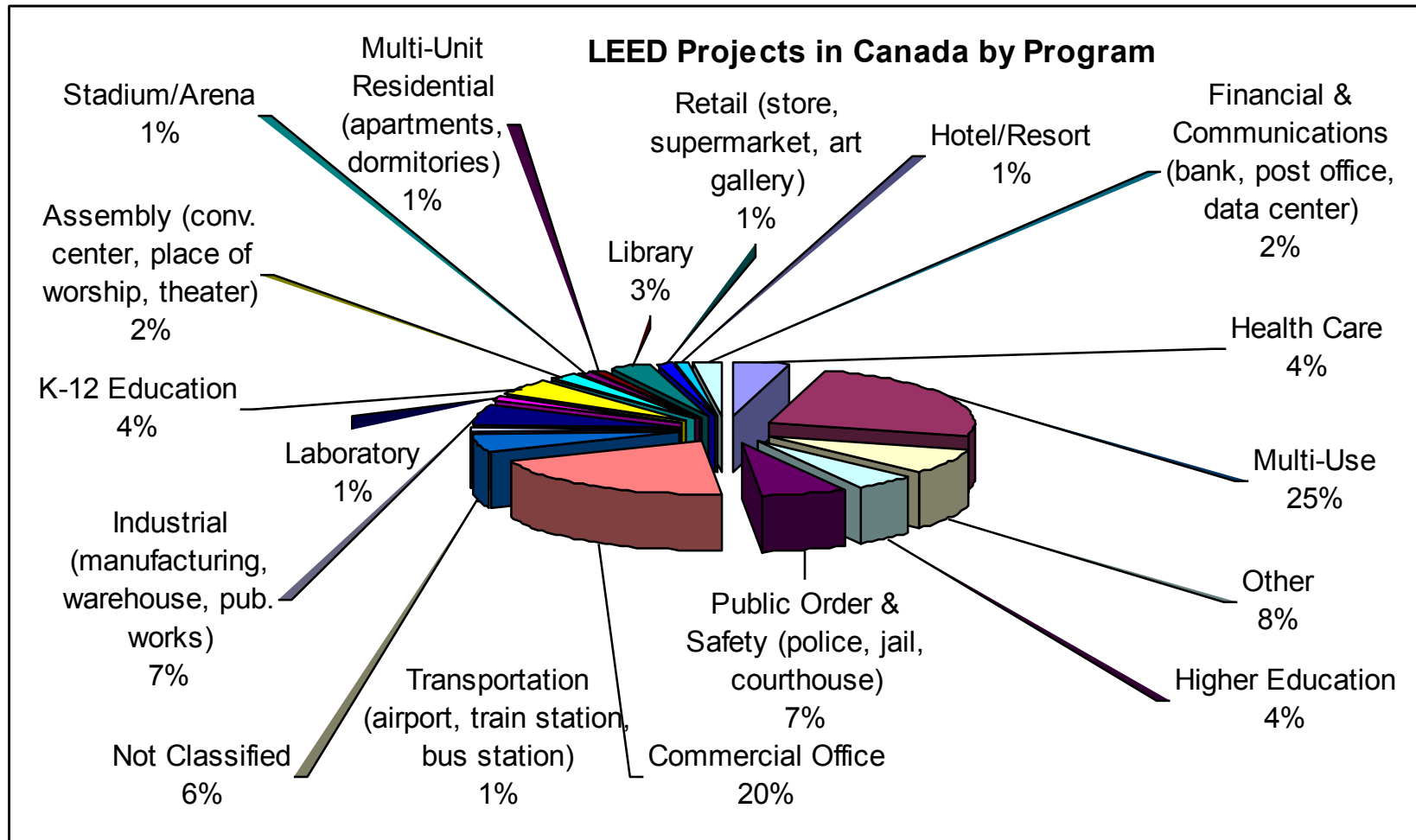


- APEG BC
- GVRD
- University of BC
- BC Buildings Corporation
- Vancouver 2010 Olympics: *Silver*
- City of Vancouver facilities: *Gold*
- City of Victoria Dockside Lands: *Platinum*

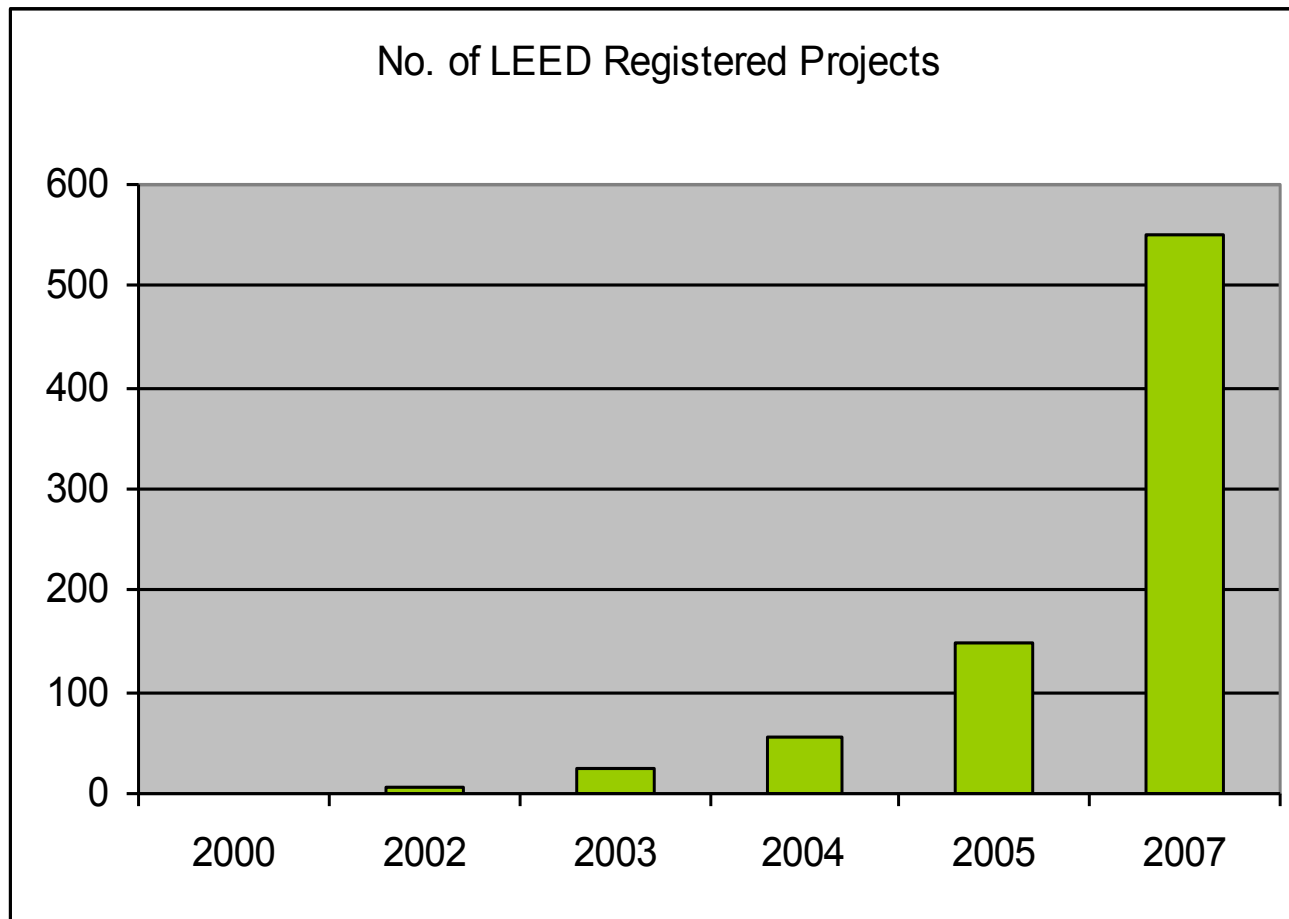
- Alberta Infrastructure Schools Pilot
- City of Calgary Sustainable Buildings Policy
- Manitoba Hydro \$150 million building
- Public Works & Government Services Canada, Capital Projects > \$10 million = LEED Gold
- La Société Immobilière du Québec, New Construction & Renovations
- Toronto Waterfront Rehabilitation Corporation: LEED Gold
- TCHC – Regent Park Revitalization: LEED Gold Region of Waterloo: LEED Silver



# LEED Projects in Canada by Program Type



# Growth in LEED Registered Projects in Canada



## LEED is not perfect...

- has been criticized *because* it is a *checklist* system
- many points are equally weighted as if they are of equal importance (which they may not be...) although this is changing
- some issues are not addressed at all (ie. Carbon Neutral, Design for Disassembly, climate differences in Regions)
- there are mandatory credits but not subtractive ones (many students have suggested that you should be penalized for having some systems or items in your buildings)
- present LEED Canada does not have as many versions as USGBC
- it is quite expensive to take your building through certification

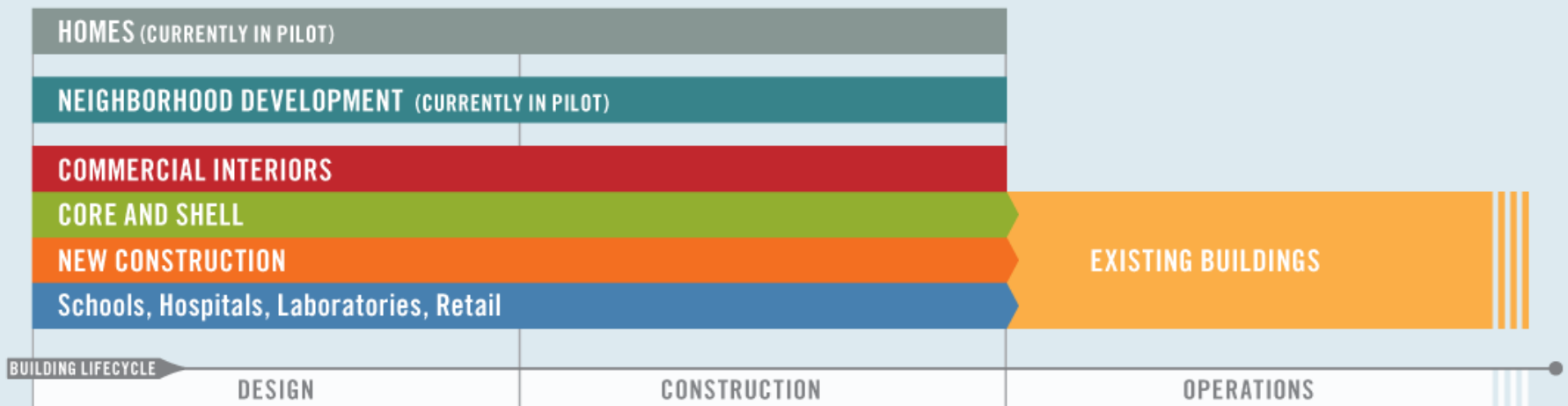


## I like LEED....

- ✓ because it is an accessible checklist system (you can find out much online for free)
- ✓ realizing it is not perfect, but you have to start changing attitudes somewhere
- ✓ students that I have asked to design to LEED standards thus far, seem to have been able to work with the basic requirements without problem
- ✓ student project work that has been produced with LEED in mind has been much more rigorous than “greenish” design in the past
- ✓ because I am going to tell you that like the Building Code, this should be considered a set of **MINIMUM** requirements!
- ✓ because they DO revise and upgrade and add new evaluation systems quite regularly

# LEED addresses the complete lifecycle of commercial buildings.

Programs are in pilot for Homes and Neighborhoods.



# USGBC LEED Rating Systems 2014

- New Construction (NC)
- Existing Buildings: Operations & Maintenance (EB: O&M)
- Commercial Interiors (CI)
- Core & Shell (CS)
- Schools (SCH)
- Retail
- Healthcare (HC)
- Homes
- Neighborhood Development (ND)

## CaGBC LEED Rating Systems 2014

- New Construction (NC)
- Existing Buildings: Operations & Maintenance (EB: O&M)
- Commercial Interiors (CI)
- Core & Shell (CS)
- Homes
- Neighborhood Development (ND)



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### Smart Growth

### Living Building Challenge

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[Submit a CIR »](#)

[View CIRs »](#)

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## NEW!!! V4 Alternate Compliance Paths

- New to LEED v4 in Canada (2014) is the adoption of Alternate Compliance Paths
- To save \$\$ on the development of Canadian specific versions of LEED
- allows Canadians to take advantage of the full breadth of rating systems provided by the USGBC and the electronic resources of LEED Online

# Choosing the right rating system

First, choose a rating system based on **construction type**

**NEW**  
CONSTRUCTION  
AND MAJOR RENOVATIONS  
**SCHOOLS**  
HEALTHCARE  
**RETAIL:**  
NEW CONSTRUCTION  
AND MAJOR RENOVATIONS  
**HOMES**

## Complete Construction

*Appropriate for:*

Buildings that are undergoing new construction or *major renovation* (or *gut rehab*, for low- and mid-rise residential) and a complete *interior fit-out*.

There are five rating systems in this category:

- LEED for New Construction and Major Renovations
- LEED for Schools
- LEED for Healthcare
- LEED for Retail: New Construction and Major Renovations
- LEED for Homes





## CORE AND SHELL DEVELOPMENT

### Core and Shell Construction

*Appropriate for:*

Buildings that are undergoing new construction or *major renovation* on its exterior shell and core mechanical, electrical, and plumbing units but NOT a complete *interior fit-out*. There is only one rating system in this category:

- LEED for Core & Shell
- 

## COMMERCIAL INTERIORS

## RETAIL: COMMERCIAL INTERIORS

### Commercial Interior Construction

*Appropriate for:*

Commercial Interior spaces that are undergoing a complete *interior fit-out* of at least 60% of the certifying gross floor area. There are two rating systems in this category:


- LEED for Commercial Interiors
  - LEED for Retail: Commercial Interiors
- 

## EXISTING BUILDINGS OPERATIONS AND MAINTENANCE

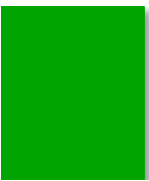
### Existing Buildings: Limited Construction

*Appropriate for:*

Existing buildings undergoing improvement work or little to no construction. There is only one rating system in this category:

- LEED for Existing Buildings: Operations & Maintenance
- 





Second, choose a rating system based on **space usage type**

**NEW**  
**CONSTRUCTION**  
AND MAJOR RENOVATIONS

*Appropriate for:*

- buildings that do not primarily serve K-12 educational, retail, or designated healthcare uses
- high rise (7+stories) residential buildings



**SCHOOLS**


*Required for:*

- buildings made up of core and ancillary learning spaces on K-12 school grounds

*Also Appropriate for:*

- buildings made up of core and ancillary learning spaces on non K-12 school grounds.
- non academic buildings on school campuses

See the Table 1 'Applying the LEED for Schools Rating System' below for more information.





# HEALTHCARE

*Required for (beginning January 1, 2012):*


- buildings that serve individuals who seek medical treatment, including licensed and federal inpatient care facilities, licensed and federal outpatient care facilities, and licensed and federal long-term care facilities. These are considered LEED for Healthcare ‘designated’ uses.

*Also Appropriate for:*

- buildings with other kinds of medically-related uses, such as unlicensed outpatient facilities, medical, dental and veterinary offices and clinics, assisted living facilities and medical education & research centers are examples of ‘non-designated’ uses, and may use LEED for Healthcare at the project team’s discretion.

See Table 2 ‘Applying the LEED for Healthcare Rating System’ below for more information.

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**RETAIL:**  
NEW CONSTRUCTION  
AND MAJOR RENOVATIONS  
**RETAIL:**  
COMMERCIAL  
INTERIORS

*Appropriate for:*

- buildings or interiors dedicated to the sale of goods or commodities directly to consumers who come onto the premise for the purpose of obtaining those goods or commodities. Includes (but is not limited to) banks, restaurants (quick and full-serve), stores of any kind, spas, etc.
- includes both direct customer service areas (showroom) and preparation or storage areas that support customer service.




**HOMES**

*Appropriate for:*

- low-rise (1-3 stories) residential buildings. The LEED for Homes Multi-Family Midrise rating system, located on the LEED for Homes page within [usgbc.org](http://usgbc.org), is appropriate for mid-rise (4-6 stories) residential buildings.

See Table 3 'Applying the LEED for Homes Rating System' below for more information.



## This is based on LEED 1.0 for Canada

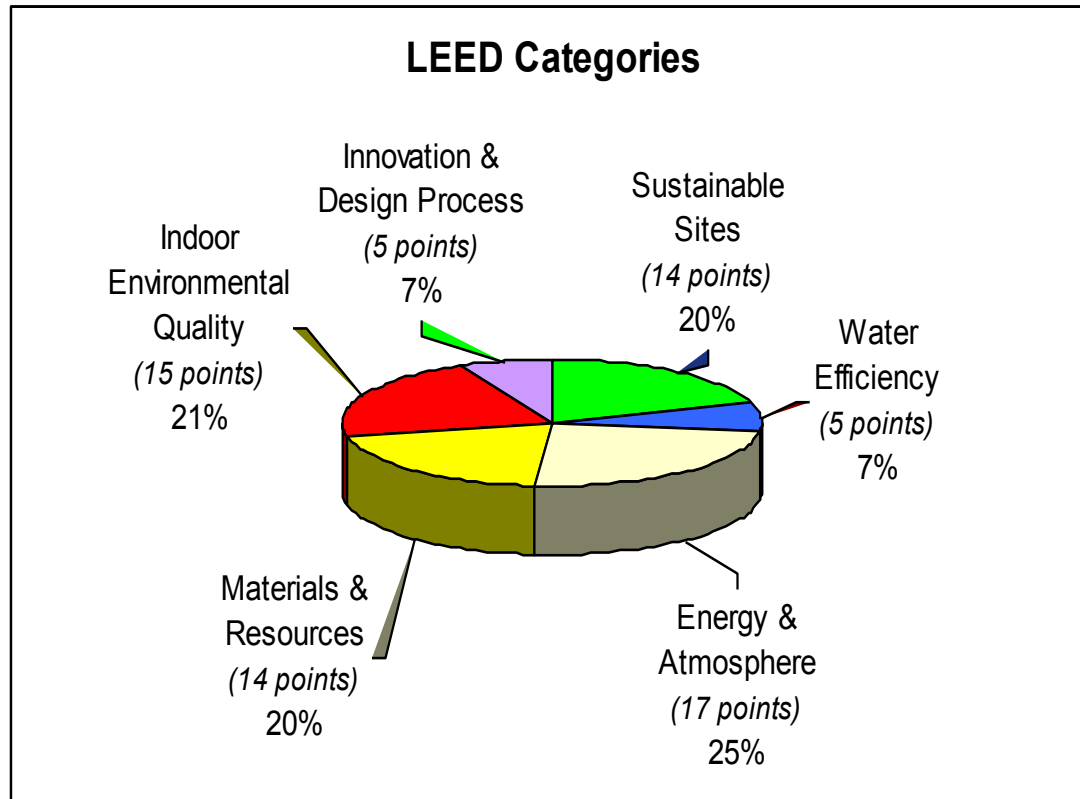


Chart based on LEED Canada 70 points

In the early days of energy consciousness, the primary focus was on energy efficiency, insulation levels and air tightness. With the introduction of a more comprehensive rating system, the role of envelope efficiency might be seen to comprise only 25% of the points available...

## LEED Version 1 for Canada

The collected LEED base sections amount to 65 points in 32 credit categories. Adding the 5 points for Innovation & Design Process results in a **potential of 70 points**. Buildings are accredited by the number of points gained:

26 to 32 point is LEED certified;

33 to 38 points is LEED Silver;

**39 to 51 is LEED Gold**, and;

**LEED Platinum is awarded to projects with 52 or more points.**

By awarding a medal to successful buildings, LEED is an incentive-based system, which can be easily understood by designers and clients alike. It can also be used as a forceful marketing tool, by “brand naming” buildings with the LEED award label. Several cities in the United States and Canada have adopted LEED Silver, for instance, as the minimum standard for all new municipal construction.



## Pre-requisite credits:

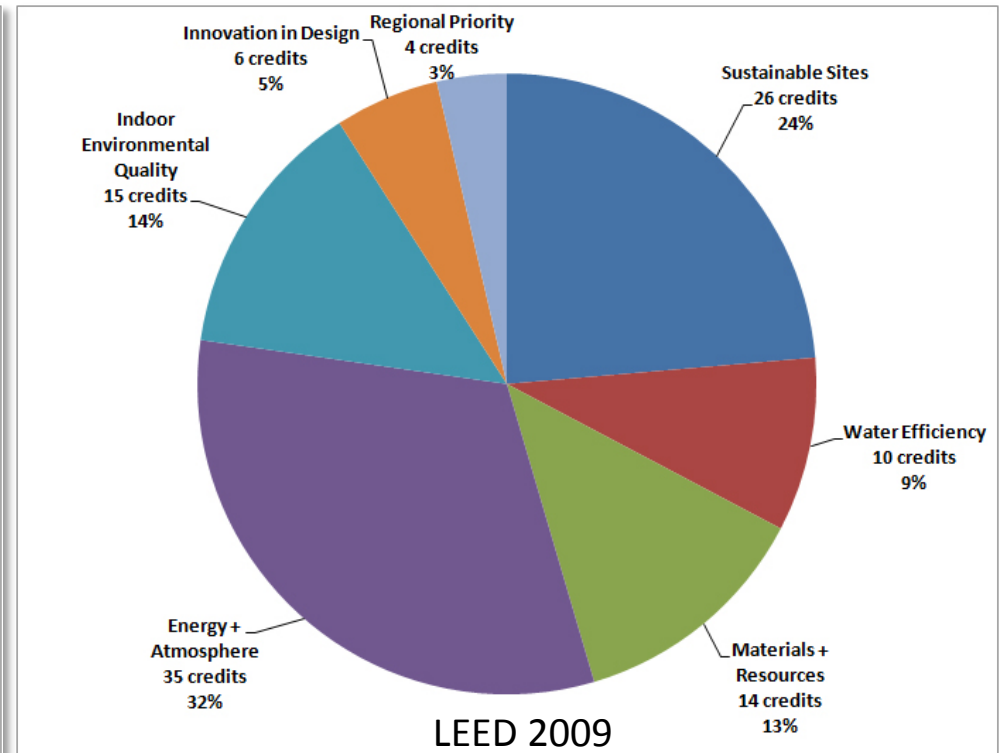
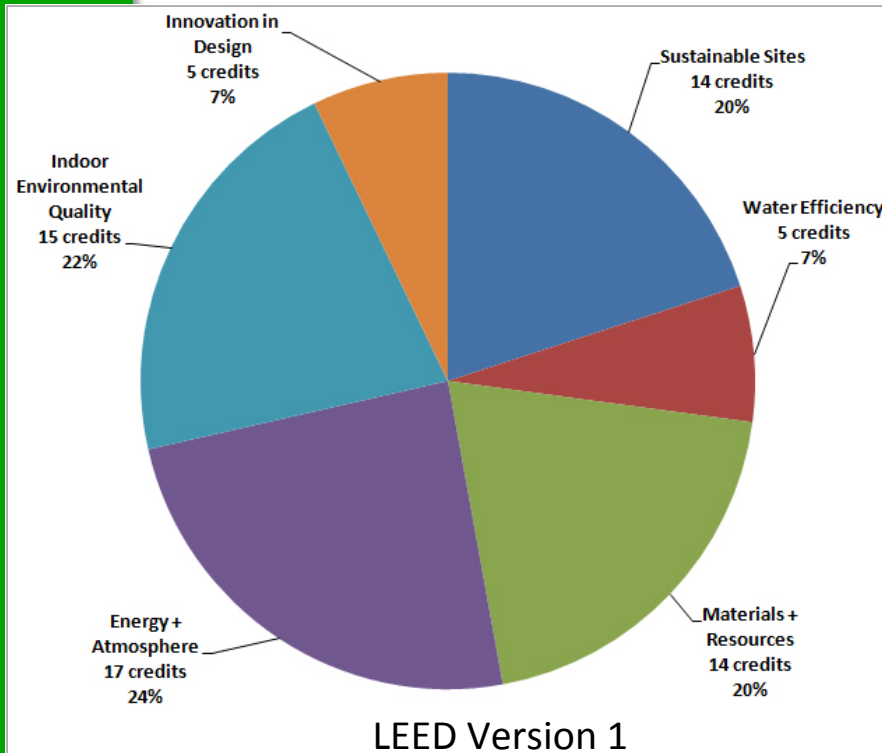
- in the LEED system, many of the categories include pre-requisite points/credits
- you MUST achieve these credits or none of the other credits in the category count
- the intent of the pre-requisite points is to set up basic criteria for sustainable building for the category
- Sustainable Sites: erosion and sedimentation control
- Energy & Atmosphere: Fundamental Building Systems Commissioning, Minimum Energy Performance, CFC Reduction
- Materials and Resources: Storage and Collection of Recyclables
- Indoor Environmental Quality: Minimum IAQ, No Tobacco Smoke

# LEED 2009

- **General Changes:**
- Total point score out of 110 rather than 70
- Credit weightings have changed, increasing some, lowering others
- Merger of two-part credits when only difference was threshold (e.g., MR Credit 4.1 and 4.2 are now MR Credit 4 with two different threshold levels)

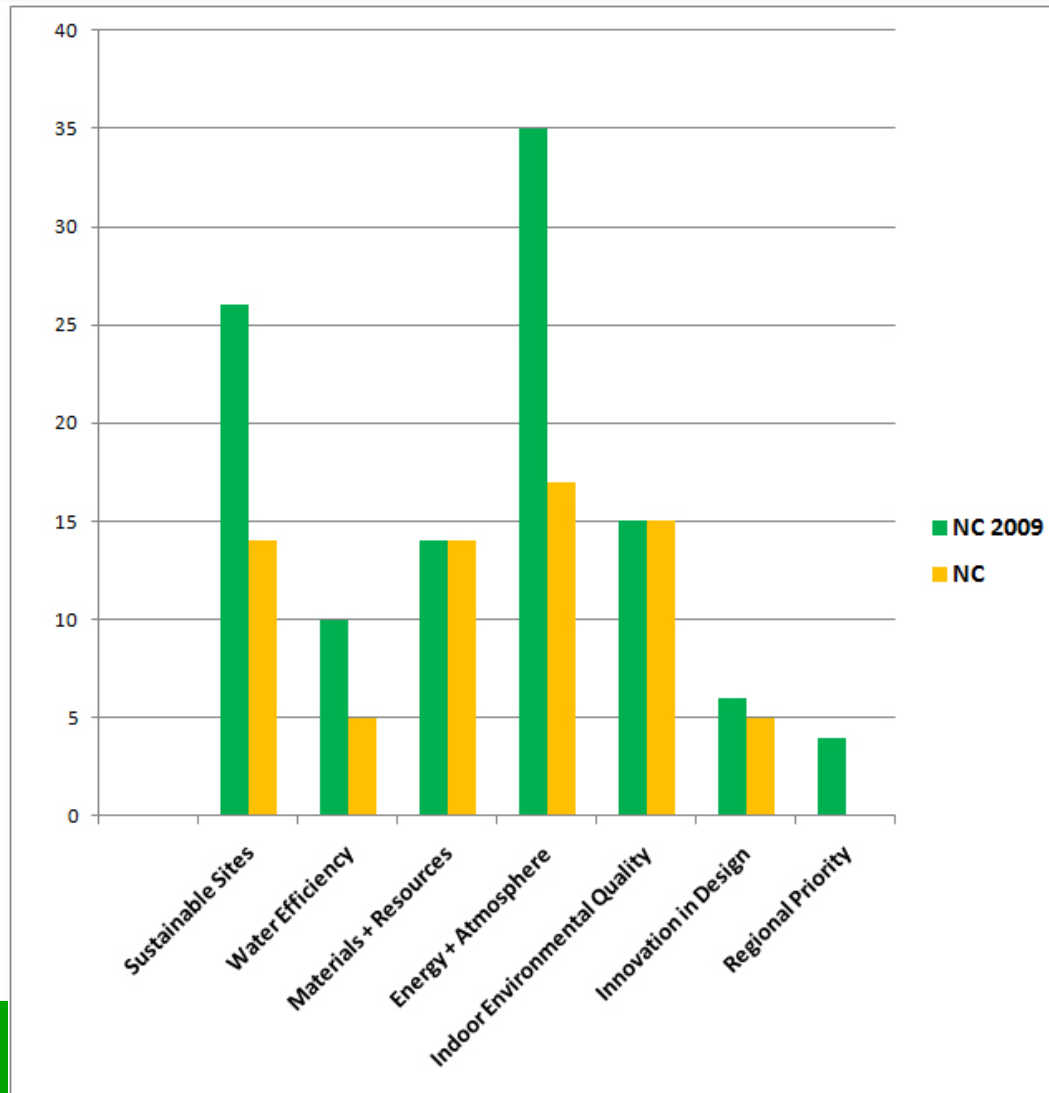


# LEED V1 and LEED 2009 Credit Comparison



The most obvious change in the system is the increase in percentage of points for Energy & Atmosphere and Sustainable Sites.

# LEED 2009 vs LEED V1 Credit Distribution



# LEED 2009 Awards

## LEED CANADA FOR NC AND MAJOR RENOVATIONS 2009

100 base points; 6 possible Innovation in Design; 4 Regional Priority points

<b>CERTIFIED</b>	40-49 points
SILVER	50-59 points
<b>GOLD</b>	60-70 points
<b>PLATINUM</b>	80 points and above

Note that projects must meet all prerequisites and achieve 40 points from other credits before they may earn any Regional Priority Credits.



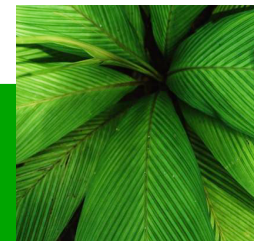
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## Sustainable Sites: 20% : 14/70 points

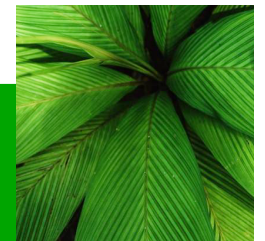
deals primarily with issues of site selection, site access and site design (materials, density, drainage). The prerequisite concerns erosion and sedimentation control on site. There are eight credits offering a total of 14 potential points. The development of sustainable site design is seen as a critical starting point for an attitude towards the entire building design in the Integrated Design Process.



## **Sustainable Sites**

### **14 Possible Points**

		Required
Prerequisite 1	Erosion & Sedimentation Control	Required
Credit 1	Site Selection	1
Credit 2	Development Density	1
Credit 3	Brownfield Redevelopment	1
Credit 4.1	Alternative Transportation, Public Transportation Access	1
Credit 4.2	Alternative Transportation, Bicycle Storage & Changing Rooms	1
Credit 4.3	Alternative Transportation, Alternative Fuel Vehicles	1
Credit 4.4	Alternative Transportation, Parking Capacity	1
Credit 5.1	Reduced Site Disturbance, Protect or Restore Open Space	1
Credit 5.2	Reduced Site Disturbance, Development Footprint	1
Credit 6.1	Stormwater Management, Rate and Quantity	1
Credit 6.2	Stormwater Management, Treatment	1
Credit 7.1	Landscape & Exterior Design to Reduce Heat Islands, Non-Roof	1
Credit 7.2	Landscape & Exterior Design to Reduce Heat Islands, Roof	1
Credit 8	Light Pollution Reduction	1

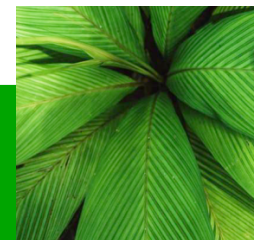


# Sustainable Sites

## SUSTAINABLE SITES

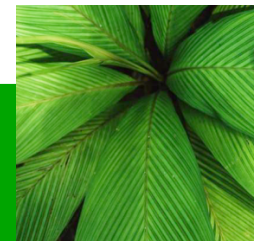
26 POSSIBLE POINTS

		Required
<input type="checkbox"/>	Prereq 1 Construction Activity Pollution Prevention	Required
<input type="checkbox"/>	Credit 1 Site Selection	1
<input type="checkbox"/>	Credit 2 Development Density and Community Connectivity	3, 5
<input type="checkbox"/>	Credit 3 Brownfield Redevelopment	1
<input type="checkbox"/>	Credit 4.1 Alternative Transportation: Public Transportation Access	3, 6
<input type="checkbox"/>	Credit 4.2 Alternative Transportation: Bicycle Storage and Changing Rooms	1
<input type="checkbox"/>	Credit 4.3 Alternative Transportation: Low-Emitting and Fuel-Efficient Vehicles	3
<input type="checkbox"/>	Credit 4.4 Alternative Transportation: Parking Capacity	2
<input type="checkbox"/>	Credit 5.1 Site Development: Protect and Restore Habitat	1
<input type="checkbox"/>	Credit 5.2 Site Development: Maximize Open Space	1
<input type="checkbox"/>	Credit 6.1 Stormwater Design: Quantity Control	1
<input type="checkbox"/>	Credit 6.2 Stormwater Design: Quality Control	1
<input type="checkbox"/>	Credit 7.1 Heat Island Effect: Non-Roof	1
<input type="checkbox"/>	Credit 7.2 Heat Island Effect: Roof	1
<input type="checkbox"/>	Credit 8 Light Pollution Reduction	1



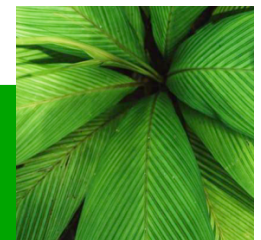
# Sustainable Sites

Credit		Major Changes
<b>Sustainable Sites</b>		
Prereq 1	<b>Construction Activity Pollution Prevention</b>	<ul style="list-style-type: none"> <li>2003 U.S. EPA Construction General Permit replaces the 1992 U.S. EPA Storm Water Management for Construction Activities, Chapter 3</li> </ul>
Credit 1	<b>Site Selection</b>	<ul style="list-style-type: none"> <li>Additional requirement to not development on land that is previously undeveloped or graded land within 15.2 metres of a water body which supports or could supports fish, recreation or industrial use</li> <li>Correction to definition of farmland as many provinces and territories do not have an agricultural land reserve as referenced previously – new definition better aligns with USGBC’s LEED NC 2009</li> </ul>
Credit 2	<b>Development Density and Community Connectivity</b>	<ul style="list-style-type: none"> <li>Update to list of services for community connectivity</li> <li>Additional option to achieve community connectivity without the site density requirement for subset of points</li> </ul>
Credit 3	<b>Brownfield Redevelopment</b>	-



# Sustainable Sites

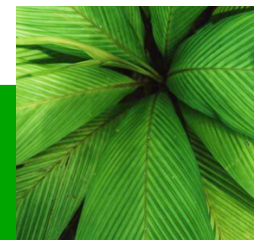
Credit	Major Changes
<b>Sustainable Sites</b>	
Credit 4.1 <b>Alternative Transportation: Public Transportation Access</b>	<ul style="list-style-type: none"> <li>Distance must be measured from main building entrance</li> <li>An alternate compliance path for a Transportation Demand Management plan has been added</li> </ul>
Credit 4.2 <b>Alternative Transportation: Bicycle Storage &amp; Changing Rooms</b>	<ul style="list-style-type: none"> <li>Bicycle storage must be covered for FTE occupants</li> <li>Calculations are based on peak transient use</li> </ul>
Credit 4.3 <b>Alternative Transportation: Low-Emitting &amp; Fuel-Efficient Vehicles</b>	<ul style="list-style-type: none"> <li>Fuel efficient vehicle definition has changed</li> </ul>
Credit 4.4 <b>Alternative Transportation: Parking Capacity</b>	<ul style="list-style-type: none"> <li>Projects are restricted to a parking capacity upper limit of 3.5 spaces per 93 m<sup>2</sup> (1000 ft<sup>2</sup>)</li> <li>Carpool requirement is based on total parking spaces (including visitor spaces)</li> </ul>
Credit 5.1 <b>Site Development: Protect and Restore Habitat</b>	<ul style="list-style-type: none"> <li>Slightly increased requirements for greenfield sites</li> </ul>
Credit 5.2 <b>Site Development: Maximize Open Space</b>	<ul style="list-style-type: none"> <li>Provided new pathway for sites with local zoning but no open space requirements</li> </ul>





# Sustainable Sites

Credit	Major Changes
<b>Sustainable Sites</b>	
Credit 6.1 <b>Stormwater Design: Quantity Control</b>	<ul style="list-style-type: none"> <li>For sites with existing imperviousness 50% or less, a new option has been provided to implement a stormwater management plan that protects receiving waterways from excessive erosion by implementing velocity and quantity control strategies</li> </ul>
Credit 6.2 <b>Stormwater Design: Quality Control</b>	<ul style="list-style-type: none"> <li>Requirement for a stormwater quality management plan has been added</li> <li>Total phosphorous requirement has been removed from calculations and replaced with a nutrient management plan to minimize pollution and eutrophication of waterways (with no specific removal levels)</li> </ul>
Credit 7.1 <b>Heat Island Effect: Non-Roof</b>	<ul style="list-style-type: none"> <li>Clarification of options and expanded to include, for example, shading from solar panels</li> </ul>
Credit 7.2 <b>Heat Island Effect: Roof</b>	-
Credit 8 <b>Light Pollution Reduction</b>	<ul style="list-style-type: none"> <li>Modified requirements for interior and exterior light pollution</li> <li>Language added to clarify IESNA RP-33 zones</li> <li>Added public rights-of-way boundary exception for zones LZ2, LZ3 &amp; LZ4</li> <li>Clarified site boundary for luminaires in intersections</li> <li>Updated referenced standard to ASHRAE/IESNA Standard 90.1-2007</li> </ul>
Credit 9 <b>Tenant Design and Construction Guidelines</b>	<ul style="list-style-type: none"> <li>New Core &amp; Shell credit</li> </ul>



## Sustainable Sites: Examples



Vancouver Public Library

- green roof
- controls site water
- offsets urban heat island effect

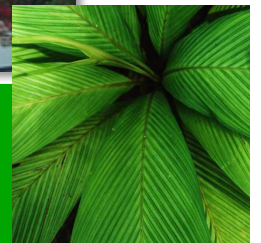


## Sustainable Sites: Examples



Green on the Grand,  
Kitchener, Ontario

- storm water retention pond
- controls site water
- offsets urban heat island effect
- also used with heating/AC system





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## Water Efficiency: 7% : 5/70 points

is the smallest section comprising only three credits, worth 5 points. This section deals with landscaping, wastewater treatment and water use reduction. Items such as Living Machines™, use of the Waterloo Biofilter™, waterless urinals and composting toilets can be rewarded with points in this category.





## **Water**

### **Efficiency**

### **5 Possible Points**

Credit 1.1	Water Efficient Landscaping, Reduce by 50%	1
Credit 1.2	Water Efficient Landscaping, No Potable Use or No Irrigation	1
Credit 2	Innovative Wastewater Technologies	1
Credit 3.1	Water Use Reduction, 20% Reduction	1
Credit 3.2	Water Use Reduction, 30% Reduction	1



# Water Efficiency

## WATER EFFICIENCY

10 POSSIBLE POINTS

<input type="checkbox"/>	Prereq 1	Water Use Reduction	Required
<input type="checkbox"/>	Credit 1	Water Efficient Landscaping	2, 4
<input type="checkbox"/>	Credit 2	Innovative Wastewater Technologies	2
<input type="checkbox"/>	Credit 3	Water Use Reduction	2-4



# Water Efficiency

	Credit	Major Changes
<b>Water Efficiency</b>		
Prereq 1	<b>Water Use Reduction, 20% Reduction</b>	<ul style="list-style-type: none"> <li>• New to LEED 2009, based on previous WE Credit 3.1 with the addition of a building/property water meter</li> <li>• Updated baselines for flow rates, based on the U.S. Energy Policy Act of 1992 and subsequent rulings by the U.S. Department of Energy, requirements of the Energy Policy Act of 2005, and the plumbing code requirements as stated in the 2006 editions of the Uniform Plumbing Code or International Plumbing Code</li> </ul>
Credit 1	<b>Water Efficiency Landscaping</b>	<ul style="list-style-type: none"> <li>• Merger of WE Credit 1.1 and WE Credit 1.2</li> <li>• Minimum area clarified (5% of total project site area (including building))</li> <li>• Added factors for calculating mid-summer baseline case</li> <li>• Addressed groundwater seepage for use in irrigation</li> <li>• Temporary irrigation systems limited to 1 year but no restrictions on type</li> </ul>
Credit 2	<b>Innovative Wastewater Technologies</b>	<ul style="list-style-type: none"> <li>• Reduction of on-site treatment threshold to 50%</li> </ul>
Credit 3	<b>Water Use Reduction</b>	<ul style="list-style-type: none"> <li>• See WE Prerequisite 1 changes for flow rate updates</li> <li>• Point thresholds have been increased with 3 levels available (30%, 35% and 40%)</li> </ul>



## Water Efficiency: Examples

YMCA  
Environmental  
Learning Centre:  
Living Machine



CMHC Healthy  
House: Waterloo  
Biofilter





# Water Efficiency: Examples

The White Rock Operations Centre uses 100% reclaimed water for both vehicle washing and landscape watering.





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## Energy and Atmosphere: 25% : 17/70 points

includes three prerequisites – fundamental building systems commissioning, minimum energy performance, and CFC reduction in HVAC&R equipment. The prerequisites are followed by six credits for energy performance, renewable energy and additional building monitoring, with a potential value of eight points.



## Energy & Atmosphere

### 17 Possible Points

Prerequisite 1	Fundamental Building Systems Commissioning	Required
Prerequisite 2	Minimum Energy Performance	Required
Prerequisite 3	CFC Reduction in HVAC&R Equipment	Required
Credit 1	Optimize Energy Performance	1 to 10
Credit 2.1	Renewable Energy, 5%	1
Credit 2.2	Renewable Energy, 10%	1
Credit 2.3	Renewable Energy, 20%	1
Credit 3	Additional Commissioning	1
Credit 4	Ozone Depletion	1
Credit 5	Measurement & Verification	1
Credit 6	Green Power	1



## Energy and Atmosphere: 25% : 17/70 points cont'd

Prior to the adoption of LEED, energy efficiency was the only motivation to improving design strategies! It did succeed in effecting:

- increased levels of insulation,
- higher efficiency ratings on appliances and heating/cooling systems
- tighter building envelopes

*Within the holistic sustainable design framework provided by LEED, the relative importance of these issues has been revised to represent only 25% of the potential credits.*





# Energy and Atmosphere

## ENERGY AND ATMOSPHERE

35 POSSIBLE POINTS

<input type="checkbox"/>	Prereq 1	Fundamental Commissioning of Building Energy Systems	Required
<input type="checkbox"/>	Prereq 2	Minimum Energy Performance	Required
<input type="checkbox"/>	Prereq 3	Fundamental Refrigerant Management	Required
<input type="checkbox"/>	Credit 1	Optimize Energy Performance	1-19
<input type="checkbox"/>	Credit 2	On-Site Renewable Energy	1-7
<input type="checkbox"/>	Credit 3	Enhanced Commissioning	2
<input type="checkbox"/>	Credit 4	Enhanced Refrigerant Management	2
<input type="checkbox"/>	Credit 5	Measurement and Verification	3
<input type="checkbox"/>	Credit 6	Green Power	2



# Energy and Atmosphere

	Credit	Major Changes
<b>Energy &amp; Atmosphere</b>		
Prereq 1	<b>Fundamental Commissioning of Building Energy Systems</b>	<ul style="list-style-type: none"> <li>• Clarified Commissioning Authority (CxA) experience</li> </ul>
Prereq 2	<b>Minimum Energy Performance</b>	<ul style="list-style-type: none"> <li>• Updated referenced standard to ASHRAE/IESNA Standard 90.1-2007</li> <li>• Performance Compliance Paths (comparison to MNECB and ASHRAE) are demonstrated through total building energy cost improvements including process loads</li> <li>• Prescriptive Compliance Paths are available</li> </ul>
Prereq 3	<b>Fundamental Refrigerant Management</b>	<ul style="list-style-type: none"> <li>• Requirement for zero use of halons in fire suppression equipment has been incorporated into EA Credit 4</li> <li>• Added alternative compliance path for campus projects using existing district chilled water plants only</li> </ul>
Credit 1	<b>Optimize Energy Performance</b>	<ul style="list-style-type: none"> <li>• As per EA Prerequisite 2</li> <li>• Point thresholds have changed</li> <li>• Different thresholds for Core &amp; Shell projects</li> </ul>
Credit 2	<b>On-Site Renewable Energy</b>	<ul style="list-style-type: none"> <li>• Point thresholds have been reduced but now based on total building energy cost (not only regulated loads)</li> <li>• Different thresholds for Core &amp; Shell projects</li> </ul>



# Energy and Atmosphere

Credit	Major Changes
<b>Energy &amp; Atmosphere</b>	
Credit 3 <b>Enhanced Commissioning</b>	<ul style="list-style-type: none"><li>• Clarified Commissioning Authority (CxA) experience and independency requirements</li><li>• The same CxA overseeing the enhanced commissioning tasks (EA Credit 3) must also oversee the fundamental commissioning tasks (EA Prerequisite 1)</li><li>• Clarifications were made to standardize LEED Commissioning Scope of Work</li></ul>
Credit 4 <b>Enhanced Refrigerant Management</b>	<ul style="list-style-type: none"><li>• Fire suppression systems must be free of ozone-depleting substances</li><li>• Refrigerants must comply with a maximum threshold for the combined contributions to ozone depletion and global warming potential</li><li>• Added option for not using refrigerants</li></ul>
Credit 5 <b>Measurement and Verification</b>	<ul style="list-style-type: none"><li>• Requirement added to provide process for corrective action if M&amp;V plan shows energy savings are not being achieved</li><li>• Removed requirement for a water M&amp;V program</li><li>• Separation of tenant submetering from base building creating two credits (EA Credit 5.1 and 5.2) for Core &amp; Shell projects</li></ul>
Credit 6 <b>Green Power</b>	<ul style="list-style-type: none"><li>• Point threshold has been reduced to 35%, but now includes all building electricity (not only regulated loads)</li><li>• Clarified that all purchases of green power are based on the quantity of energy consumed, not cost</li></ul>



# Energy and Atmosphere: Examples



Terasen Gas, Surrey, BC.

- orientation differentiation
- shading devices
- natural ventilation
- passive gain





# Energy and Atmosphere: Examples



Revenue Canada, Surrey, BC.

- orientation differentiation
- shading devices
- natural ventilation
- passive gain





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## Materials and Resources: 20% : 14/70 points

with 14 points generated in seven credits, this section has only one prerequisite: storage and collection of recyclables. The credits focus on building reuse; waste management; reused, recycled or certified materials; as well as local or regional materials.

LEED Canada has introduced a new credit in this category to recognize the importance of building durably.



## Credit 8: Durable Building

- “Minimize materials use and construction waste over a building’s life resulting from premature failure of the building and its constituent components and assemblies”
- promotes the incorporation of materials based upon a Life Cycle Assessment viewpoint
- credit references the *Guideline on Durability in Buildings CSA S478-95 (R2001)*
- If components cannot be proven to last for the design service life of the building, then they are to be specified and constructed with disassembly in mind
- demonstrate the predicted service life of chosen components or assemblies by documenting demonstrated effectiveness or modelling deterioration
- submittals require documentation of the training of the building envelope designer in the area of building science



## Materials & Resources

14 Possible Points

		Required
Prerequisite 1	Storage & Collection of Recyclables	Required
Credit 1.1	Building Reuse, Maintain 75% of Existing Shell	1
Credit 1.2	Building Reuse, Maintain 100% of Shell	1
Credit 1.3	Building Reuse, Maintain 100% of Shell & 50% Non-Shell	1
Credit 2.1	Construction Waste Management, Divert 50%	1
Credit 2.2	Construction Waste Management, Divert 75%	1
Credit 3.1	Resource Reuse, Specify 5%	1
Credit 3.2	Resource Reuse, Specify 10%	1
Credit 4.1	Recycled Content, Specify 5% p.c. or 10% p.c. + 1/2 p.i.	1
Credit 4.2	Recycled Content, Specify 5% p.c. or 20% p.c. + 1/2 p.i.	1
Credit 5.1	Local/Regional Materials, 20% Manufactured Locally	1
Credit 5.2	Local/Regional Materials, of 20% in MRc5.1, 50% Harvested Loc	1
Credit 6	Rapidly Renewable Materials	1
Credit 7	Certified Wood	1
Credit 8	Durable Building	1

Just added in LEED Canada V1, Credit 8: Durability, making the total a score out of 70.



# Materials and Resources

## MATERIALS AND RESOURCES

14 POSSIBLE POINTS

<input type="checkbox"/>	Prereq 1	Storage and Collection of Recyclables	Required
<input type="checkbox"/>	Credit 1.1	Building Reuse: Maintain Existing Walls, Floors, and Roof	1-3
<input type="checkbox"/>	Credit 1.2	Building Reuse: Maintain Interior Non-Structural Elements	1
<input type="checkbox"/>	Credit 2	Construction Waste Management	1-2
<input type="checkbox"/>	Credit 3	Materials Reuse	1-2
<input type="checkbox"/>	Credit 4	Recycled Content	1-2
<input type="checkbox"/>	Credit 5	Regional Materials	1-2
<input type="checkbox"/>	Credit 6	Rapidly Renewable Materials	1
<input type="checkbox"/>	Credit 7	Certified Wood	1



# Materials and Resources

Credit		Major Changes
<b>Materials &amp; Resources</b>		
Prereq 1	<b>Storage and Collection of Recyclables</b>	<ul style="list-style-type: none"> <li>Area for the collection of organic waste must be provided in municipalities that support such collection</li> </ul>
Credit 1.1	<b>Building Reuse: Maintain Existing Walls, Floors, and Roof</b>	<ul style="list-style-type: none"> <li>Combined with previous MR Credit 1.2</li> <li>Point added for new lower threshold (55%)</li> </ul>
Credit 1.2	<b>Building Reuse: Maintain Interior Non-structural Elements</b>	<ul style="list-style-type: none"> <li>Credit no longer available to Core &amp; Shell projects</li> </ul>
Credit 2	<b>Construction Waste Management</b>	-
Credit 3	<b>Materials Reuse</b>	<ul style="list-style-type: none"> <li>Only lower threshold available to Core &amp; Shell projects (5%)</li> </ul>
Credit 4	<b>Recycled Content</b>	<ul style="list-style-type: none"> <li>Point thresholds have been increased (10% and 20%)</li> </ul>
Credit 5	<b>Regional Materials</b>	<ul style="list-style-type: none"> <li>Point thresholds have been increased (20% and 30%)</li> <li>Products must be extracted and processed within 800 km of the manufacturer rather than site</li> <li>Allowance for fractions of products to be used to achieve credit</li> </ul>
Credit 6	<b>Rapidly Renewable Materials</b>	<ul style="list-style-type: none"> <li>Point threshold has been reduced (2.5%)</li> <li>Credit no longer available to Core &amp; Shell projects</li> </ul>
Credit 6/7	<b>Certified Wood</b>	<ul style="list-style-type: none"> <li>Credit 6 for Core &amp; Shell projects</li> <li>No exemption from Chain-of-Custody requirements for last vendor</li> </ul>





## Materials and Resources: Examples



Liu Centre for Asian Studies, UBC

- low energy/durable materials
- re-used large timbers in roof structure
- also low site impact - no destruction of local trees, retained site vegetation
- flyash concrete



# Materials and Resources: Examples



Telus Building,  
Vancouver, BC

- avoided demolition of building
- re-used concrete structure
- energy efficient double skin façade (EA)
- exposed concrete for passive gain (EA)





# Materials and Resources: Examples



C.K. Choi Institute,  
UBC

- re-used brick on exterior
- re-used large timber structures on interior
- composting toilets (WE)
- natural ventilation (IEQ)



# Materials and Resources: Flyash Concrete



York University, Computer Science Building, Toronto

BC Gas, Surrey, BC

Flyash is a waste product from the production of steel that can be used to replace a significant portion of the cement in the concrete mix. Cement is environmentally bad because of its high embodied energy.





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## Indoor Environmental Quality: 22% : 15/70 points

is the largest category with two prerequisites, IAQ performance and environmental tobacco smoke control, eight credits and a total of 15 points. The credits in the indoor environment quality cover many issues of air quality, including ventilation and carbon dioxide monitoring, low-emitting materials, construction IAQ, controllability of systems, operable windows, **thermal comfort** and **daylight and view access**. This category places high emphasis on occupant comfort and well-being – issues that are not addressed in other mandatory code requirements – this category falling outside issues of life safety, structural integrity and minimum energy requirements.

*(Indoor Environmental Quality is not addressed in the Building Code to any extent, so many commercial and institutional buildings ignore this requirement completely)*



**Indoor  
Environment  
Quality**

**15 Possible Points**

Prerequisite 1	Minimum IAQ Performance	Required
Prerequisite 2	Environmental Tobacco Smoke (ETS) Control	Required
Credit 1	Carbon Dioxide (CO <sub>2</sub> ) Monitoring	1
Credit 2	Ventilation Effectiveness	1
Credit 3.1	Construction IAQ Management Plan, During Construction	1
Credit 3.2	Construction IAQ Management Plan, Before Occupancy	1
Credit 4.1	Low-Emitting Materials, Adhesives & Sealants	1
Credit 4.2	Low-Emitting Materials, Paints	1
Credit 4.3	Low-Emitting Materials, Carpet	1
Credit 4.4	Low-Emitting Materials, Composite Wood	1
Credit 5	Indoor Chemical & Pollutant Source Control	1
Credit 6.1	Controllability of Systems, Perimeter	1
Credit 6.2	Controllability of Systems, Non-Perimeter	1
Credit 7.1	Thermal Comfort, Comply with ASHRAE 55-1992	1
Credit 7.2	Thermal Comfort, Permanent Monitoring System	1
Credit 8.1	Daylight & Views, Daylight 75% of Spaces	1
Credit 8.2	Daylight & Views, Views for 90% of Spaces	1





# Indoor Environmental Quality

## INDOOR ENVIRONMENTAL QUALITY

15 POSSIBLE POINTS

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



# Indoor Environmental Quality

Credit		Major Changes
<b>Indoor Environmental Quality</b>		
Prereq 1	<b>Minimum Indoor Air Quality Performance</b>	<ul style="list-style-type: none"> <li>Updated referenced standard to ASHRAE Standard 90.1-2007</li> <li>Residential (Case 2) clarified to include hotels, motels, and dormitories</li> <li>Added language addressing signage in Option 1 and Option 2</li> <li>Added requirement to weatherstrip exterior doors and windows in residential projects</li> </ul>
Prereq 2	<b>Environmental Tobacco Smoke (ETS) Control</b>	<ul style="list-style-type: none"> <li>Added requirement to weatherstrip all residential unit doors leading to common hallways – however, if the common hallways are pressurized with respect to the residential units, an allowance is provided to follow Option 2 (considering the residential unit as the smoking room)</li> <li>Updated referenced standard for demonstrating acceptable sealing of residential units to Chapter 4 (Compliance Through Quality Construction) of the Residential Manual for Compliance with California’s 2001 Energy Efficiency Standards</li> </ul>
Credit 1	<b>Outdoor Air Delivery Monitoring</b>	<ul style="list-style-type: none"> <li>Updated referenced standard to ASHRAE Standard 62.1-2007</li> <li>Clarified requirement to monitor CO<sub>2</sub> concentrations in all densely occupied areas (Case 1 - Mechanically Ventilated Spaces)</li> <li>Added requirement for outdoor airflow measurement (Case 1 - Mechanically Ventilated Spaces)</li> <li>Added specific requirements for naturally ventilated spaces (Case 2 - Naturally Ventilated Spaces)</li> </ul>
Credit 2	<b>Increased Ventilation</b>	<ul style="list-style-type: none"> <li>Credit has been changed from ventilation effectiveness to requiring outdoor air ventilation rates 30% above minimum rates required by ASHRAE Standard 62.1-2007</li> <li>Naturally ventilated spaces may alternatively meet the recommendations of the CIBSE Applications Manual</li> <li>Specific compliance path (Case 3) for residential projects requiring outdoor air ducted directly to the suite with air distributed to all regularly occupied areas</li> </ul>



# Indoor Environmental Quality

Credit	Major Changes
<b>Indoor Environmental Quality</b>	
Credit 3.1 <b>Construction Indoor Air Quality Management Plan During Construction</b>	<ul style="list-style-type: none"> <li>Updated referenced standard to the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines For Occupied Buildings Under Construction, 2nd Edition 2007, ANSI/SMACNA 008-2008 (Chapter 3)</li> <li>Clarified that filtration media must be replaced immediately prior to occupancy</li> <li>Removed requirement to make provisions for inspections of building HVAC systems</li> </ul>
Credit 3.2 <b>Construction Indoor Air Quality Management Plan Before Occupancy</b>	<ul style="list-style-type: none"> <li>Clarified the IAQ Management Plan implementation timeline requirements</li> <li>Clarified that all finishes must be installed prior to flush-out</li> <li>Flush-out during occupancy ventilation rate has been increased from 0.76 to 1.54 L/s/m<sup>2</sup></li> <li>Threshold for formaldehyde level was revised from 50 to 27 parts per billion in Option 2, Air Testing</li> </ul>
Credit 4.1 <b>Low-Emitting Materials: Adhesives and Sealants</b>	<ul style="list-style-type: none"> <li>Clarification on use of VOC budget</li> <li>Clarification on interior of the building</li> <li>VOC thresholds no longer updated to match date of building permit but set as per rating system requirements</li> </ul>
Credit 4.2 <b>Low-Emitting Materials: Paints and Coatings</b>	<ul style="list-style-type: none"> <li>As per IEQ Credit 4.1</li> <li>Moved primers from Green Seal requirements to SCAQMD requirements</li> </ul>
Credit 4.3 <b>Low-Emitting Materials: Flooring Systems</b>	<ul style="list-style-type: none"> <li>Requirements now reflect all low-emitting flooring materials and finishes</li> <li>All flooring must comply with a minor exemption of up to 5% for speciality areas</li> </ul>
Credit 4.4 <b>Low-Emitting Materials: Composite Wood and Agrifibre Products</b>	-





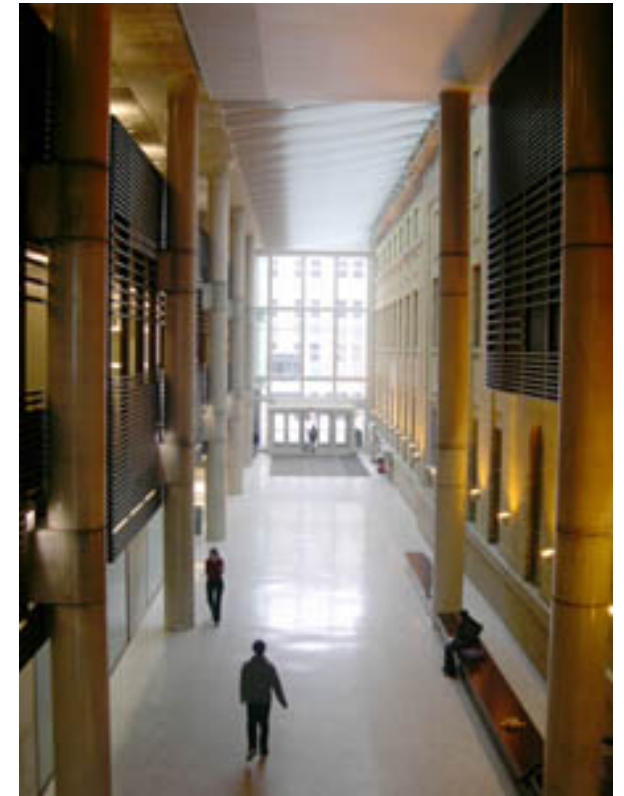
# Indoor Environmental Quality

Credit	Major Changes
<b>Indoor Environmental Quality</b>	
Credit 5 <b>Indoor Chemical and Pollutant Source Control</b>	<ul style="list-style-type: none"> <li>• Required entryway system travel distance length increased and systems are required at regular entry points</li> <li>• Combinations of permanently installed systems along with walk-off mats with provisions for maintenance are allowed</li> <li>• Added exemption for new air filtration media for air handling equipment with a maximum flow rate of 283 L/s (600 cfm) or less provided they are equipped with the highest supply air filtration level commercially available for the specific equipment</li> <li>• For residential projects, carbon monoxide alarms are required in areas adjacent to combustion equipment</li> </ul>
Credit 6.1 <b>Controllability of System: Lighting</b>	<ul style="list-style-type: none"> <li>• Re-structured credit from perimeter spaces to lighting control</li> <li>• Credit not available to Core &amp; Shell projects</li> </ul>
Credit 6.2 <b>Controllability of System: Thermal Comfort</b>	<ul style="list-style-type: none"> <li>• Re-structured credit from non-perimeter spaces to thermal comfort control</li> <li>• Clarification of requirements for use of operable windows</li> <li>• Thermal comfort controls as described by ASHRAE Standard 55-2004</li> <li>• Clarification on scope for Core &amp; Shell projects</li> </ul>
Credit 7.1 <b>Thermal Comfort: Design</b>	<ul style="list-style-type: none"> <li>• Increased demonstration of compliance with ASHRAE 55-2004 -now required.</li> </ul>
Credit 7.2 <b>Thermal Comfort: Verification</b>	<ul style="list-style-type: none"> <li>• An occupant thermal comfort survey is required</li> <li>• An alternative compliance path was added for residential buildings</li> <li>• Credit no longer available to Core &amp; Shell projects</li> </ul>
Credit 8.1 <b>Daylight and Views: Daylight</b>	<ul style="list-style-type: none"> <li>• Multiple options now available – simulation, prescriptive, measurement or combination</li> </ul>
Credit 8.2 <b>Daylight and Views: Views</b>	-



# Indoor Environmental Quality: Examples

Bahen Centre, UofT



- daylighting





# Indoor Environmental Quality: Examples



Jackson-Triggs Estate Winery,  
Niagara-on-the-Lake, Ontario



- daylighting





# Indoor Environmental Quality: Daylighting and Views



Richmond City Hall,  
Richmond, BC



Mountain Equipment  
Coop, Ottawa



Information  
Technology Building,  
UofO, Ottawa





# LEED

Build green. Everyone profits.

U.S. GREEN BUILDING COUNCIL

## Innovation and Design Process: 7% : 5/70 points

allows a building to obtain as many as four design innovation points, as well as one additional point for including a LEED accredited professional in the design process. The design innovation points may be awarded for achievements such as lifecycle analysis, community development or education of occupants. Substantially exceeding one of the earlier credits, may also merit an innovation point.



## **Innovation & Design**

### **Process**

### **5 Possible Points**

Credit 1.1	Innovation in design	1
Credit 1.2	Innovation in design	1
Credit 1.3	Innovation in design	1
Credit 1.4	Innovation in design	1
Credit 2	LEED™ Accredited Professional	1

This is likely the trickiest set of credits to get... and the ones that involve the greatest commitment of effort (aside from Credit 2 which is a no-brainer!)



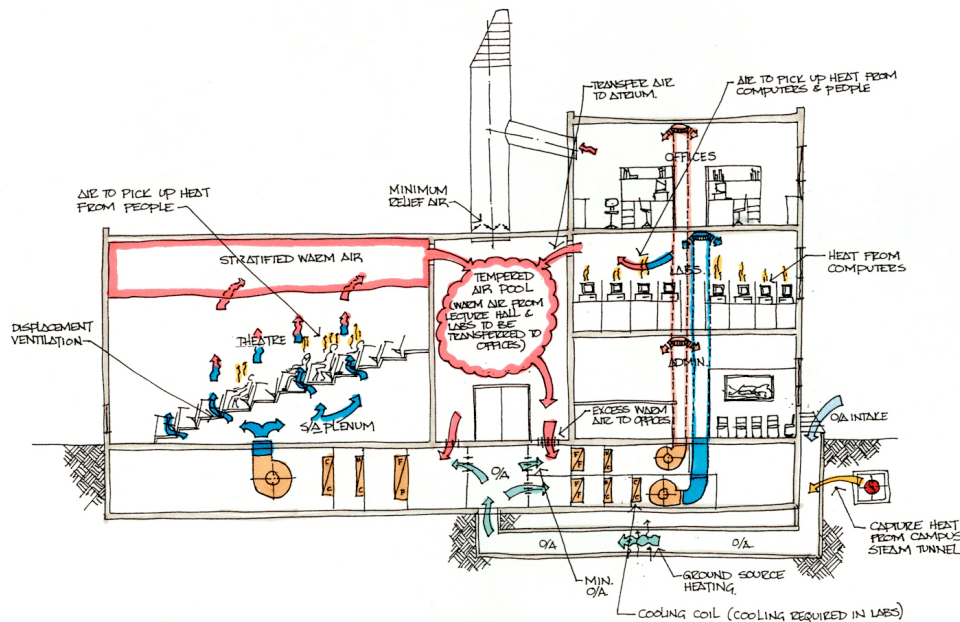


# Innovation and Design Process: Examples

**YORK UNIVERSITY**

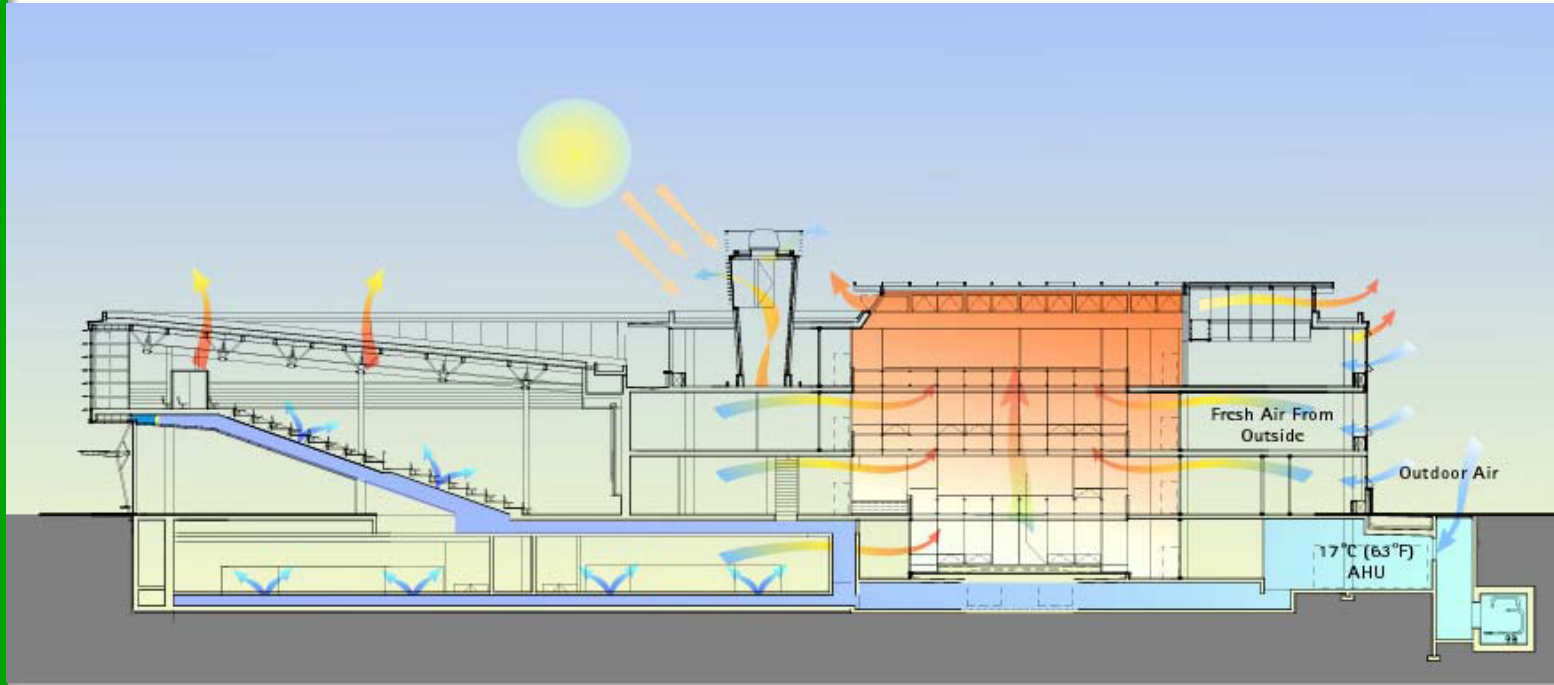
WINTER MODE

**keen**

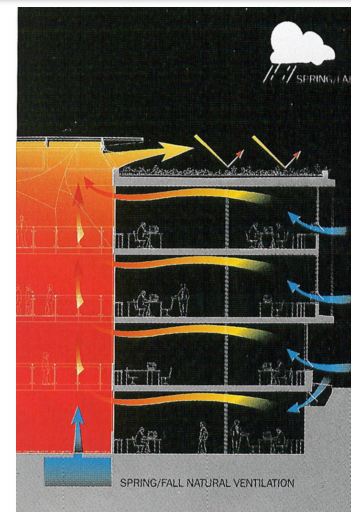


York University Computer Science Building: A critical part of the success of this project was the involvement of the ENTIRE design team from the outset of the project. Working with the mechanical engineer allowed the Architects to lay out the building to properly zone the uses so to have heat generating process on the cool side of the building, etc.





The realization of the shape of the building and the relationships between the spaces was not remarkably dissimilar from the early IDP sketches generated by the team.



# Innovation in Design + Regional Priority

## INNOVATION IN DESIGN

6 POSSIBLE POINTS

- |                          |          |                               |     |
|--------------------------|----------|-------------------------------|-----|
| <input type="checkbox"/> | Credit 1 | Innovation in Design          | 1-5 |
| <input type="checkbox"/> | Credit 2 | LEED® Accredited Professional | 1   |

## REGIONAL PRIORITY

4 POSSIBLE POINTS

- |                          |          |                          |     |
|--------------------------|----------|--------------------------|-----|
| <input type="checkbox"/> | Credit 1 | Durable Building         | 1   |
| <input type="checkbox"/> | Credit 2 | Regional Priority Credit | 1-3 |



# Innovation in Design

	Credit	Major Changes
<b>Innovation in Design</b>		
Credit 1	<b>Innovation in Design</b>	<ul style="list-style-type: none"><li>• Expanded innovation strategies allowed from 4 to 5</li><li>• Added stipulation that no more than 3 exemplary performance points can be awarded</li></ul>
Credit 2	<b>LEED® Accredited Professional</b>	-



# Regional Priority

Credit		Major Changes
<b>Regional Priority</b>		
Credit 1	<b>Durable Building</b>	<ul style="list-style-type: none"><li>• Formerly MR Credit 8 in LEED Canada NC v1.0</li></ul>
Credit 2	<b>Regional Priority Credit</b>	<ul style="list-style-type: none"><li>• New to LEED 2009</li></ul>



# LEED-NC<sup>®</sup> Certification Process

A three step process:

- Step 1: Project Registration
  - LEED Letter Templates, CIR access, and on-line project listing
- Step 2: Technical Support
  - Reference Package
  - Credit Inquiries and Rulings (CIR)
- Step 3: Building Certification
  - Upon documentation submittal and USGBC review





# Cost of LEED Certified Buildings

Figure III-1. Level of Green Standard and Average Green Cost Premium

Level of Green Standard	Average Green Cost Premium
Level 1 – Certified	0.66%
Level 2 – Silver	2.11%
Level 3 – Gold	1.82%
Level 4 – Platinum	6.50%
Average of 33 Buildings	1.84%

Source: USGBC, Capital E Analysis



## Cost of LEED Certified Buildings

- Average cost for for a green building is around 2% cost premium, which is \$3-5/s.f.
- The financial benefits of green design run from \$50 (Certified & Silver) to \$75 (Gold & Platinum) per s.f. in a LEED™ building – more than 10 times the additional cost associated with building green up to LEED™ Gold level makes financial sense today sustainable buildings are a cost-effective investment.

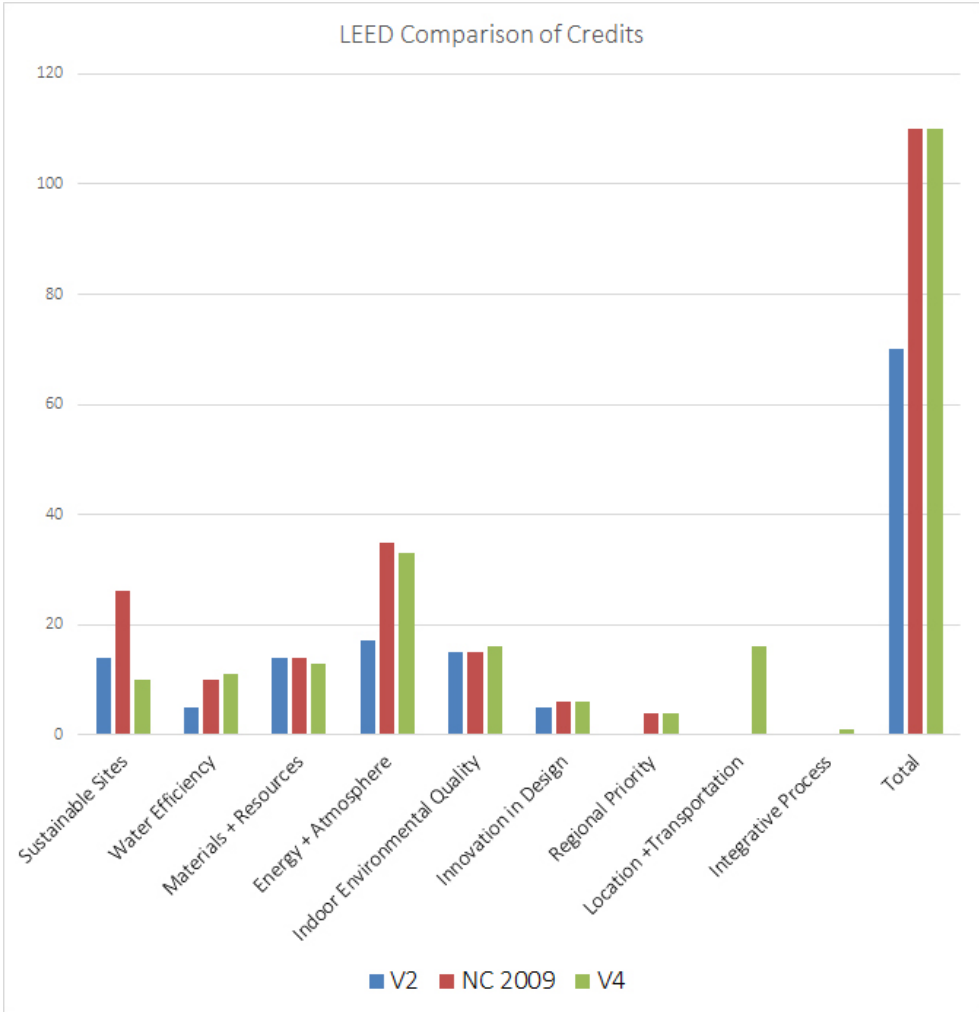


## LEED Canada-NC 1.0 Changes from USGBC LEED 2.1: Highlights of Major Changes

- Substitution of applicable base Canadian codes, standards, regulations where possible
- Some increases in performance targets
- Clearer definitions of requirements
- Added flexibility in many credits
- One new additional credit, Durability, exclusive to Canada



# The changing face of LEED



# V4 Location (brand new category)



## **LOCATION & TRANSPORTATION**

**POSSIBLE: 16**

Credit	LEED for Neighborhood Development location	16
Credit	Sensitive land protection	1
Credit	High priority site	2
Credit	Surrounding density and diverse uses	5
Credit	Access to quality transit	5
Credit	Bicycle facilities	1
Credit	Reduced parking footprint	1
Credit	Green vehicles	1

# V4 Sustainable Sites



## **SUSTAINABLE SITES**

**POSSIBLE: 10**

		<b>REQUIRED</b>
Prereq	Construction activity pollution prevention	
Credit	Site assessment	1
Credit	Site development - protect or restore habitat	2
Credit	Open space	1
Credit	Rainwater management	3
Credit	Heat island reduction	2
Credit	Light pollution reduction	1



# V4 Water Efficiency



## WATER EFFICIENCY

**POSSIBLE: 11**

Prereq	Outdoor water use reduction	REQUIRED
Prereq	Indoor water use reduction	REQUIRED
Prereq	Building-level water metering	REQUIRED
Credit	Outdoor water use reduction	2
Credit	Indoor water use reduction	6
Credit	Cooling tower water use	2
Credit	Water metering	1

# V4 Materials and Resources



## **MATERIAL & RESOURCES**

**POSSIBLE: 13**

Prereq	Storage and collection of recyclables	REQUIRED
Prereq	Construction and demolition waste management planning	REQUIRED
Credit	Building life-cycle impact reduction	5
Credit	Building product disclosure and optimization - environmental product declarations	2
Credit	Building product disclosure and optimization - sourcing of raw materials	2
Credit	Building product disclosure and optimization - material ingredients	2
Credit	Construction and demolition waste management	2

# V4 Energy and Atmosphere



## ENERGY & ATMOSPHERE

**POSSIBLE: 33**

Prereq	Fundamental commissioning and verification	REQUIRED
Prereq	Minimum energy performance	REQUIRED
Prereq	Building-level energy metering	REQUIRED
Prereq	Fundamental refrigerant management	REQUIRED
Credit	Enhanced commissioning	6
Credit	Optimize energy performance	18
Credit	Advanced energy metering	1
Credit	Demand response	2
Credit	Renewable energy production	3
Credit	Enhanced refrigerant management	1
Credit	Green power and carbon offsets	2

# V4 Indoor Environmental Quality



## INDOOR ENVIRONMENTAL QUALITY

**POSSIBLE: 16**

Prereq	Minimum IAQ performance	REQUIRED
Prereq	Environmental tobacco smoke control	REQUIRED
Credit	Enhanced IAQ strategies	2
Credit	Low-emitting materials	3
Credit	Construction IAQ management plan	1
Credit	IAQ assessment	2
Credit	Thermal comfort	1
Credit	Interior lighting	2
Credit	Daylight	3
Credit	Quality views	1
Credit	Acoustic performance	1

# V4 Innovation, Regional Priority, Totals



## **INNOVATION**

**POSSIBLE: 6**

Credit	Innovation	5
Credit	LEED Accredited Professional	1



## **REGIONAL PRIORITY**

**POSSIBLE: 4**

Credit	Regional priority	4
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## **TOTAL**

**110**

40-49 Points  
CERTIFIED

50-59 Points  
SILVER

60-79 Points  
GOLD

80+ Points  
PLATINUM

## LEED V4

- <http://www.usgbc.org/credits>



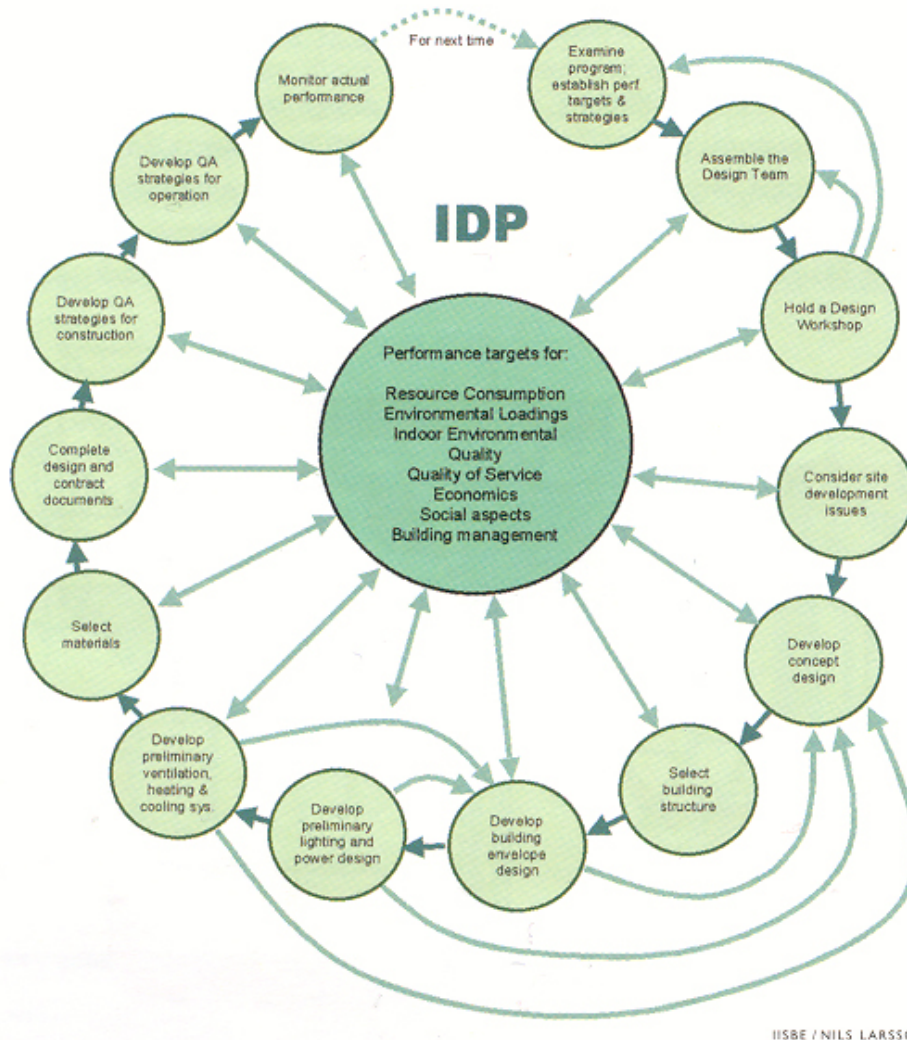
## Integrated Design Process (IDP)

Conventional Design Process: the architect (or designer) and the client agree on a design concept consisting of a general massing scheme, orientation, fenestration and the general exterior appearance of the building. Then the mechanical, electrical and structural engineers are asked to implement the design and to suggest appropriate systems.

The problem with conventional practice is that this design process is too quick and simple, often resulting in high operating costs, poor comfort performance and very few sustainable gestures that fall within the client's restrained budget.

This is often a surprise to the owners, operators and users, since the conventional design process usually does not involve computer simulations of predicted energy performance and cost. In fact, engineers have little or no enthusiasm in this context as their role is limited to applying code requirements, cost-benefit analysis and, at times, satisfying the whimsical desires of traditional designers.

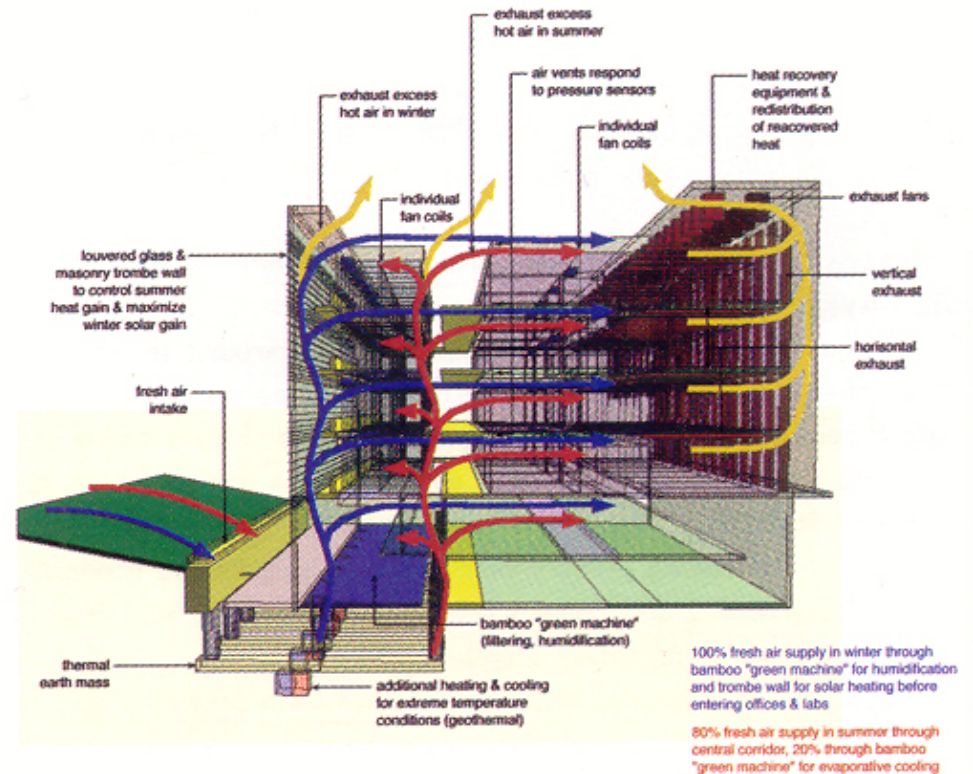
# Integrated Design Process (IDP)



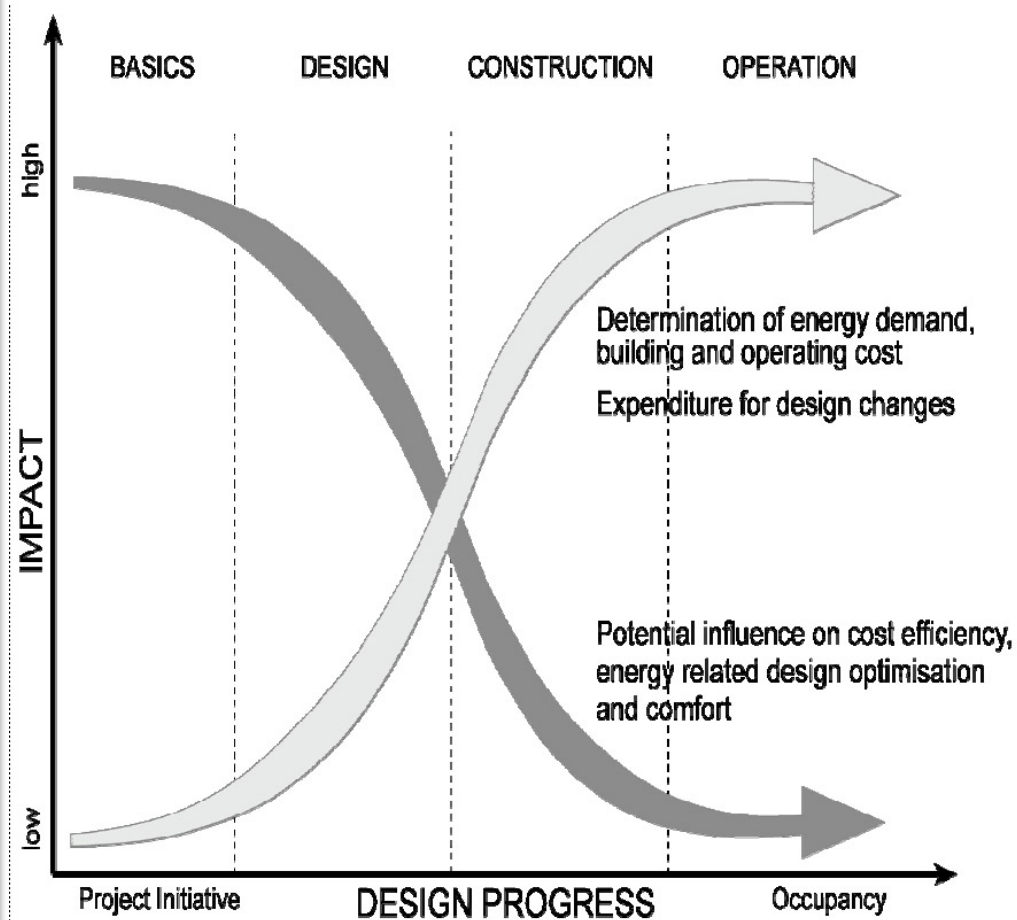
In professional practice, IDP has a significant impact on the makeup and role-playing of the initial design team. The client takes a more active role than usual, the architect becomes a team leader rather than the sole form-giver, and the structural, mechanical and electrical engineers take on active roles at early design stages. The team includes an energy specialist (simulator) and hopefully, a bio-climatic engineer.

# Integrated Design Process (IDP)

IDP is not a mechanized design approach that stunts creative iterations; in fact it can help evaluate the potential of numerous schematic design approaches with corresponding bio-climatic strategies at the earliest design stage possible. More specifically, it is the realization that more than 80% of the poetic, economic and ecological potential of a design approach is defined at the earliest stage, and thus it is crucial to have as much input from as wide a cross section of disciplines as possible, involved even at the most embryonic design stage.



# Integrated Design Process (IDP)



It is generally accepted that the impact of decisions varies inversely with the time in the process the decision is made, while the direct cost of such decisions vary directly with time. In other words, early decisions are usually cheap and have a major impact on the ultimate performance of the building, while later changes are expensive and have little hope of improving performance .