Quantifying Sustainable Design: Introduction to LEED ™

The many versions of LEED

- LEED is constantly coming out with new, updated versions
- For your sustainability case study essay you need to determine which version it was designed to meet
- The first versions were US only. Canadian came out later and included Canadian code information and regulations
- The number of credits and pre-requisites varies
  - USGBC version 1
  - USGBC version 2
  - CaGBC early versions
  - USGBC 2009
  - LEED Version 4

The Primary Objectives of LEED are:

Energy

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

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

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.

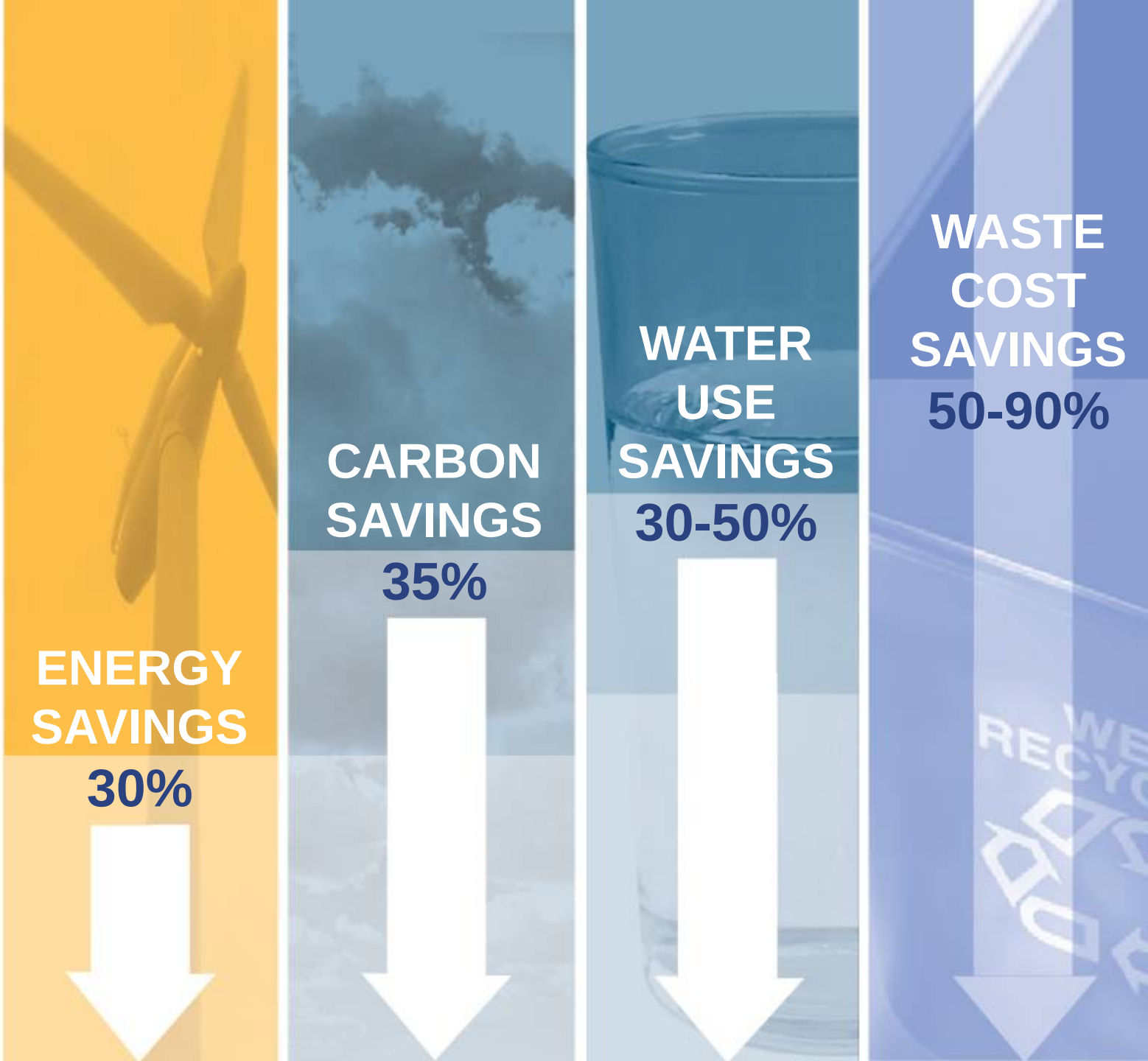
Implementation

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

Economic Benefits - The Soft Numbers

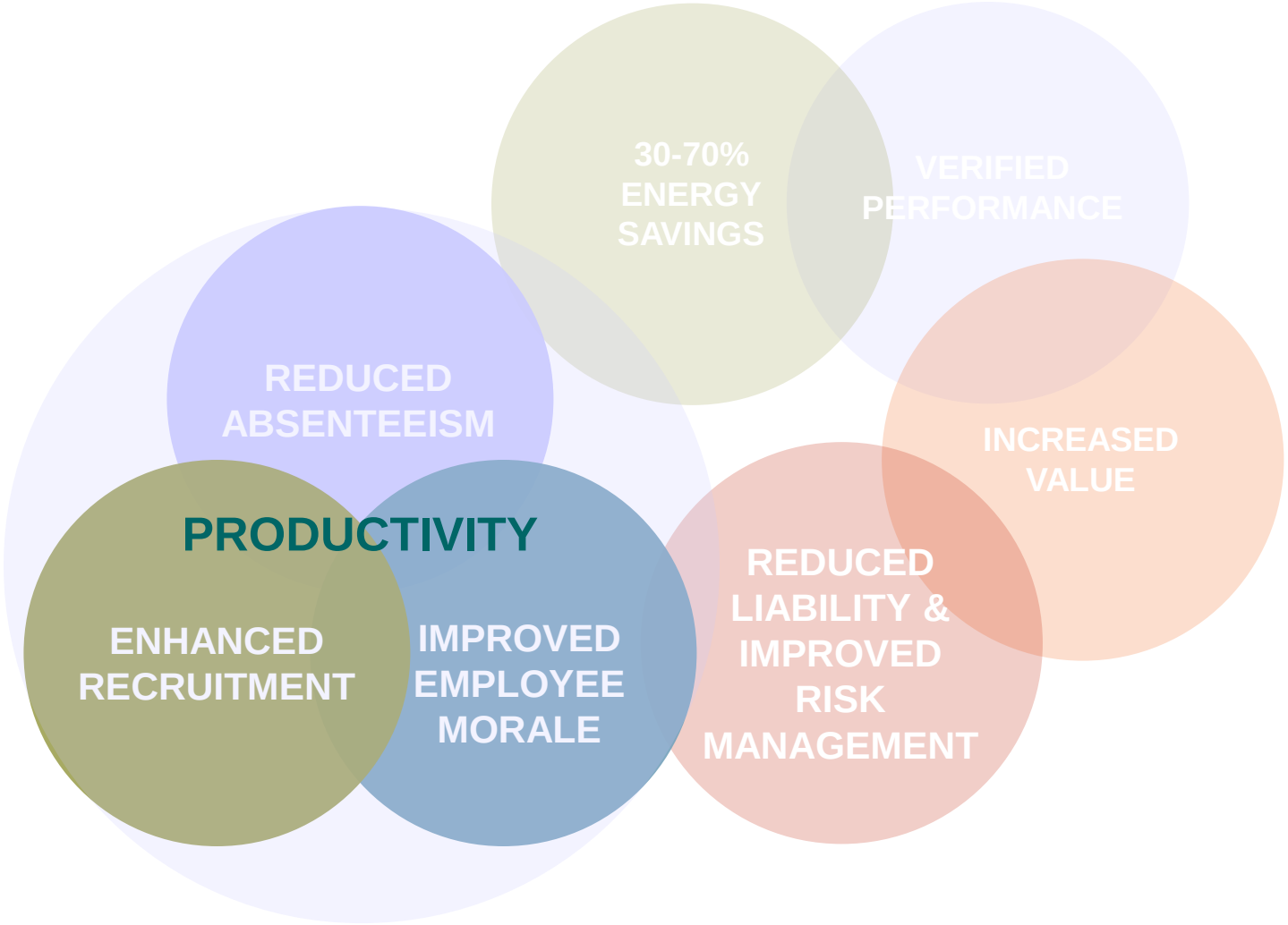
- Reduce liability
  - Improve risk management
- Increase retail sales with daylighting
  - Studies have shown ~40% improvement[2]
- Impact on Schools and Education
- Improve productivity
  - Estimated $29 –168 billion in national productivity losses per year
- Reduce absenteeism and turnover
  - Providing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

Average Savings of Green Buildings

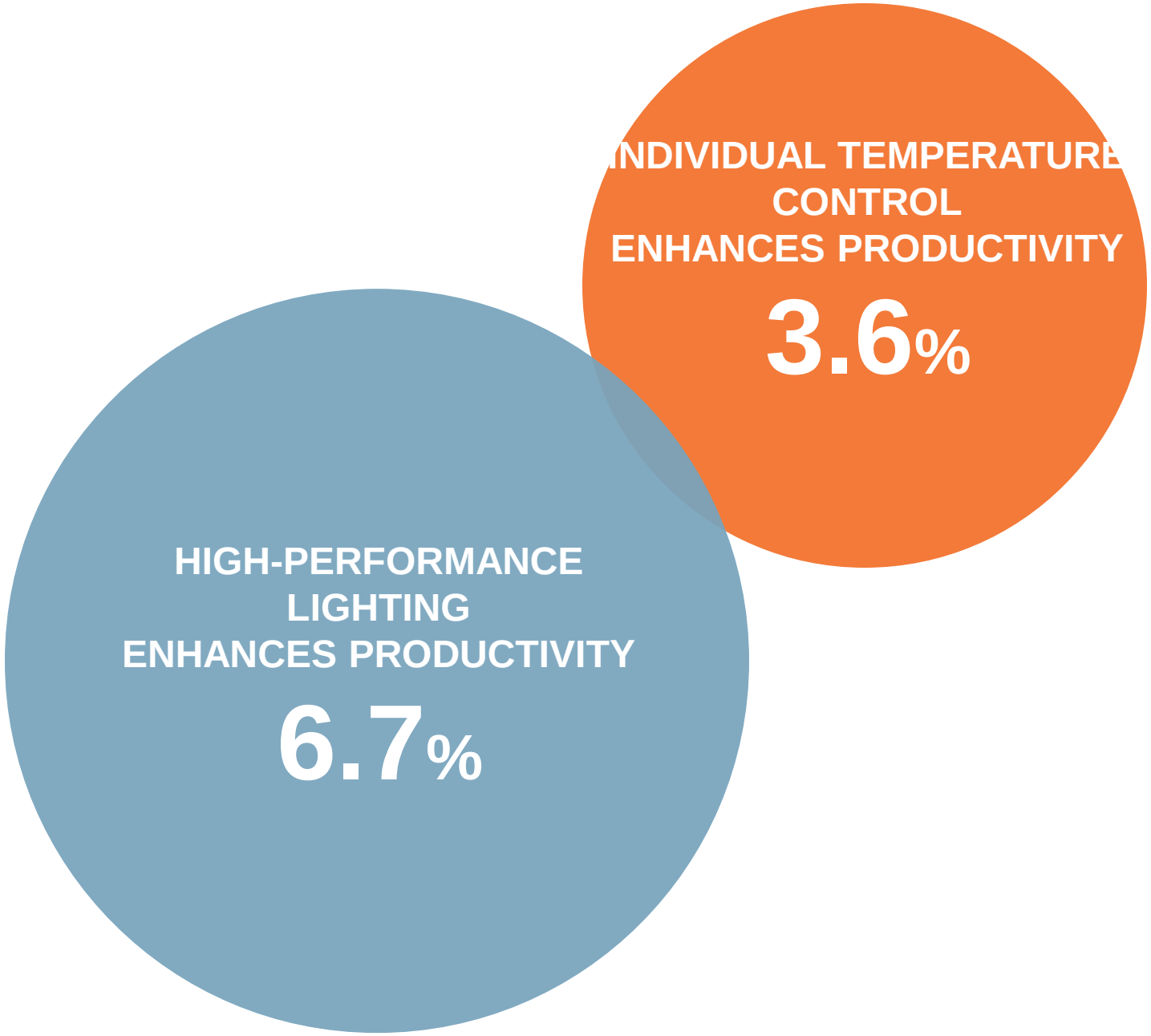


Source:
Capital E

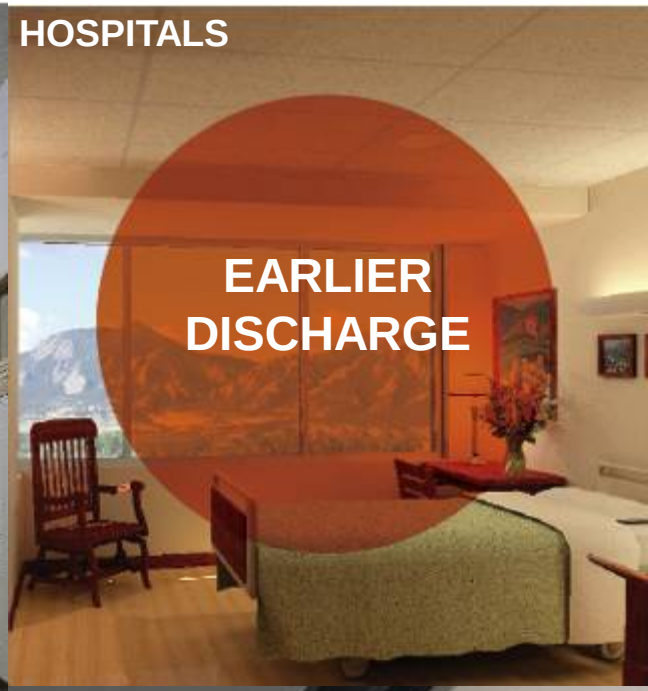
Improved Bottom Line.

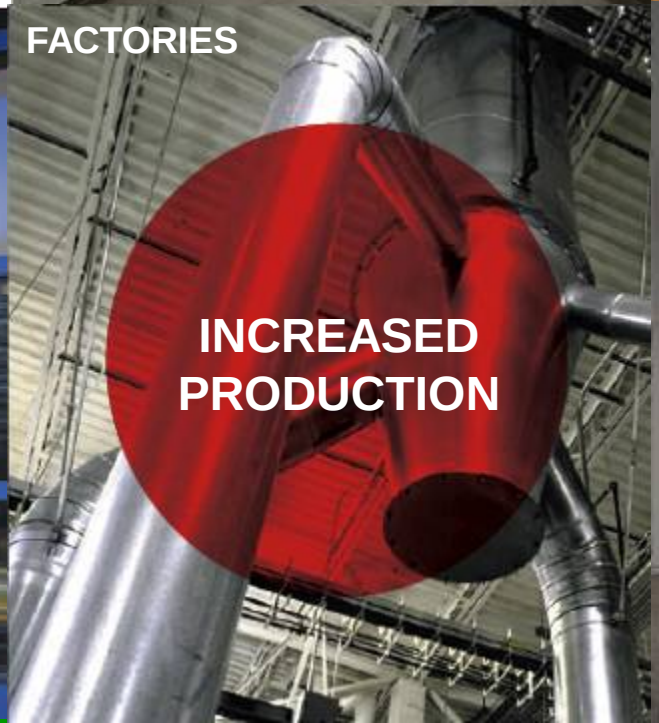


Average Productivity Gains

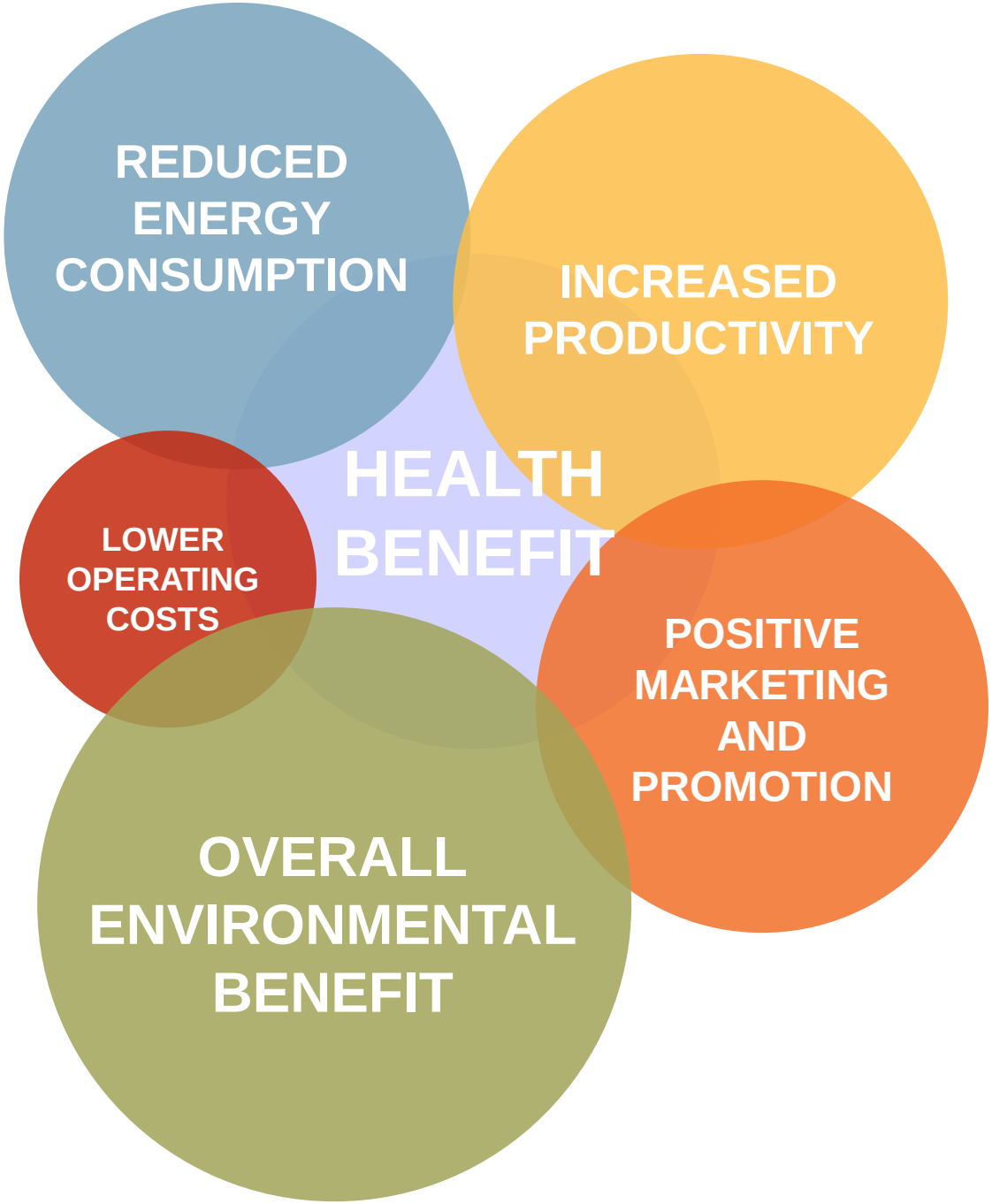


Increased Productivity.





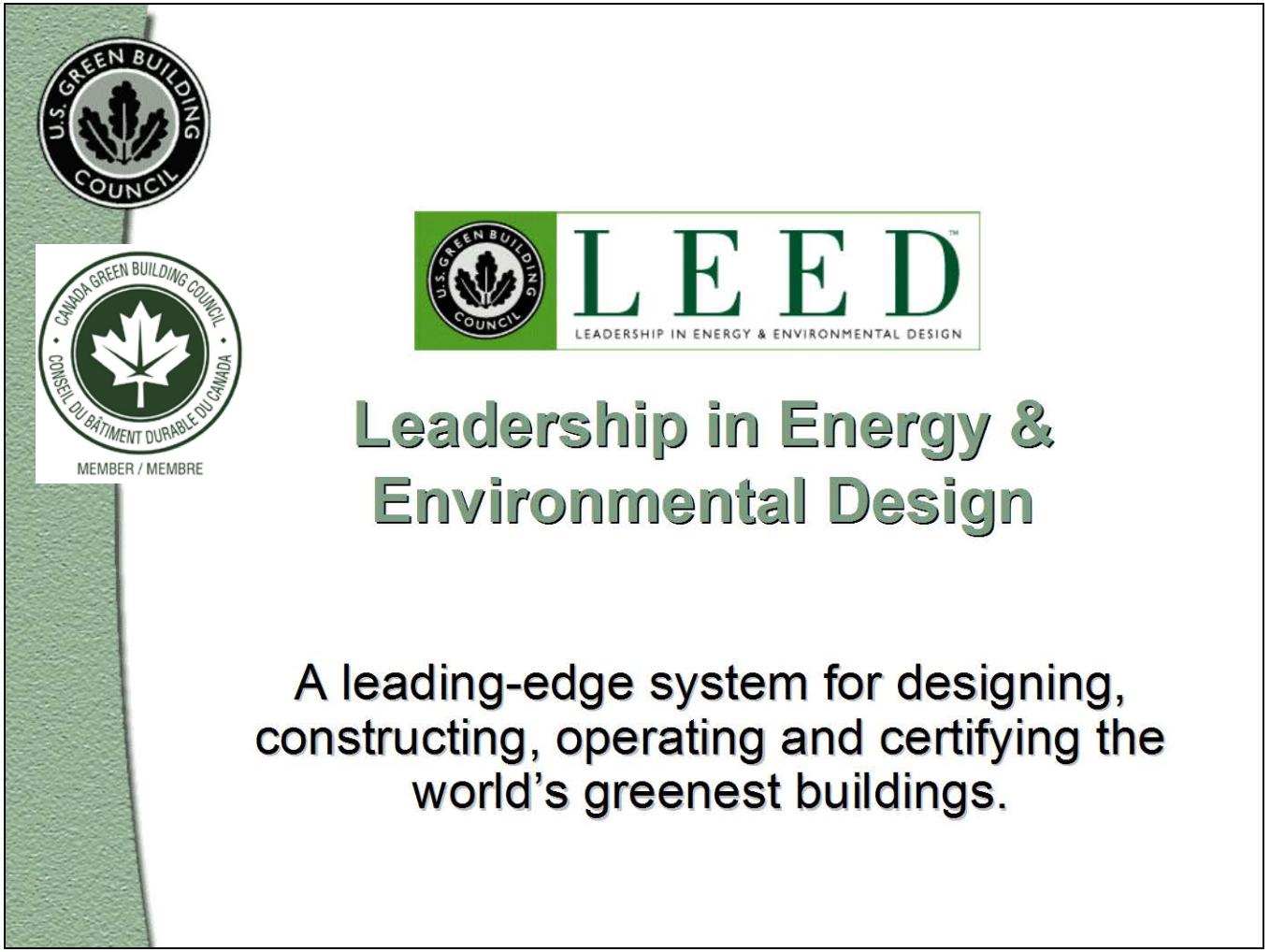
Occupants and tenants perceive value of working in a green building to be:



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”.

Leadership in **E**nergy and **E**nvironmental **D**esign:



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!

What is the LEED System?

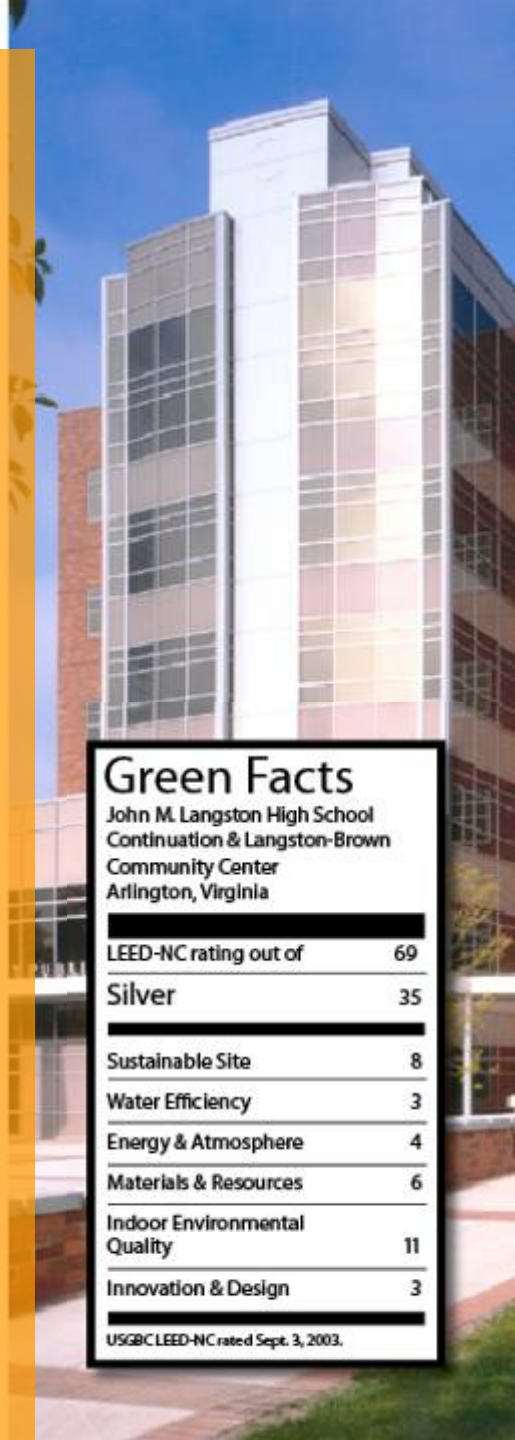
LEADERSHIP in ENERGY and ENVIRONMENTAL DESIGN

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



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

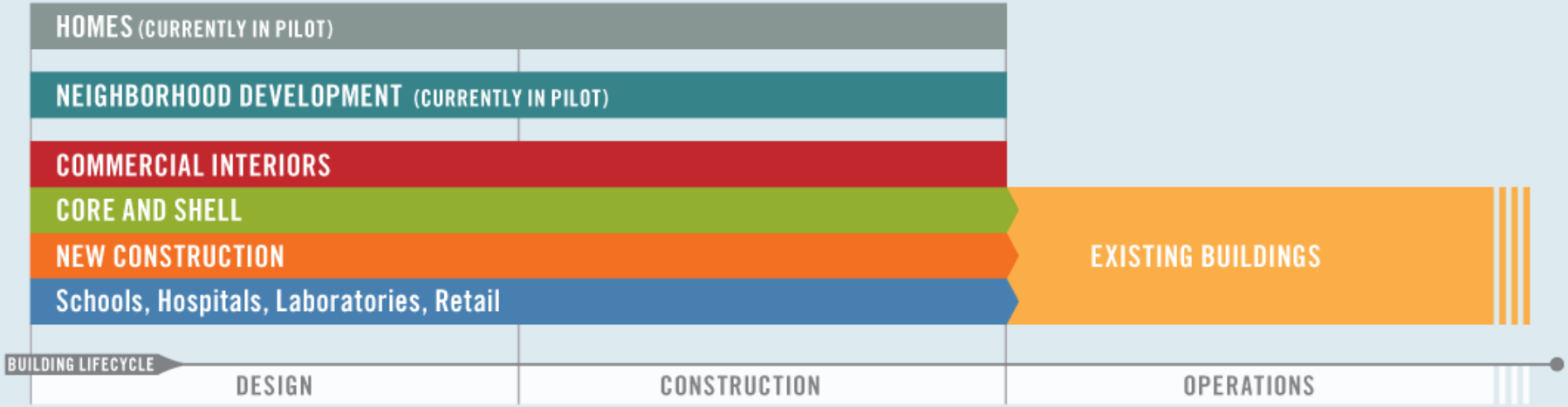
- If we can't quantify, we can't compare.
- If we don't know how green it is, we can't really sell the idea convincingly to clients or the public.
- If we don't know how much environmental saving results, then we are just producing "soft" products that may or may not have any real value. If we don't 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

LEED Building variations recognized

- First versions of LEED were only really valid for commercial or institutional buildings and New Construction
- Over the years both Canada and the US have developed systems that have been tuned to suit a variety of building types.
- When looking at your case study, be sure to understand your building type and check to see exactly which system it was designed to meet

LEED addresses the complete lifecycle of commercial buildings.

Programs are in pilot for Homes and Neighborhoods.



USGBC LEED Rating Systems 2015

- 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)
- LEED Version 4

CaGBC LEED Rating Systems 2015

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

LEED

- Going Green with LEED
- Green Homes
- Commercial Green Buildings
  - Owners and Property Managers
  - Tenants and Employees
  - Certification Process
  - Rating Systems
  - Project Fees
  - Submit a CIR
  - View CIRs
  - Technical bulletins
- Register a Project
- My Projects
- Project Profiles
- Marketing Your Project
- LEED v4

Building Performance

Smart Growth

Living Building Challenge

Home/Accueil → Programs → LEED → Commercial Green Buildings

Commercial Green Buildings

Register a Project Now »

- Owners and property managers »
- Tenants and Employees »

- Certification Process »
- Project Fees »
- Rating Systems Overview »
- New Construction »
- Core and Shell »
- Commercial Interiors »
- Existing Buildings »
- Neighbourhoods »

- Submit a CIR »
- View CIRs »
- Technical bulletins »

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**

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.

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:

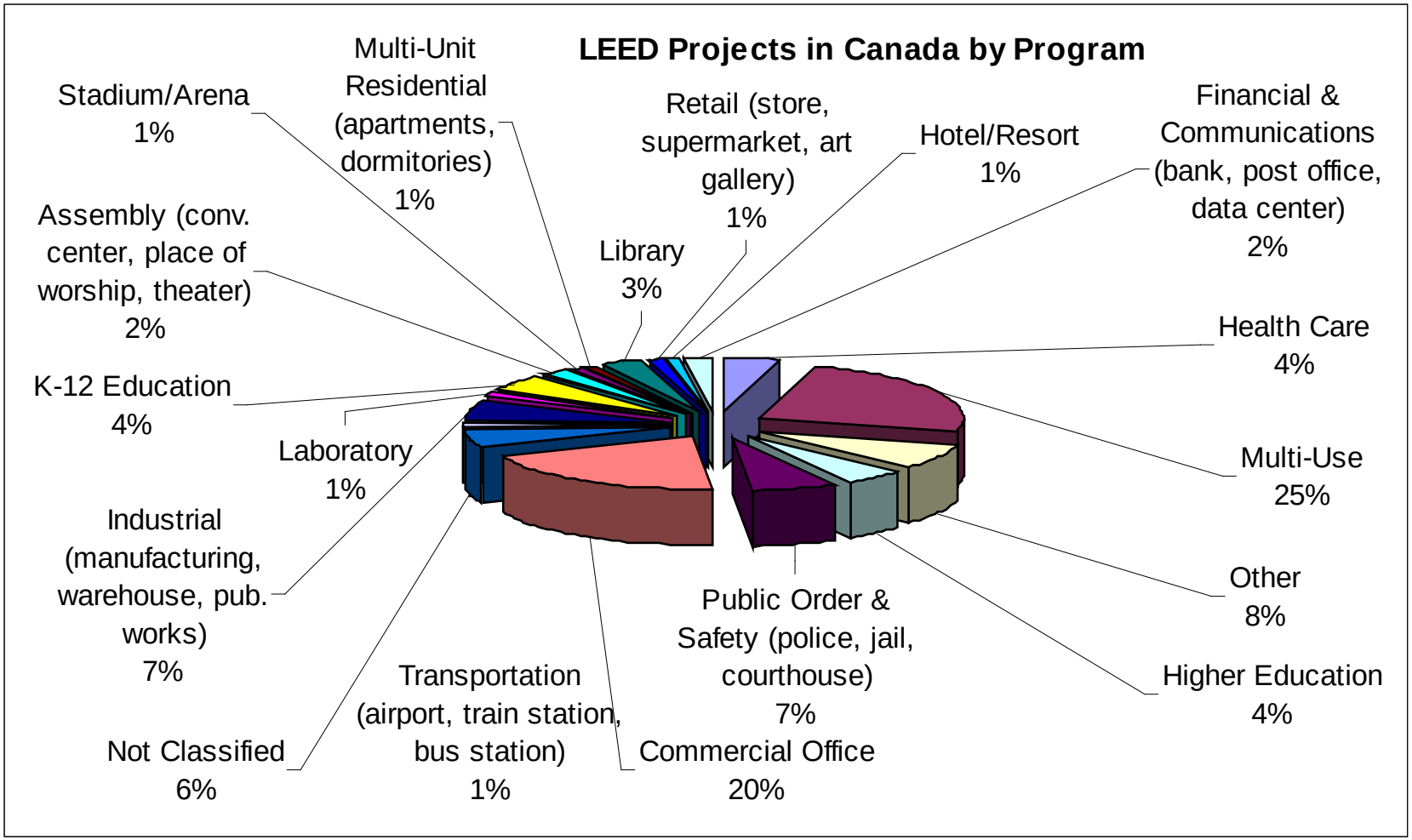
- low-rise (1-3 stories) *residential* buildings. The LEED for Homes Multi-Family Midrise rating system, located on the LEED for Homes page within usgbc.org, is appropriate for mid-rise (4-6 stories) *residential* buildings.

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

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 Projects in Canada by Program Type



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

This is based on LEED 1.0 for Canada

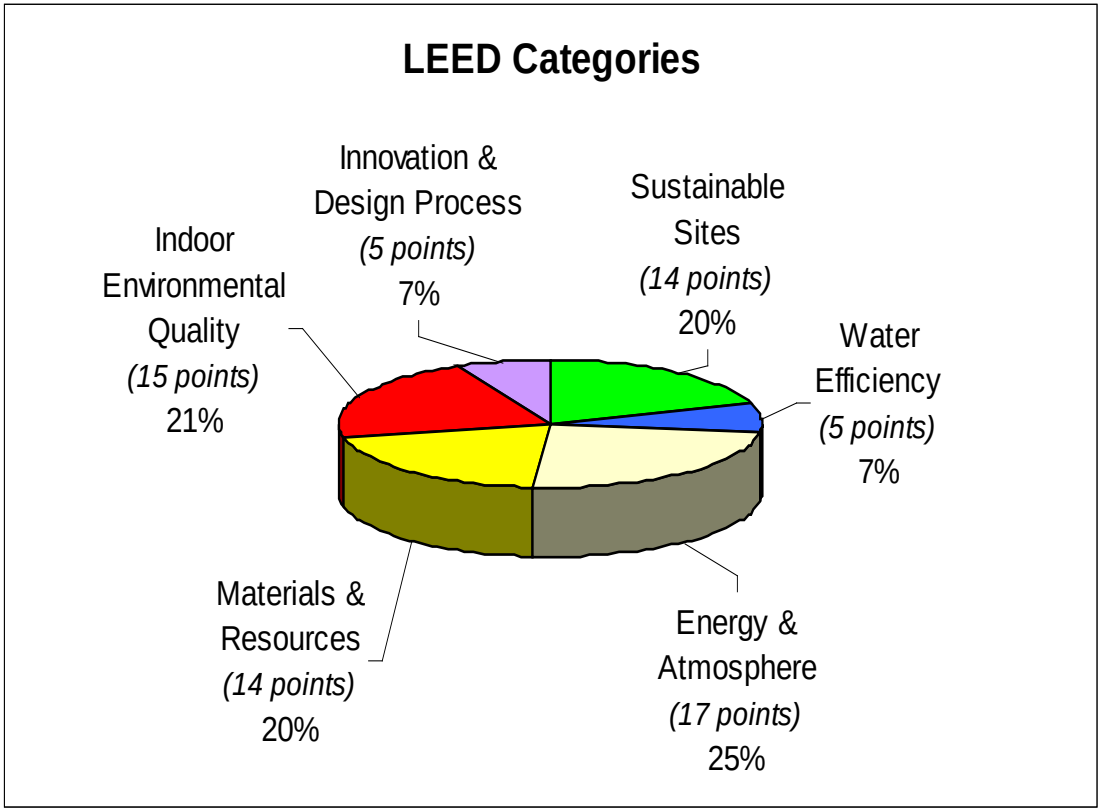


Chart based on LEED Canada 70 points

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.

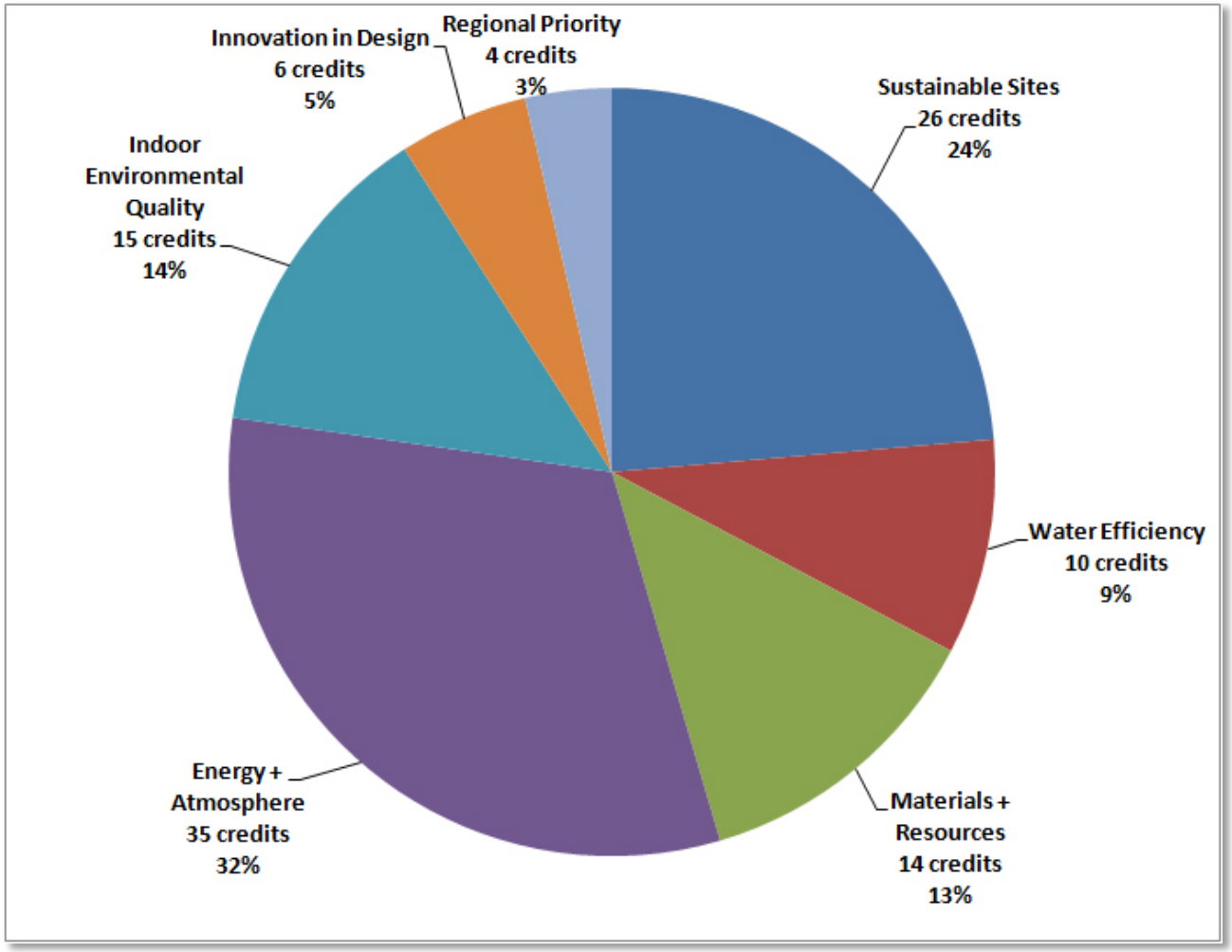
Pre-requisite credits:

- 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

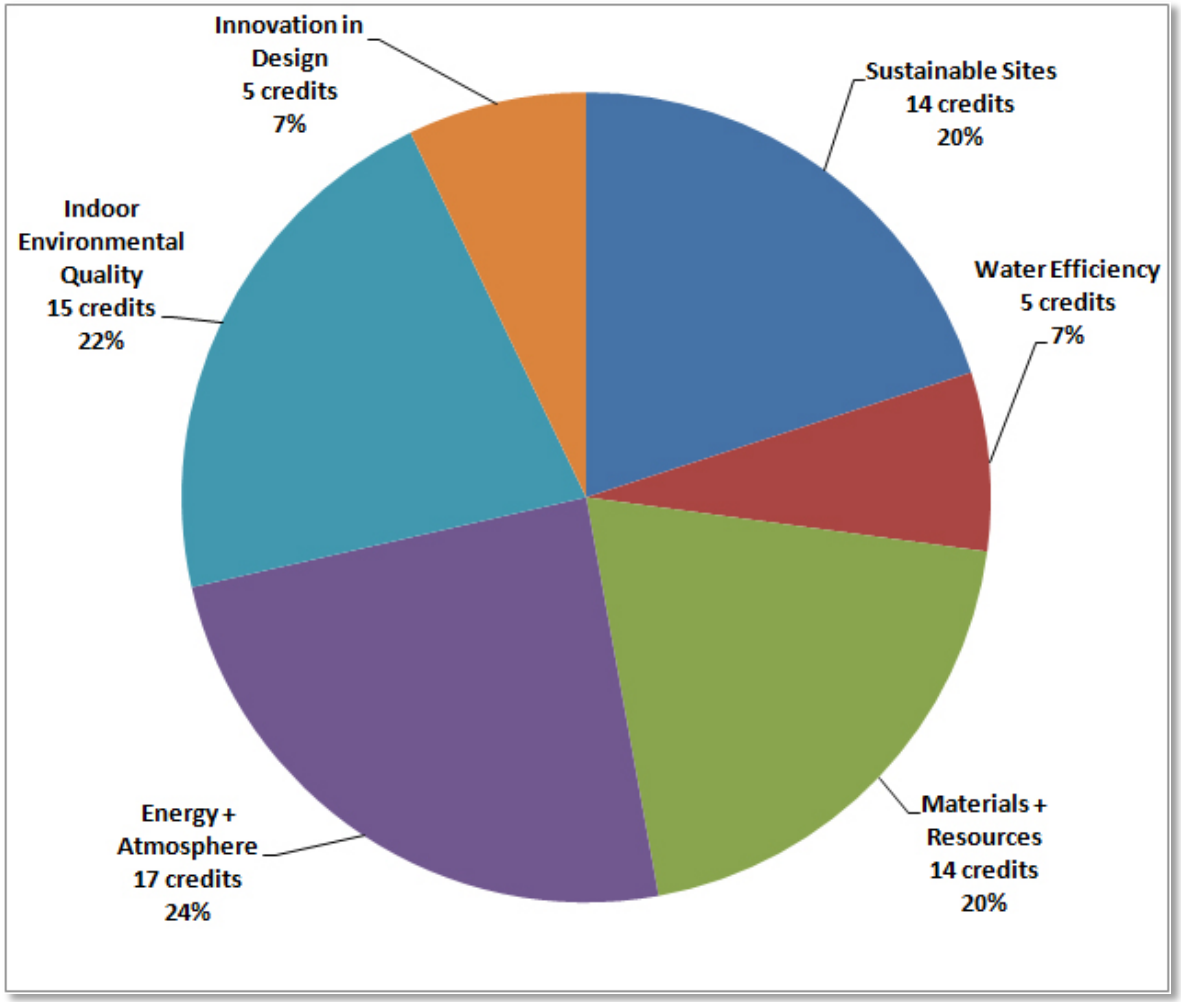
LEED 2009

- **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)

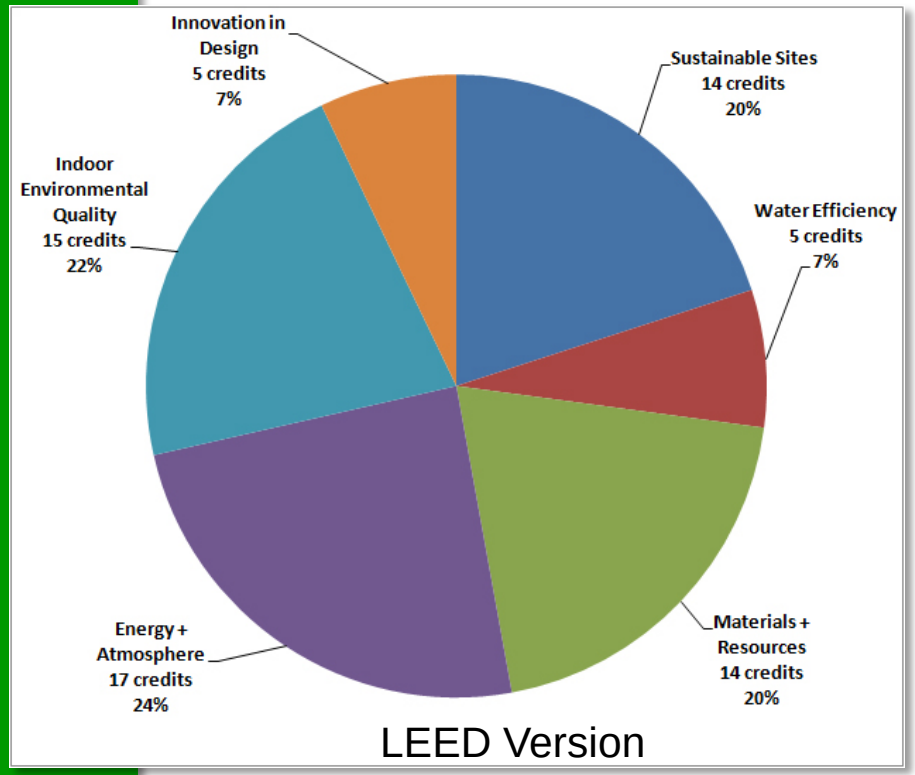
LEED 2009 Credit Distribution



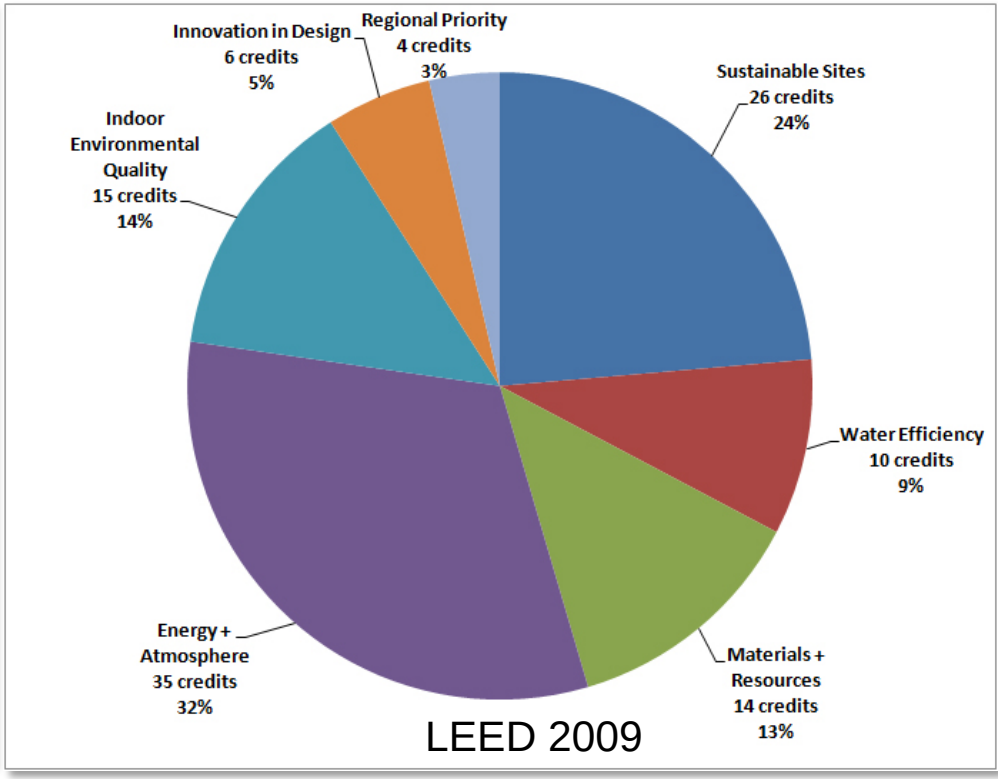
LEED NC Credit Distribution



LEED V1 and LEED 2009 Credit Comparison



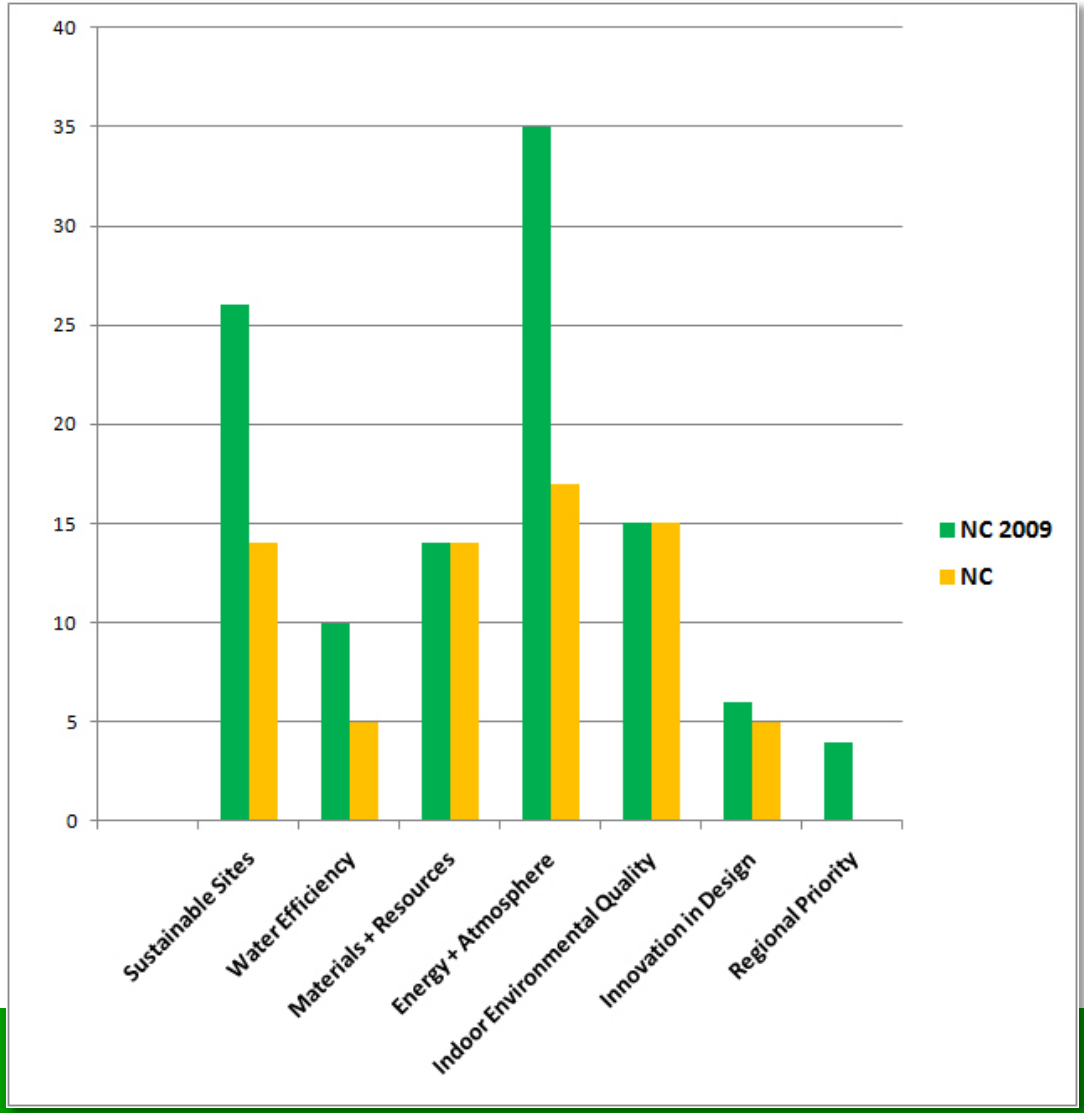
LEED Version 1



LEED 2009

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

CERTIFIED	40-49 points
SILVER	50-59 points
GOLD	60-70 points
PLATINUM	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.

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

Sustainable Sites

Credit		Major Changes
Sustainable Sites		
Prereq 1	**Construction Activity Pollution Prevention**	• *2003 U.S. EPA Construction General Permit* replaces the *1992 U.S. EPA Storm Water Management for Construction Activities, Chapter 3*
Credit 1	**Site Selection**	• 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 • 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
Credit 2	**Development Density and Community Connectivity**	• Update to list of services for community connectivity • Additional option to achieve community connectivity without the site density requirement for subset of points
Credit 3	**Brownfield Redevelopment**	-

Sustainable Sites

Credit		Major Changes
Sustainable Sites		
Credit 4.1	**Alternative Transportation: Public Transportation Access**	• Distance must be measured from main building entrance • An alternate compliance path for a Transportation Demand Management plan has been added
Credit 4.2	**Alternative Transportation: Bicycle Storage & Changing Rooms**	• Bicycle storage must be covered for FTE occupants • Calculations are based on peak transient use
Credit 4.3	**Alternative Transportation: Low-Emitting & Fuel-Efficient Vehicles**	• Fuel efficient vehicle definition has changed
Credit 4.4	**Alternative Transportation: Parking Capacity**	• Projects are restricted to a parking capacity upper limit of 3.5 spaces per 93 m^2 (1000 ft^2) • Carpool requirement is based on total parking spaces (including visitor spaces)
Credit 5.1	**Site Development: Protect and Restore Habitat**	• Slightly increased requirements for greenfield sites
Credit 5.2	**Site Development: Maximize Open Space**	• Provided new pathway for sites with local zoning but no open space requirements

Sustainable Sites

Credit		Major Changes
Sustainable Sites		
Credit 6.1	**Stormwater Design: Quantity Control**	• 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
Credit 6.2	**Stormwater Design: Quality Control**	• Requirement for a stormwater quality management plan has been added • 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)
Credit 7.1	**Heat Island Effect: Non-Roof**	• Clarification of options and expanded to include, for example, shading from solar panels
Credit 7.2	**Heat Island Effect: Roof**	-
Credit 8	**Light Pollution Reduction**	• Modified requirements for interior and exterior light pollution • Language added to clarify IESNA RP-33 zones • Added public rights-of-way boundary exception for zones LZ2, LZ3 & LZ4 • Clarified site boundary for luminaires in intersections • Updated referenced standard to ASHRAE/IESNA Standard 90.1-2007
Credit 9	**Tenant Design and Construction Guidelines**	• New Core & Shell credit

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

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
❒ Prereq 1	Water Use Reduction	Required
❒ Credit 1	Water Efficient Landscaping	2, 4
❒ Credit 2	Innovative Wastewater Technologies	2
❒ Credit 3	Water Use Reduction	2-4

Water Efficiency

Credit		Major Changes
Water Efficiency		
Prereq 1	**Water Use Reduction, 20% Reduction**	• New to LEED 2009, based on previous WE Credit 3.1 with the addition of a building/property water meter • 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
Credit 1	**Water Efficiency Landscaping**	• Merger of WE Credit 1.1 and WE Credit 1.2 • Minimum area clarified (5% of total project site area (including building)) • Added factors for calculating mid-summer baseline case • Addressed groundwater seepage for use in irrigation • Temporary irrigation systems limited to 1 year but no restrictions on type
Credit 2	**Innovative Wastewater Technologies**	• Reduction of on-site treatment threshold to 50%
Credit 3	**Water Use Reduction**	• See WE Prerequisite 1 changes for flow rate updates • Point thresholds have been increased with 3 levels available (30%, 35% and 40%)

Water Efficiency: Examples

YMCA Environmental Learning Centre: Living Machine

CMHC Healthy House: Waterloo Biofilter

Water Efficiency: Example

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

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
❒ Prereq 1	Fundamental Commissioning of Building Energy Systems	Required
❒ Prereq 2	Minimum Energy Performance	Required
❒ Prereq 3	Fundamental Refrigerant Management	Required
❒ Credit 1	Optimize Energy Performance	1-19
❒ Credit 2	On-Site Renewable Energy	1-7
❒ Credit 3	Enhanced Commissioning	2
❒ Credit 4	Enhanced Refrigerant Management	2
❒ Credit 5	Measurement and Verification	3
❒ Credit 6	Green Power	2

Energy and Atmosphere

	Credit	Major Changes
Energy & Atmosphere		
Prereq 1	**Fundamental Commissioning of Building Energy Systems**	• Clarified Commissioning Authority (CxA) experience
Prereq 2	**Minimum Energy Performance**	• Updated referenced standard to ASHRAE/IESNA Standard 90.1-2007 • Performance Compliance Paths (comparison to MNECB and ASHRAE) are demonstrated through total building energy cost improvements including process loads • Prescriptive Compliance Paths are available
Prereq 3	**Fundamental Refrigerant Management**	• Requirement for zero use of halons in fire suppression equipment has been incorporated into EA Credit 4 • Added alternative compliance path for campus projects using existing district chilled water plants only
Credit 1	**Optimize Energy Performance**	• As per EA Prerequisite 2 • Point thresholds have changed • Different thresholds for Core & Shell projects
Credit 2	**On-Site Renewable Energy**	• Point thresholds have been reduced but now based on total building energy cost (not only regulated loads) • Different thresholds for Core & Shell projects

Energy and Atmosphere

Credit		Major Changes
Energy & Atmosphere		
Credit 3	**Enhanced Commissioning**	• Clarified Commissioning Authority (CxA) experience and independency requirements • The same CxA overseeing the enhanced commissioning tasks (EA Credit 3) must also oversee the fundamental commissioning tasks (EA Prerequisite 1) • Clarifications were made to standardize LEED Commissioning Scope of Work
Credit 4	**Enhanced Refrigerant Management**	• Fire suppression systems must be free of ozone-depleting substances • Refrigerants must comply with a maximum threshold for the combined contributions to ozone depletion and global warming potential • Added option for not using refrigerants
Credit 5	**Measurement and Verification**	• Requirement added to provide process for corrective action if M&V plan shows energy savings are not being achieved • Removed requirement for a water M&V program • Separation of tenant submetering from base building creating two credits (EA Credit 5.1 and 5.2) for Core & Shell projects
Credit 6	**Green Power**	• Point threshold has been reduced to 35%, but now includes all building electricity (not only regulated loads) • Clarified that all purchases of green power are based on the quantity of energy consumed, not cost

Energy and Atmosphere: Examples

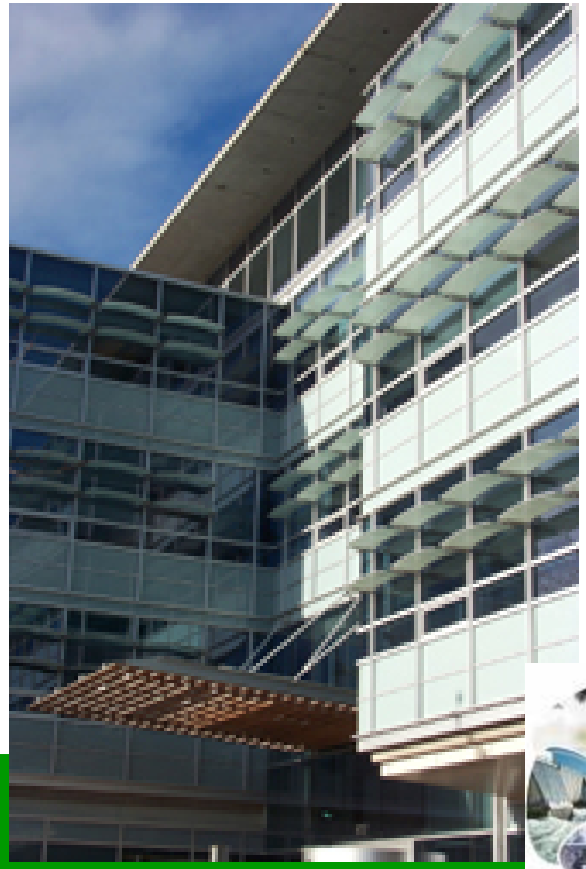
Terasen Gas, Surrey, BC.

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

Energy and Atmosphere: Examples

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

Revenue Canada, Surrey, BC.



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

Materials and Resources

Credit		Major Changes
Materials & Resources		
Prereq 1	**Storage and Collection of Recyclables**	• Area for the collection of organic waste must be provided in municipalities that support such collection
Credit 1.1	**Building Reuse: Maintain Existing Walls, Floors, and Roof**	• Combined with previous MR Credit 1.2 • Point added for new lower threshold (55%)
Credit 1.2	**Building Reuse: Maintain Interior Non-structural Elements**	• Credit no longer available to Core & Shell projects
Credit 2	**Construction Waste Management**	-
Credit 3	**Materials Reuse**	• Only lower threshold available to Core & Shell projects (5%)
Credit 4	**Recycled Content**	• Point thresholds have been increased (10% and 20%)
Credit 5	**Regional Materials**	• Point thresholds have been increased (20% and 30%) • Products must be extracted and processed within 800 km of the manufacturer rather than site • Allowance for fractions of products to be used to achieve credit
Credit 6	**Rapidly Renewable Materials**	• Point threshold has been reduced (2.5%) • Credit no longer available to Core & Shell projects
Credit 6/7	**Certified Wood**	• Credit 6 for Core & Shell projects • No exemption from Chain-of-Custody requirements for last vendor

Materials and Resources: Examples

- 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

Liu Centre for Asian Studies, UBC

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

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

C.K. Choi Institute, UBC

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.

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_2) 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
❒ Prereq 1	Minimum Indoor Air Quality Performance	Required
❒ Prereq 2	Environmental Tobacco Smoke (ETS) Control	Required
❒ Credit 1	Outdoor Air Delivery Monitoring	1
❒ Credit 2	Increased Ventilation	1
❒ Credit 3.1	Construction Indoor Air Quality Management Plan: During Construction	1
❒ Credit 3.2	Construction Indoor Air Quality Management Plan: Before Occupancy	1
❒ Credit 4.1	Low-Emitting Materials: Adhesives and Sealants	1
❒ Credit 4.2	Low-Emitting Materials: Paints and Coatings	1
❒ Credit 4.3	Low-Emitting Materials: Flooring Systems	1
❒ Credit 4.4	Low-Emitting Materials: Composite Wood and Agrifibre Products	1
❒ Credit 5	Indoor Chemical and Pollutant Source Control	1
❒ Credit 6.1	Controllability of System: Lighting	1
❒ Credit 6.2	Controllability of System: Thermal Comfort	1
❒ Credit 7.1	Thermal Comfort: Design	1
❒ Credit 7.2	Thermal Comfort: Verification	1
❒ Credit 8.1	Daylight and Views: Daylight	1
❒ Credit 8.2	Daylight and Views: Views	1

Indoor Environmental Quality

Credit		Major Changes
Indoor Environmental Quality		
Prereq 1	**Minimum Indoor Air Quality Performance**	• Updated referenced standard to ASHRAE Standard 90.1-2007
Prereq 2	**Environmental Tobacco Smoke (ETS) Control**	• Residential (Case 2) clarified to include hotels, motels, and dormitories • Added language addressing signage in Option 1 and Option 2 • Added requirement to weatherstrip exterior doors and windows in residential projects • 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) • 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
Credit 1	**Outdoor Air Delivery Monitoring**	• Updated referenced standard to ASHRAE Standard 62.1-2007 • Clarified requirement to monitor CO_2 concentrations in all densely occupied areas (Case 1 - Mechanically Ventilated Spaces) • Added requirement for outdoor airflow measurement (Case 1 - Mechanically Ventilated Spaces) • Added specific requirements for naturally ventilated spaces (Case 2 - Naturally Ventilated Spaces)
Credit 2	**Increased Ventilation**	• Credit has been changed from ventilation effectiveness to requiring outdoor air ventilation rates 30% above minimum rates required by ASHRAE Standard 62.1-2007 • Naturally ventilated spaces may alternatively meet the recommendations of the CIBSE Applications Manual • Specific compliance path (Case 3) for residential projects requiring outdoor air ducted directly to the suite with air distributed to all regularly occupied areas

Indoor Environmental Quality

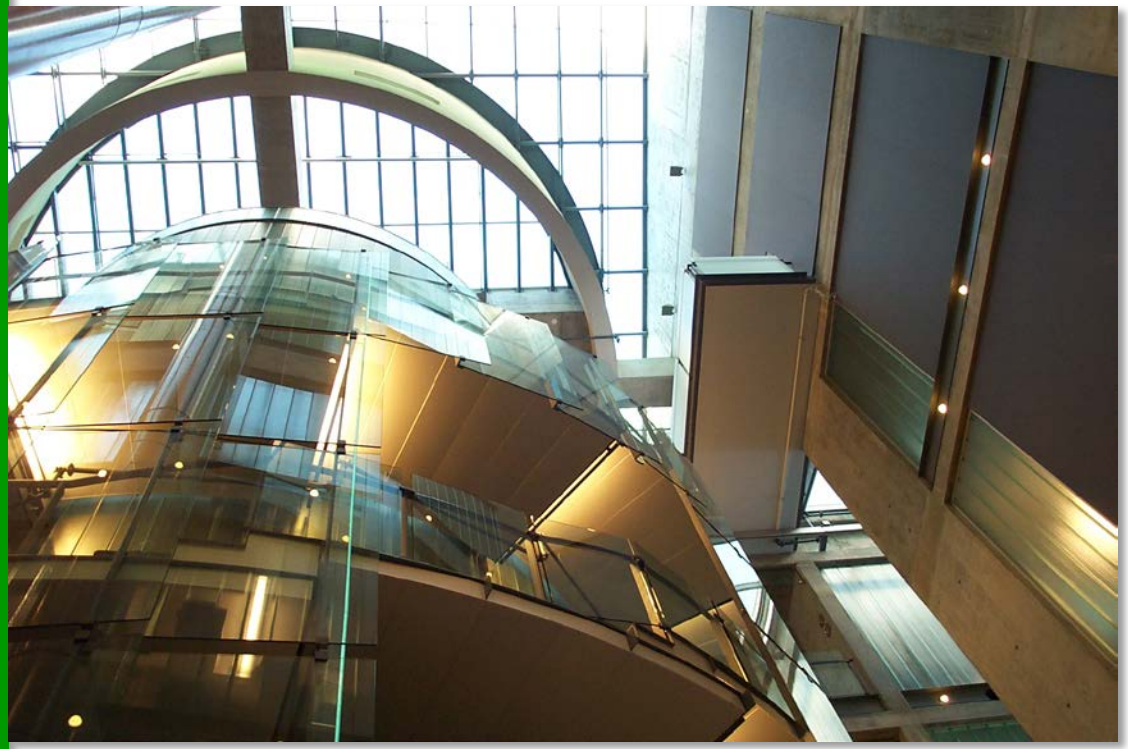
Credit		Major Changes
Indoor Environmental Quality		
Credit 3.1	**Construction Indoor Air Quality Management Plan During Construction**	• Updated referenced standard to the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines For Occupied Buildings Under Construction, 2nd Edition 2007, ANSI/SMACNA 008-2008 (Chapter 3) • Clarified that filtration media must be replaced immediately prior to occupancy • Removed requirement to make provisions for inspections of building HVAC systems
Credit 3.2	**Construction Indoor Air Quality Management Plan Before Occupancy**	• Clarified the IAQ Management Plan implementation timeline requirements • Clarified that all finishes must be installed prior to flush-out • Flush-out during occupancy ventilation rate has been increased from 0.76 to 1.54 L/s/m^2 • Threshold for formaldehyde level was revised from 50 to 27 parts per billion in Option 2, Air Testing
Credit 4.1	**Low-Emitting Materials: Adhesives and Sealants**	• Clarification on use of VOC budget • Clarification on interior of the building • VOC thresholds no longer updated to match date of building permit but set as per rating system requirements
Credit 4.2	**Low-Emitting Materials: Paints and Coatings**	• As per IEQ Credit 4.1 • Moved primers from Green Seal requirements to SCAQMD requirements
Credit 4.3	**Low-Emitting Materials: Flooring Systems**	• Requirements now reflect all low-emitting flooring materials and finishes • All flooring must comply with a minor exemption of up to 5% for speciality areas
Credit 4.4	**Low-Emitting Materials: Composite Wood and Agrifibre Products**	-

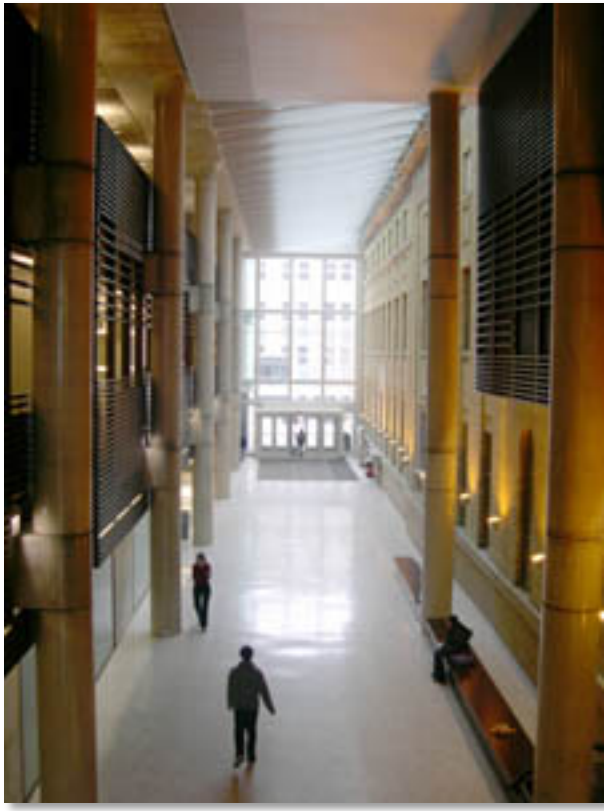
Indoor Environmental Quality

Credit		Major Changes
Indoor Environmental Quality		
Credit 5	**Indoor Chemical and Pollutant Source Control**	• Required entryway system travel distance length increased and systems are required at regular entry points • Combinations of permanently installed systems along with walk-off mats with provisions for maintenance are allowed • 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 • For residential projects, carbon monoxide alarms are required in areas adjacent to combustion equipment
Credit 6.1	**Controllability of System: Lighting**	• Re-structured credit from perimeter spaces to lighting control • Credit not available to Core & Shell projects
Credit 6.2	**Controllability of System: Thermal Comfort**	• Re-structured credit from non-perimeter spaces to thermal comfort control • Clarification of requirements for use of operable windows • Thermal comfort controls as described by ASHRAE Standard 55-2004 • Clarification on scope for Core & Shell projects
Credit 7.1	**Thermal Comfort: Design**	• Increased demonstration of compliance with ASHRAE 55-2004 -now required.
Credit 7.2	**Thermal Comfort: Verification**	• An occupant thermal comfort survey is required • An alternative compliance path was added for residential buildings • Credit no longer available to Core & Shell projects
Credit 8.1	**Daylight and Views: Daylight**	• Multiple options now available – simulation, prescriptive, measurement or combination
Credit 8.2	**Daylight and Views: Views**	-

Indoor Environmental Quality: Examples

Bahen Centre, UofT





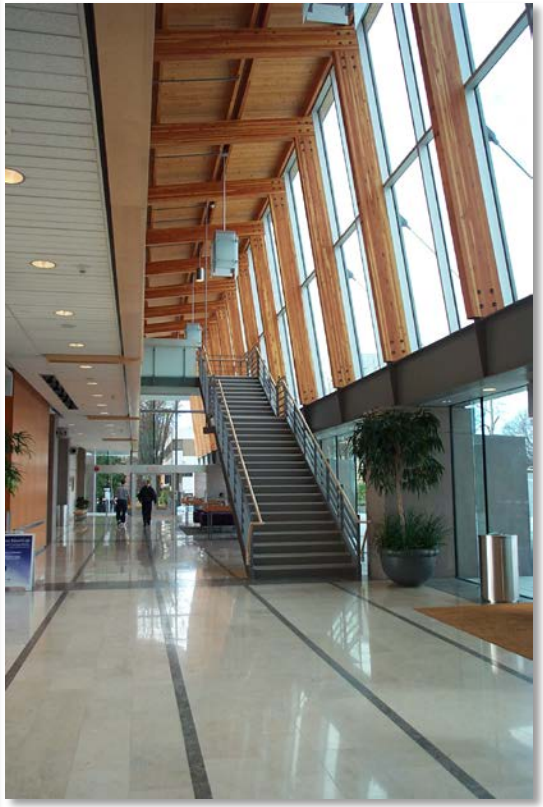
- daylighting

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

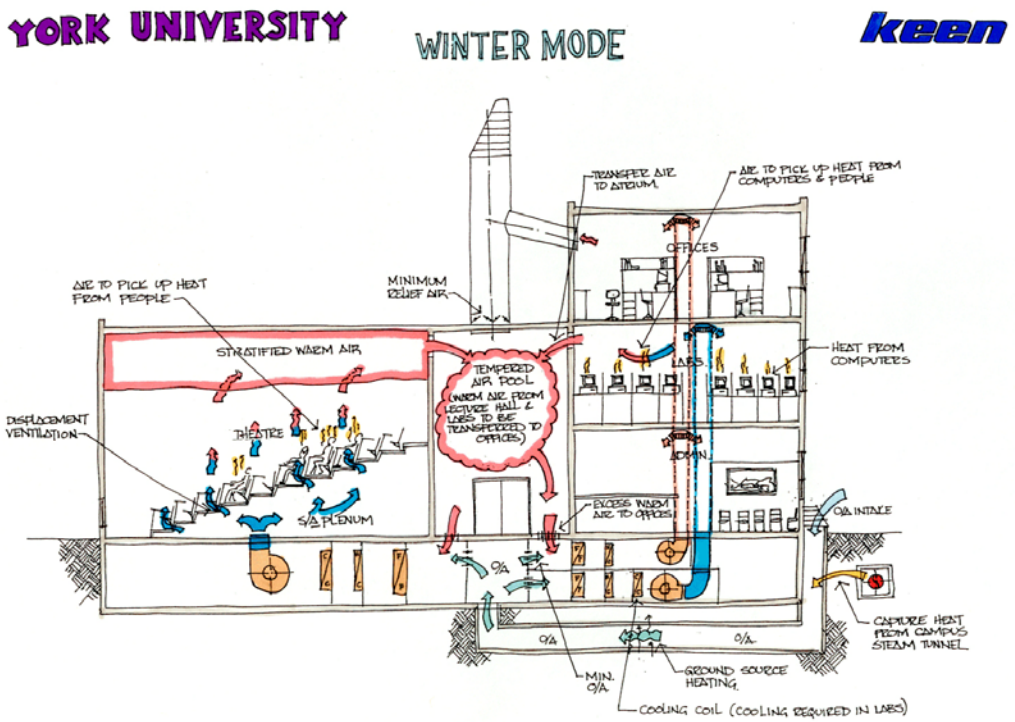
Innovation and Design Process: 7% : 5/70 points

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.

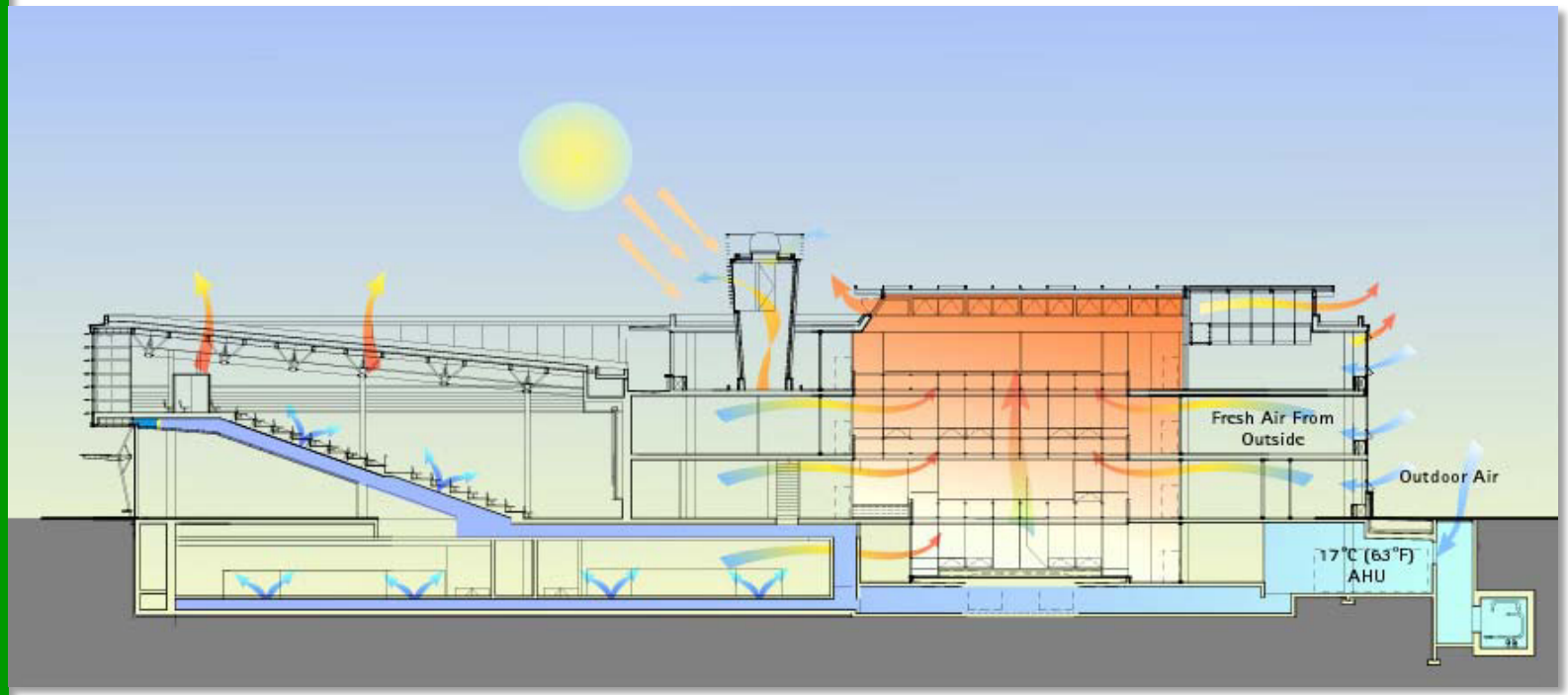
Innovation & Design Process	**5 Possible Points**	
Credit 1.1	Innovation in design	1
Credit 1.2	Innovation in design	1
Credit 1.3	Innovation in design	1
Credit 1.4	Innovation in design	1
Credit 2	LEED™ Accredited Professional	1

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!)

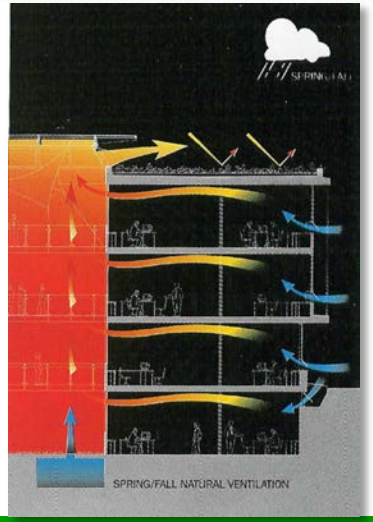
Innovation and Design Process: Examples



York University 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
❒ Credit 1	Innovation in Design	1-5
❒ Credit 2	LEED® Accredited Professional	1

REGIONAL PRIORITY		4 POSSIBLE POINTS
❒ Credit 1	Durable Building	1
❒ Credit 2	Regional Priority Credit	1-3

Innovation in Design

	Credit	Major Changes
Innovation in Design		
Credit 1	**Innovation in Design**	• Expanded innovation strategies allowed from 4 to 5 • Added stipulation that no more than 3 exemplary performance points can be awarded
Credit 2	**LEED® Accredited Professional**	-

Regional Priority

	Credit	Major Changes
Regional Priority		
Credit 1	**Durable Building**	• Formerly MR Credit 8 in LEED Canada NC v1.0
Credit 2	**Regional Priority Credit**	• New to LEED 2009

LEED-NC® 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 V4

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

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

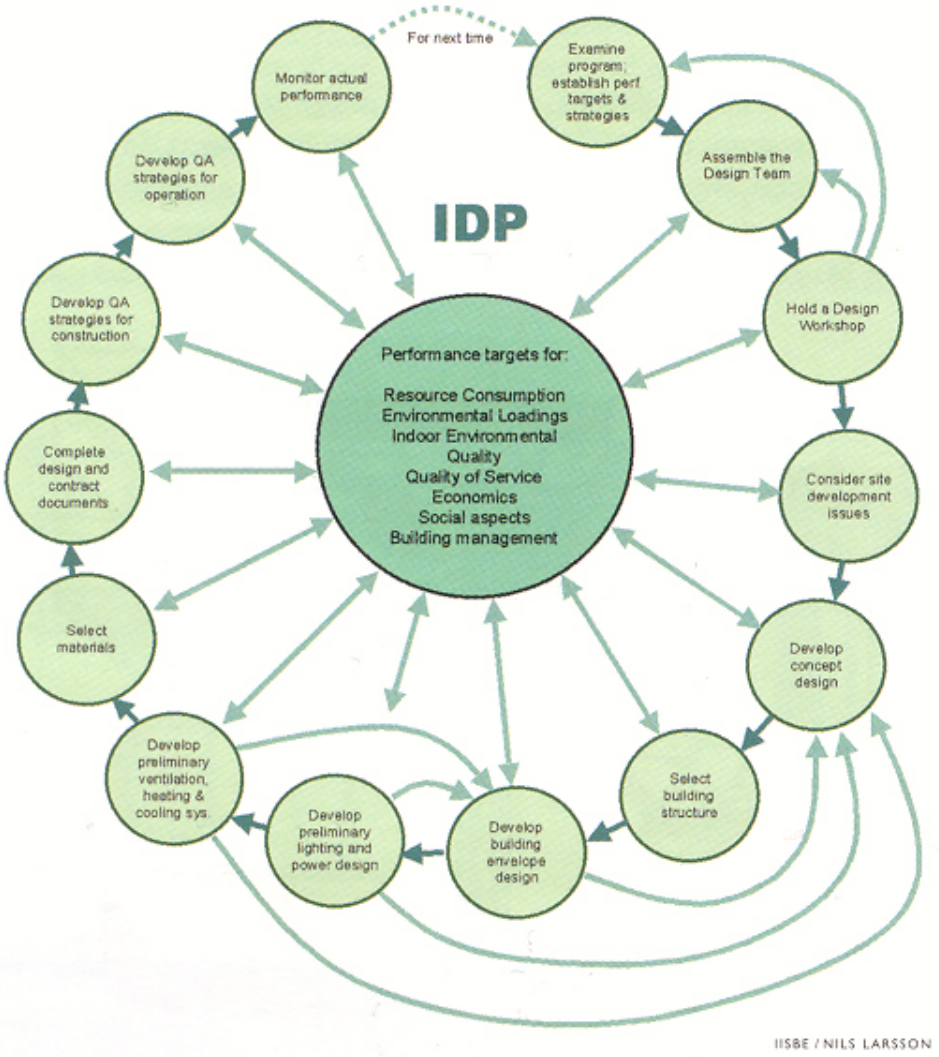
Integrated Design Process (IDP)

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.

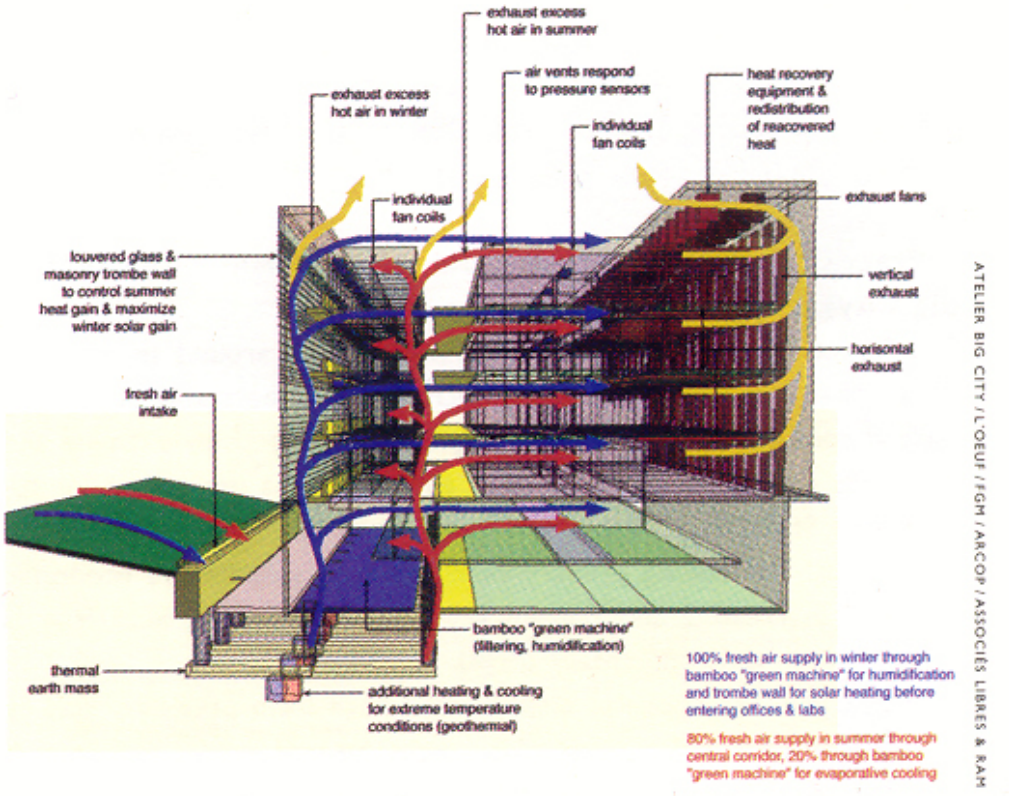
Integrated Design Process (IDP)



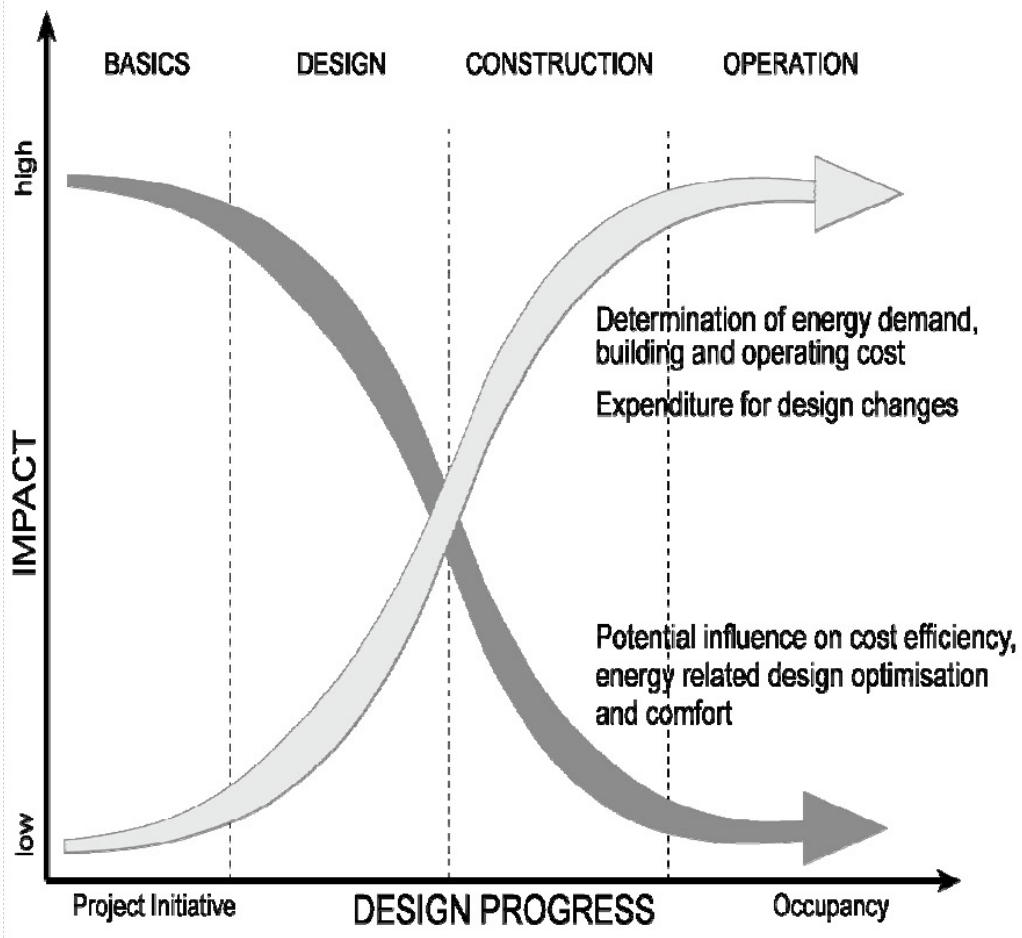
In professional practice, IDP has a significant impact on the makeup and role-playing of the initial design team. The client takes a more active role than usual, the architect becomes a team leader rather than the sole form-giver, and the structural, mechanical and electrical engineers take on active 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 .

More detailed LEED info

- http://www.tboake.com/follow.html