

Guest Lecture to CityU (7 June 2011)
BC6609 Green Building, Architecture and People



Building Environmental Assessment



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- Assessment Criteria
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Basic Principles



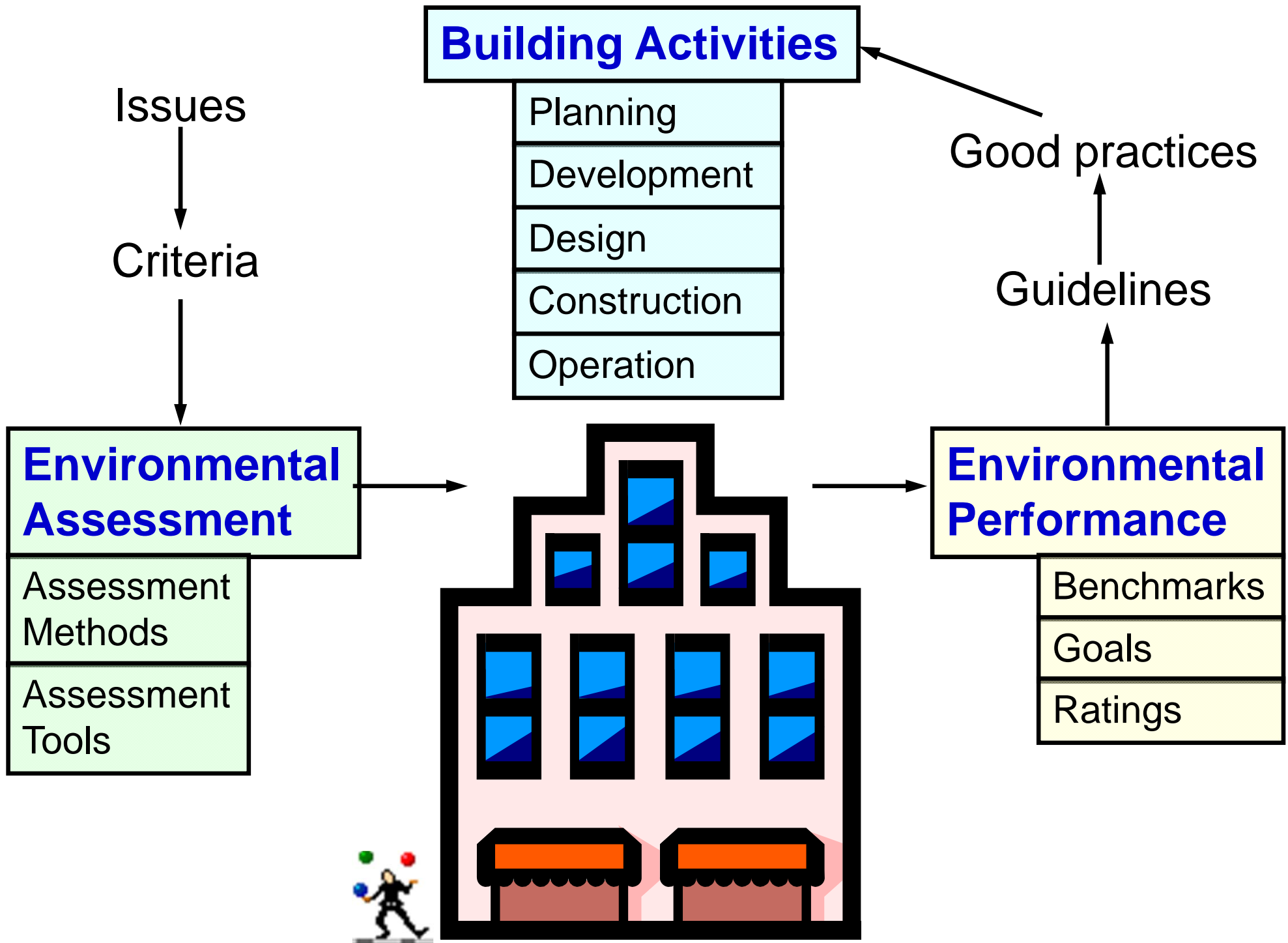
- Building environmental assessment
 - Identify & evaluate the environmental effects of building development or operation
 - Inform decision making and promote sustainable design & management
- An objective assessment is a useful starting point from which to make design and building improvements

For supporting decision making

Basic Principles



- Why environmental assessment?
 - Provide a common set of criteria & targets
 - Guide design decisions & choices
 - Raise awareness of environmental issues/standards
 - Recognise & encourage good practices
 - Stimulate the market for sustainable construction
 - Allow a verifiable method & framework
 - Enable policies & regulation (e.g. certificate/label)
 - Improve management & prioritization (incentives)



Basic Principles

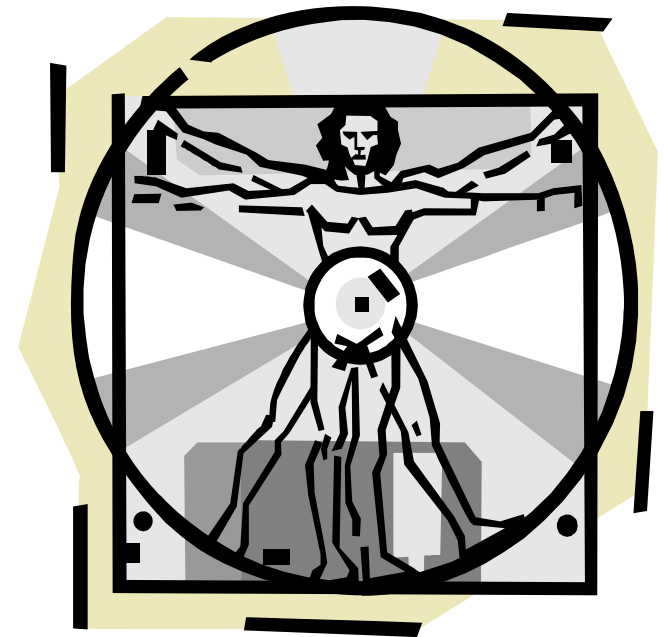


- Design guidelines provide a broader range of issues; Assessment methods give structure and priority, and provide strategic advice
 - Enhance environmental knowledge
- Enable building performance to be described
 - Performance-based indicators
 - Declared benchmarks
 - Prescriptive requirements (proxies for actual performance)

Basic Principles



- Scope/Scale of the evaluation
 - Building products
 - Building processes
 - Structural members/elements
 - Building systems
 - Single buildings
 - Groups of buildings
 - District, urban, regional & city
- New, existing & refurbished buildings



Assessment Criteria



- A broad range of criteria
 - Qualitative issues
 - Quantitative issues
- Types of criteria
 - Ecological *vs* health-related
 - Direct impacts *vs* indirect impacts
 - Immediate *vs* long-term implications
 - Global *vs* local



- site selection
- urban design
- landscape planning

- CO₂ emissions
- acid rain
- ozone depletion
- rainforest depletion

- energy performance
- renewable energy
- water conservation

**Environmental
Criteria &
Factors**

- environmental policy
- transport strategy
- building maintenance

- material selection
- recycling of materials
- waste management
- disposal & reuse

- air quality
- thermal comfort
- lighting & noise
- hazardous materials

Assessment Criteria



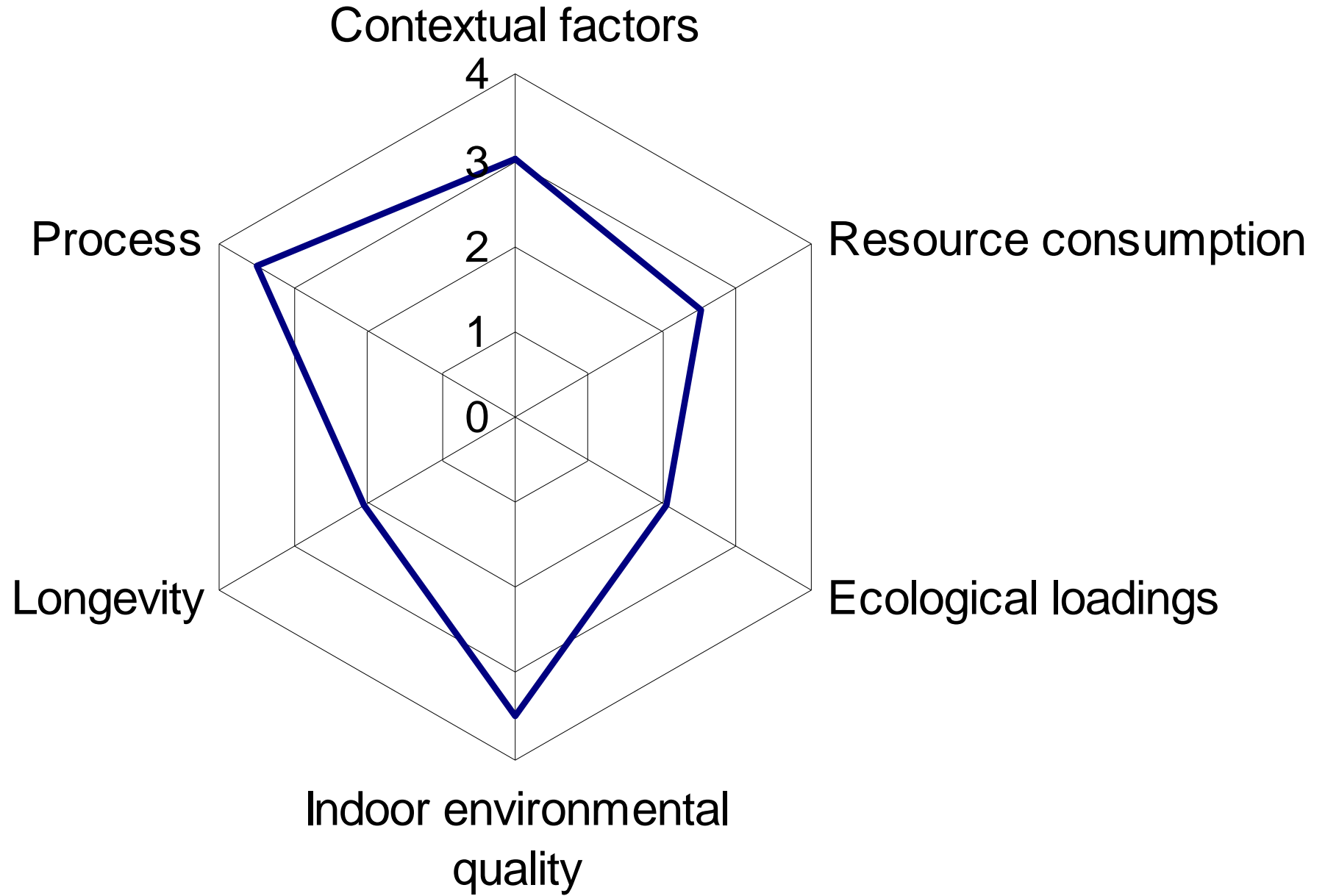
- Assessment process
 - Examine the performance of a building or its sub-system against a declared set of criteria
 - Usually voluntary (aim to stimulate the market)
- Scale of performance
 - Measure & assess relative performance
 - Assign 'points' or 'score' to various aspects
 - Quantitative criteria: relative to a baseline
 - Qualitative criteria: presence/absence of such features

Assessment Criteria



- Assessing multiple criteria
 - Indicate the ‘best’ overall performance
 - Methodology
 - Cost (or monetary value \$)
 - Equivalence method (e.g. air/water pollution index)
 - EcoCost (in common Gaia scale 0-1)
 - EcoPoint or EcoProfile
- Weighting system
 - To show relative importance, scale and urgency

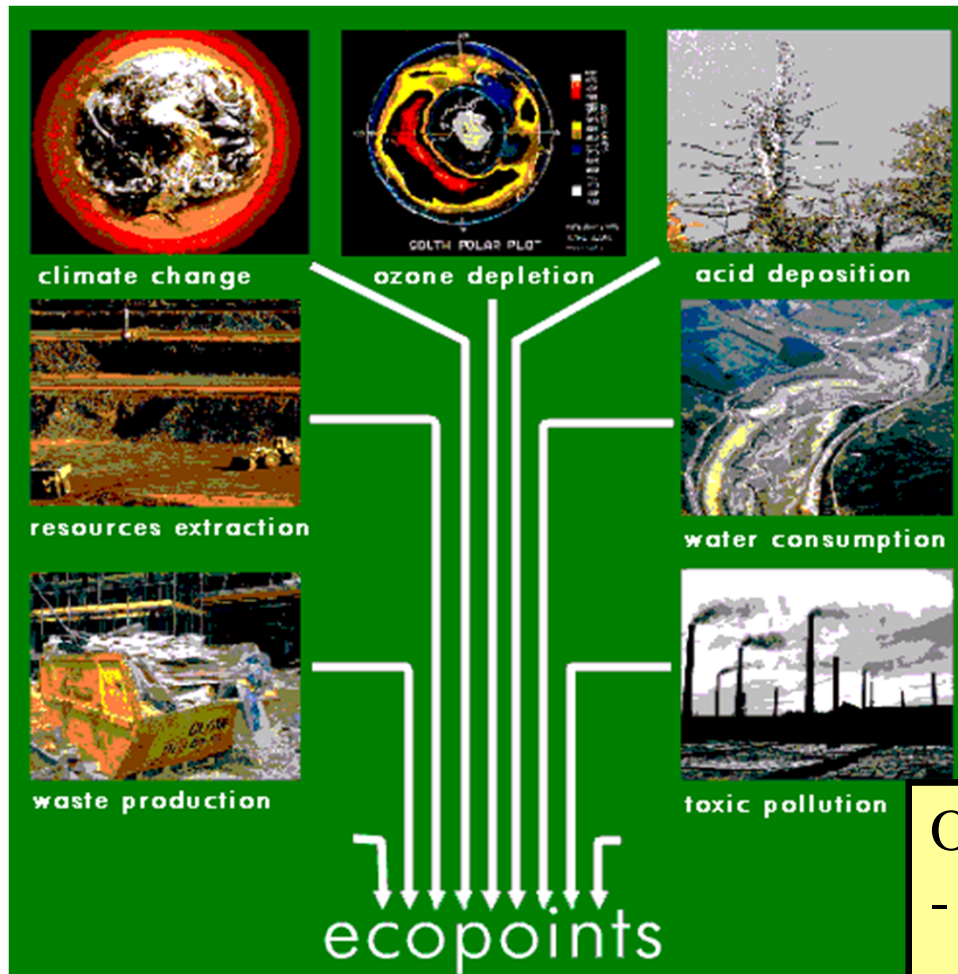
How to visualize assessment results?



Radar chart for assessing multiple criteria

How to combine different criteria?

“Ecopoint” concept in the ENVEST (environmental impact estimating) tool (UK BRE)



One “**ecopoint**” is equivalent to:

- 320 kWh electricity
- 83 m³ Water: enough to fill 1,000 baths
- 65 miles by articulated truck
- landfilling 1.3 tonnes of waste
- manufacturing 3/4 tonnes brick (250 bricks)
- 540 tonne kms by sea freight
- 1.38 tonnes mineral extraction
- 300 miles of urban driving in new petrol car

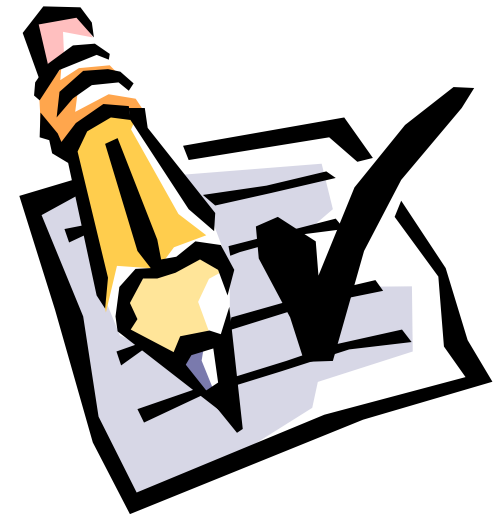


(Source: UK BRE)

Assessment Methods



- Common approaches
 - Checklists or forms
 - Computer-based methods
 - Spreadsheet or computer programs
- Models used
 - Environment model
 - Product model
 - Life cycle model
- Data required: from simple to very detailed



Assessment Methods



Further info: http://en.wikipedia.org/wiki/Green_building

- Examples

- Europe:

- BREEAM (UK)
- CEPHEUS (Germany)
- ECO-PRO (Germany)
- EcoProP & PIMWAQ (Finland)
- EQUER (France)
- ECO QUANTUM (Netherlands)
- MINERGIE (Switzerland)
- BREEAM-NL (Netherlands)
- VERDE (Spain)

Assessment Methods



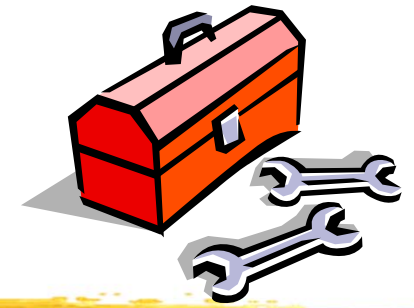
- Examples (cont'd)
 - Canada & USA:
 - BREEAM-Canada & BEPAC-Canada
 - LEED Canada
 - LEED (USA)
 - BEES (USA) (for building products)
 - GreenGlobes (Canada & USA)
 - Australia & New Zealand
 - Green Star (Australia)
 - Green Office Scheme (New Zealand)

Assessment Methods



- Examples (cont'd)
 - Asian countries:
 - Japan Green Building Guide & CASBEE
 - Korea Green Building Rating System
 - GB/T 50378-2006 and GOBAS (Mainland China)
 - Taiwan Green Building Label
 - HK-BEAM and CEPAS (HK)
 - Green Mark Scheme (Singapore)
 - Green Building Index (Malaysia)
 - TGBRS (India)

Current Tools

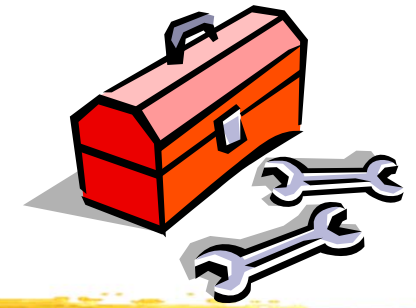


- BREEAM – UK (since 1990)
 - **B**uilding **R**esearch **E**stablishment **E**nvironmental **A**ssessment **M**ethod
 - Used as a reference in many countries
 - BREEAM family of assessment methods & tools
 - Any types of buildings (new and existing)
 - BREEAM International (outside of UK)
 - BREEAM In-Use (building management)
 - BREEAM Communities (planning stage)
 - Website: www.breeam.org/

breeam



Current Tools



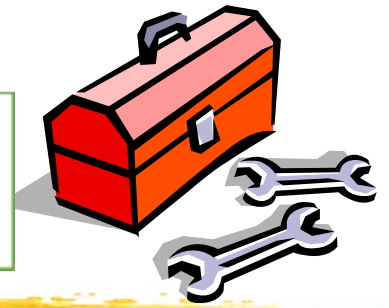
- BREEAM – UK (cont'd)
 - Credits awarded for a set of performance criteria
 - Energy, water, pollution, materials, transport, ecology and land use, health and well being
 - Construction & building operational management
 - A weighting system is applied to determine final rating
 - Stages of building development
 - Design & procurement
 - Management & operation
 - Post construction review

Current Tools



- BREEAM – UK (cont'd)
 - Overall score rating:
 - Pass, Good, Very Good, Excellent, Outstanding
 - BREEAM Assessors
 - BREEAM Accredited Professional (**BREEAM AP**) and examination/training
 - Up to two credits if a BREEAM AP is engaged

Current Tools



- LEED Green Building Rating System
 - Leadership in Energy & Environmental Design
 - By US Green Building Council
 - Current LEED systems:
 - New construction & major renovation (LEED-NC)
 - Existing building operations (LEED-EB)
 - Commercial interiors projects (LEED-CI)
 - Core and shell projects (LEED-CS)
 - Schools, Retail, Healthcare, Homes
 - Neighborhood development (LEED-ND) (in pilot)

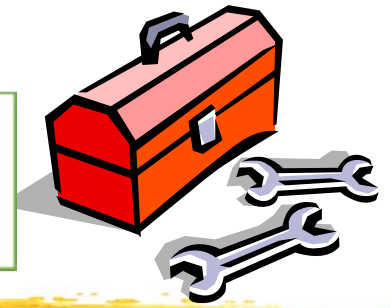
Video Presentation



- Intro to LEED Certification (6.5 min.)
[www.youtube.com/watch?v=G7qUUbrcVfY]
- US Green Building Council
- LEED Certification
- LEED Exam Overview



Current Tools



- LEED Green Building Rating System

- Evaluates and recognizes performance in accepted green design categories, including:



- Sustainable sites



- Water efficiency



- Energy and atmosphere

- Materials and resources



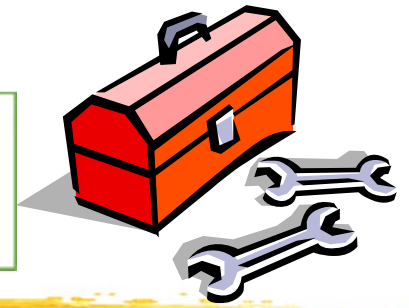
- Indoor environmental quality

- Innovation credits



- Website: www.leadbuilding.org

Current Tools

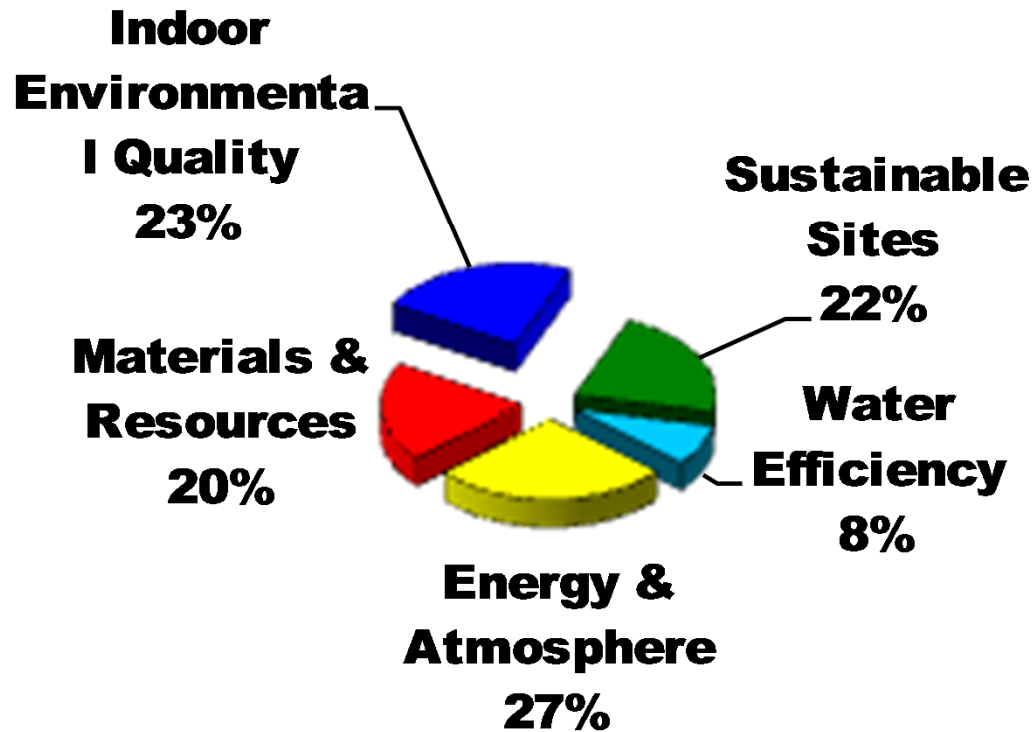


- LEED Green Building Rating System
 - Whole-building approach encourages & guides a collaborative, integrated design & construction process
 - Optimizes environmental and economic factors
- Four levels of certification (for version 2 or before)
 - LEED Certified 26 - 32 points
 - Silver Level 33 - 38 points
 - Gold Level 39 - 51 points
 - Platinum Level 52+ points (69 possible)
- LEED Accredited Professional



Which are the most important criteria?

LEED Point Distribution (version 2)



(Source: USGBC)

The relative importance of the criteria may change from one society to another one.

Phillip Merrill Environmental Center Headquarters Annapolis, Maryland



LEED™ 1.0 Certification:
PLATINUM

Notes from the Project Team: *LEED™ was instrumental in conveying the importance of the sustainable elements of the design to CBF's Board of Trustees.*

- Sustainable Sites
 - **Site Selection:** *Erected in Smart Growth Funding Area on footprint of existing structure. 26.6 acres remain undisturbed in Land Trust.*
 - **Educational Model:** *Interpretive trails & demonstrations for public visitors*
 - **Storm/Waste Water:** *All Composting Toilets & Bioretention/Wetland*
 - **Resource Protection:** *Woodland, Wetland, & Tidal Water Restoration*
- Water Efficiency
 - **Water:** *Rainwater Catchment & Reuse for Hand Washing & Irrigation*
- Energy and Atmosphere
 - **Domestic Hot Water:** *Thermomax-Solar Technology*
 - **Energy:** *Exceeds ASHRAE/IES Standard 90.1-1989 by 50%*
 - **HVAC:** *Natural Ventilation and Desiccant Dehumidification & Heat Recovery*
 - **Controls/Monitoring:** *Building Energy management System, "Green Light" notifies staff to open windows when outside conditions comply*
 - **Power Source:** *30% Renewable with Geo-Exchange & Photovoltaics*
 - **Lighting:** *Daylight Harvesting and time clock lighting controls*
 - **Rapidly Renewable:** *Bamboo, cork and linoleum floorings*
 - **Recycled Content:** *Metal roofing and siding, acoustic ceiling, ceramic tile, and MDF cabinetry*
- Materials and Resources
 - **Structure:** *Rapidly Renewable-Paralam Post, Beam, and Truss system*
 - **Envelope:** *Structural Insulated Panels (SIP) R-20 walls, R-30 roof*
- Indoor Environmental Quality
 - **Indoor Environmental Quality:** *CO₂ and VOC monitors.*
 - **Furniture:** *Small, open offices allow for communal space. Systems furniture allows flexible layout to accommodate "churn"*

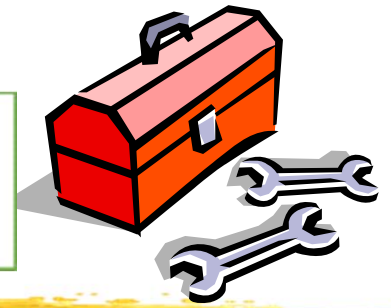





Owner:	Chesapeake Bay Foundation		
Project Team:	Architect:	SmithGroup, Inc.	
	Engineer:	SmithGroup, Inc.	
	P.Manager:	Synthesis, Inc.	
	Contractor:	Clark Construction Group	
	Consultant:	Janet Harrison, Architect	
Building Statistics:			
Completion Date:	November, 2000		
Cost:	\$6.36 M		
Size:	30,600 gross square feet		
Footprint:	12,000 square feet		
Construction Type:	3B, Two Stories over Open Parking		
Use Group:	Business(B), Assembly(A-3), Storage(S-2)		
Lot Size:	33 acres		

Annual Energy Use: 23 kBtu/sf/year

Occupancy: 90 staff
(Source: USGBC)

Current Tools



- LEED version 3 and new schemes
 - Include other criteria
 - Locations & linkages 
 - Awareness & education 
 - Regional priority 
 - LEED Professionals
 - LEED Green Associate
 - LEED AP (different types)
 - Bldg design & construction, O&M, Homes, Interior design, Neighborhood development

LEED® for New Construction

Total Possible Points 110***

 Sustainable Sites	26
 Water Efficiency	10
 Energy & Atmosphere	35
 Materials & Resources	14
 Indoor Environmental Quality	15

* Out of a possible 100 points + 10 bonus points

** Certified 40+ points, Silver 50+ points, Gold 60+ points, Platinum 80+ points

 Innovation in Design	6
 Regional Priority	4



LEED® for Existing Buildings

Total Possible Points 110***

 Sustainable Sites	26
 Water Efficiency	14
 Energy & Atmosphere	35
 Materials & Resources	10
 Indoor Environmental Quality	15

* Out of a possible 100 points + 10 bonus points

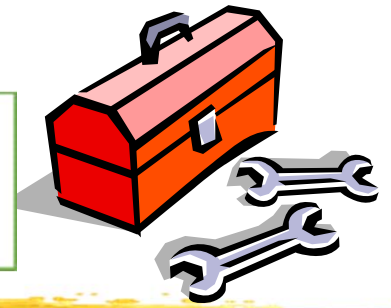
** Certified 40+ points, Silver 50+ points, Gold 60+ points, Platinum 80+ points

 Innovation in Operations	6
 Regional Priority	4

(Source: USGBC)

For LEED version 3

Current Tools



- New LEED professionals system (3 tiers)
 - LEED Green Associate
 - LEED AP+ with specialty
 - LEED AP Fellow



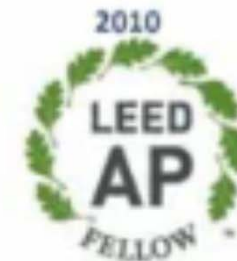
Tier 1



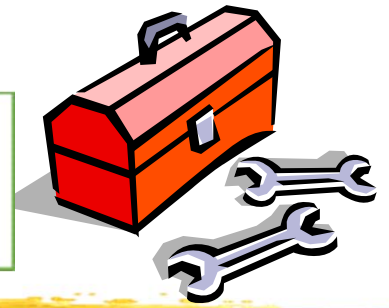
Tier 2



Tier 3

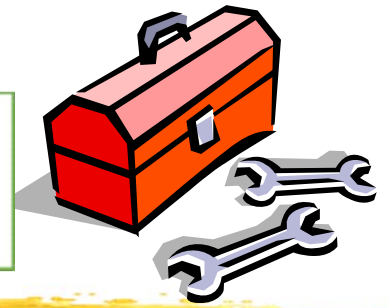


Current Tools



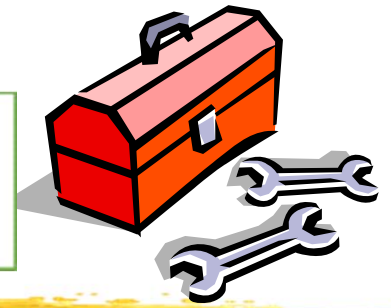
- LEED project registration and certification
 - Submit online registration form (www.gbci.org)
 - Fees vary depending on project type, size
 - LEED Platinum will receive a rebate of the fees
- Choose a project's market sector
 - New construction & major renovation (LEED-NC)
 - Commercial interiors projects (LEED-CI)
 - Core and shell projects (LEED-CS)
 - Existing building operations (LEED-EB)
 - Schools, Retail, Healthcare, Homes

Current Tools



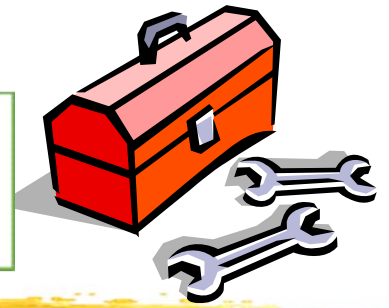
- Application process
 - The project team submits LEED letter templates and other documentation for credit review and certification
 - Decision makers: the professional responsible for submitting the templates and documentation
 - Such as LEED AP, architect, building services engineer, civil engineer, commissioning authority, facility engineer, interior designer, landscape architect
 - Two phases of submission:
 - Design phase + Construction phase

Current Tools



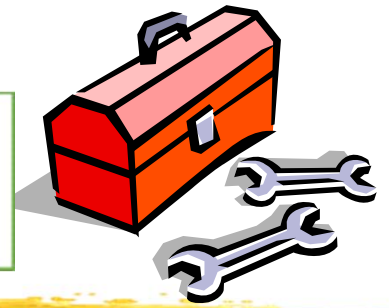
- Minimum program requirements (MPRs)
 - Define minimum characteristics that a project must possess in order to be eligible for LEED
 - Must comply with Environmental Laws
 - Must be a building
 - Must use a reasonable site boundary
 - Must comply with minimum floor area requirements
 - Must comply with minimum occupancy rates
 - Must allow USGBC to access whole building energy & water usage data
 - Registration & certification activity must comply with reasonable timetables


Current Tools



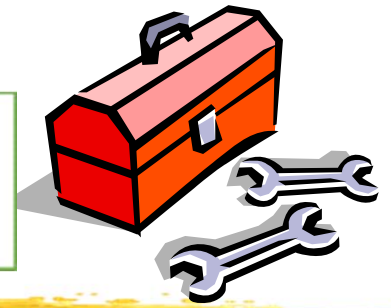
- Prerequisite (New Construction)
 - SSp1: Construction activity pollution prevention
 - WEp1: Water use reduction
 - EAp1: Fundamental commissioning of building energy systems
 - EAp2: Minimum energy performance
 - EAp3: Fundamental refrigerant management
 - MRp1: Storage and collection of recyclables
 - IEQp1: Minimum IAQ performance
 - IEQp2: Environmental tobacco smoke control



Current Tools



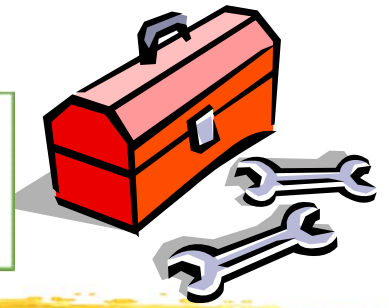
- Sustainable sites 
 - Develop only on appropriate sites
 - Provide for non-auto access
 - Preserve open space
 - Manage stormwater
 - Reduce urban heat island effect
 - Reduce light pollution of the night sky

Current Tools



- Water conservation 
 - Reduce use of potable water for irrigation and for building water use and sewage conveyance
- Energy efficiency and atmosphere protection 
 - Reduce building energy use
 - Use less harmful chemicals for refrigerants
 - Generate renewable energy on-site
 - Provide for ongoing energy savings
 - Purchase green power for project use

Current Tools

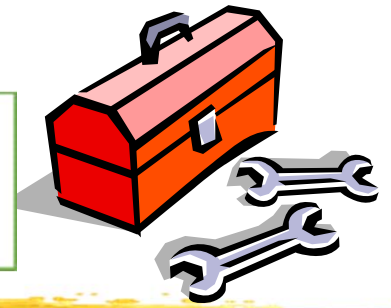



• Materials and resource conservation

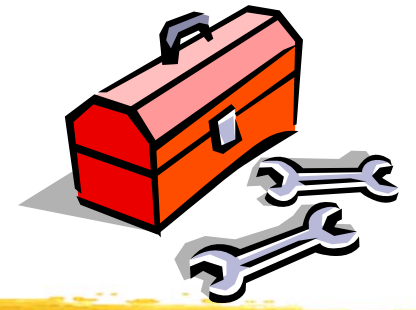


- Provide for recycling
- Reuse existing buildings
- Reduce construction waste generation
- Use salvaged and recycled content materials
- Source materials regionally
- Use rapidly renewable (agricultural) materials and certified wood products

Current Tools



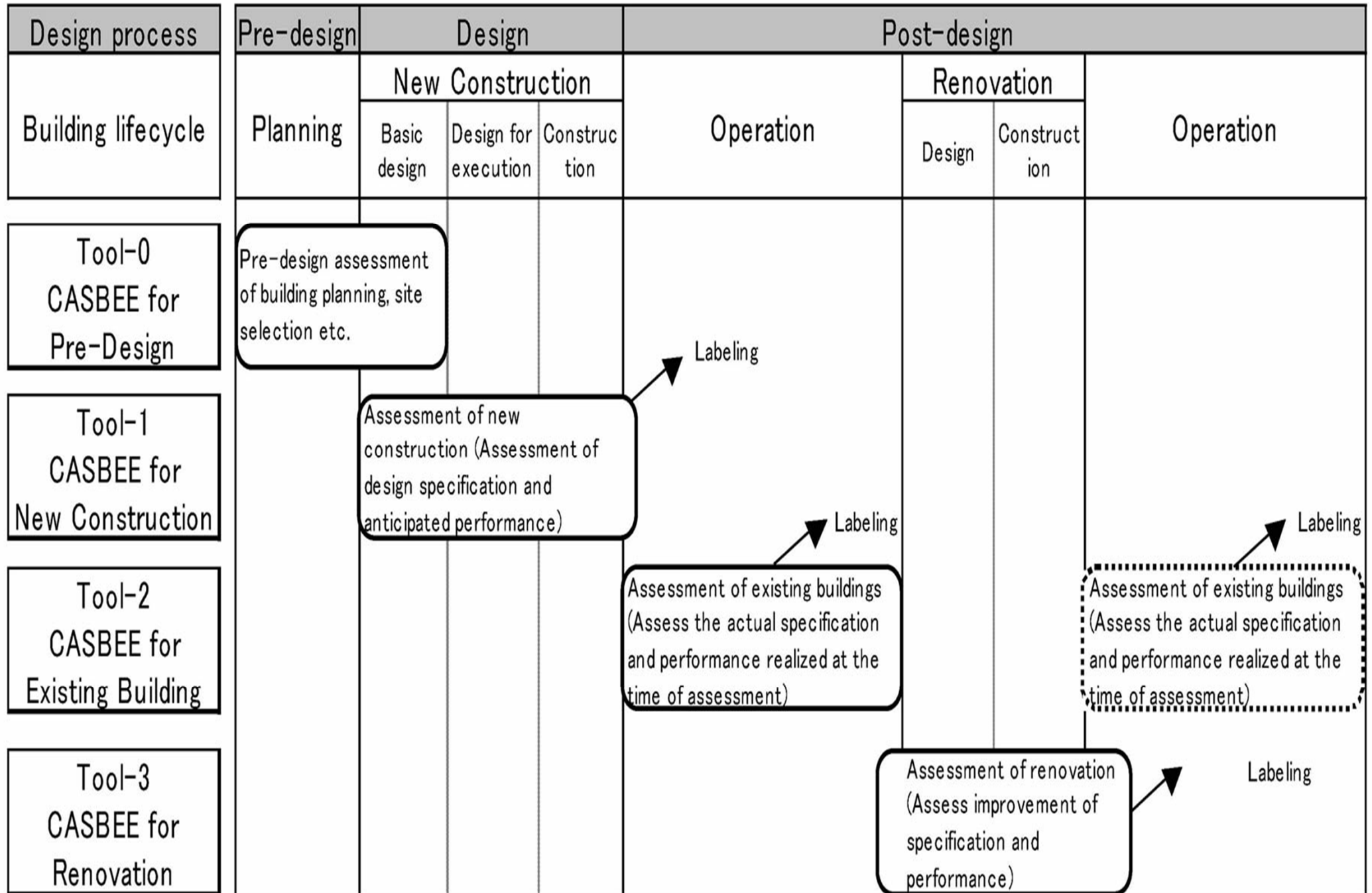
- Indoor environmental quality 
 - Improve indoor air quality
 - Increase outside air ventilation
 - Manage air quality during construction
 - Use only nontoxic quality finishes, carpets, and composite wood products
 - Reduce exposure to toxic chemicals during building operations
 - Provide for individual comfort control
 - Maintain thermal comfort standards



Current Tools

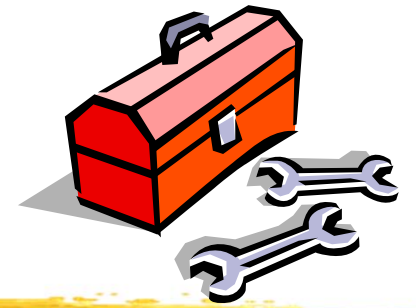
- CASBEE (Comprehensive Assessment System for Building Environmental Efficiency), Japan
 - Tool-0: Pre-design
 - Tool-1: New Construction
 - Tool-2: Existing Buildings
 - Tool-3: Renovation
 - Website: www.ibec.or.jp/CASBEE/

CASBEE Building Lifecycle and Four Assessment Tools



(Source: IBEC, Japan)

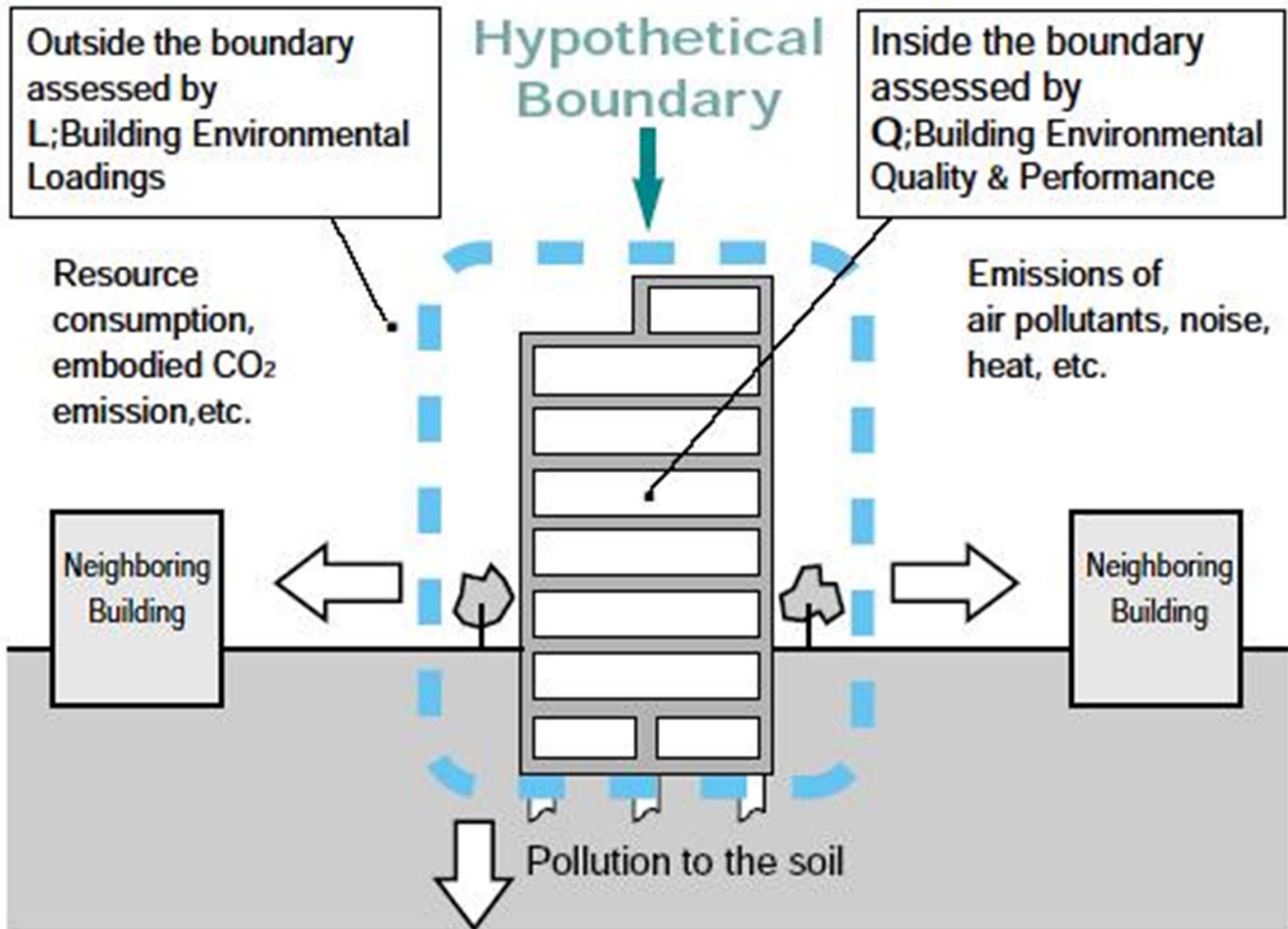
Current Tools



- CASBEE system:
 - CASBEE for New Construction
 - CASBEE for Existing Building
 - CASBEE for Renovation
 - CASBEE for Heat Island
 - CASBEE for Urban Development
 - CASBEE for an Urban Area + Buildings
 - CASBEE for Home (Detached House)

CASBEE[®] 建築環境総合性能評価システム

Comprehensive Assessment System for Built Environment Efficiency

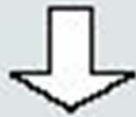


(Source: IBEC, Japan)

From Eco-efficiency of a building to BEE

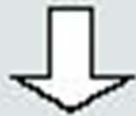
Original definition:
(WBCSD)

$$\frac{\text{Values of products or services}}{\text{Environmental load unit}}$$



Modeled definition:

$$\frac{\text{Beneficial output}}{\text{Input + Non-beneficial output}}$$



Definition of BEE
in CASBEE:

$$\frac{\text{Building Environmental Quality \& Performance}}{\text{Building Environmental Loadings}}$$

Building Environmental Efficiency (BEE)

$$= \frac{\text{Building Environmental Quality \& Performance}}{\text{Building Environmental Loadings}}$$

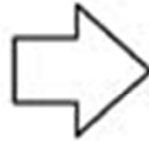
(1) Energy efficiency

(2) Resource efficiency

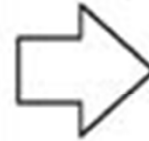
(3) Local environment

(4) Indoor environment

(Approx. 80 sub-items in total)



Recategorized into
Q (Quality)
and
L (Loadings)



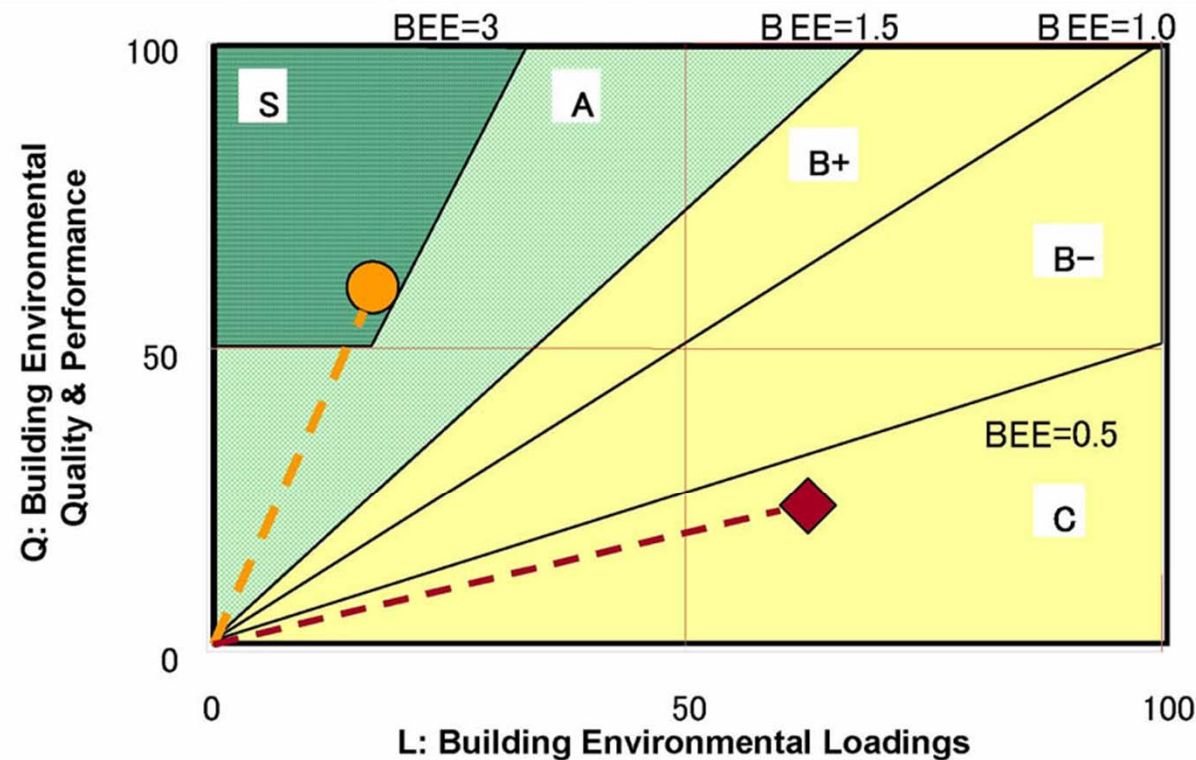
Q-1 Indoor environment
Q-2 Quality of service
Q-3 Outdoor environment on site

Numerator
of BEE

L-1 Energy
L-2 Resources and materials
L-3 Off-site environment

Denominator
of BEE

Sustainability Ranking of Building by BEE



: Ordinary Building



: Sustainable building
(Sample)

(Source: IBEC, Japan)

CASBEE® 評価内容

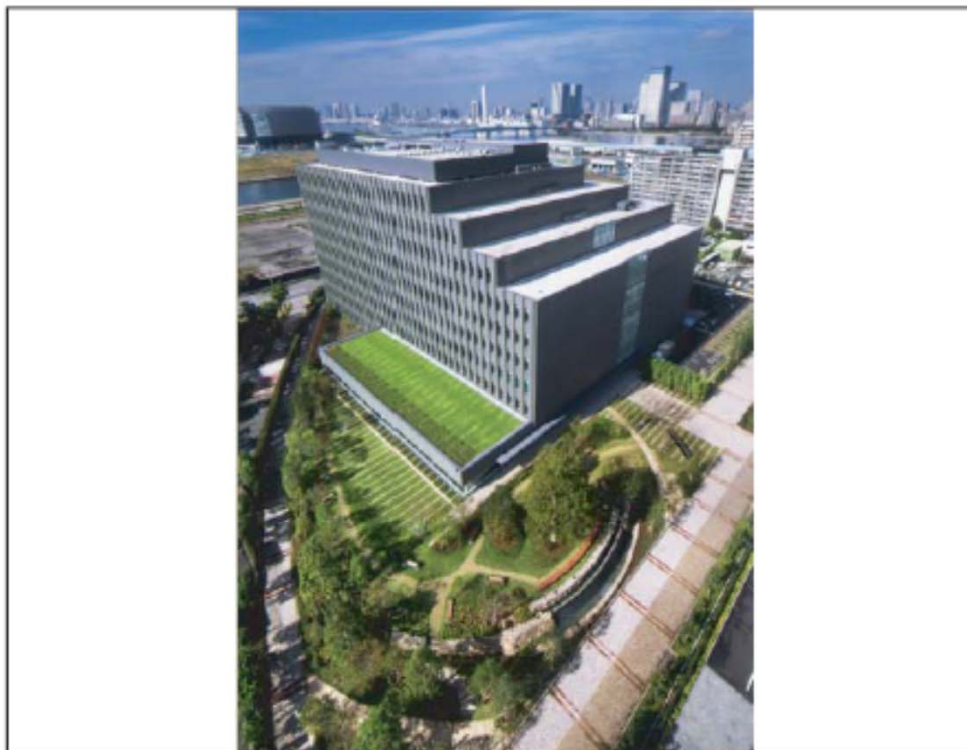
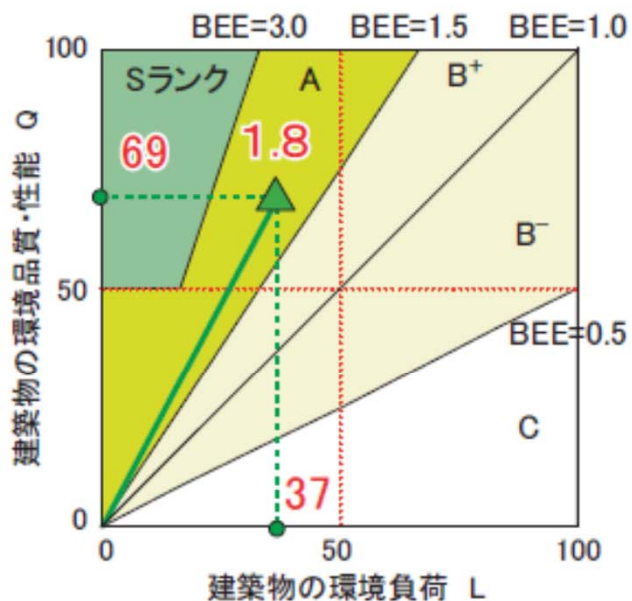
CASBEE-新築(簡易版)

評価ツール CASBEE-NCb_2006v1.2
 認証番号 IBEC-C0046-NCb(c)
 交付日 2009年3月10日

建物名称	NBF豊洲ガーデンフロント	敷地面積	12,551.33㎡
建物用途	事務所	建築面積	5,092.29㎡
建設地	東京都江東区豊洲5丁目6-7	延床面積	36,310.82㎡
気候区分	—	階数	地上10階
地域・地区	準工業地域、準防火地域、第三種高度地区	構造	S造
竣工日	2007年9月30日	平均居住人員	5,660人
		年間使用時間	2,500時間/年

建築物の環境性能効率 (BEE: Building Environmental Efficiency)

BEEによる建築物のサステナビリティランキング

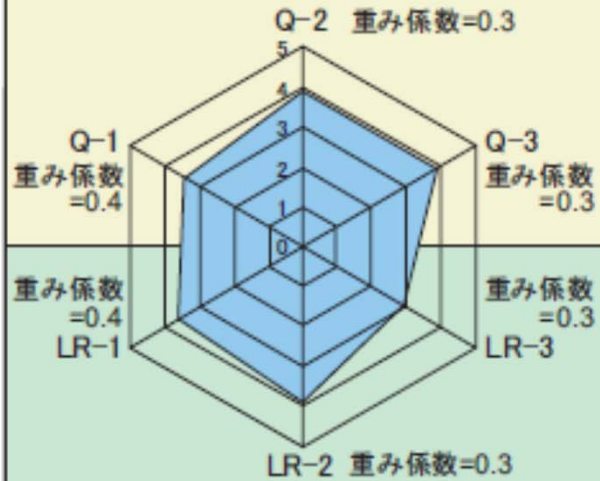


$$BEE = \frac{\text{建築物の環境品質・性能 } Q}{\text{建築物の環境負荷 } L} = \frac{25 \times (S_Q - 1)}{25 \times (5 - S_{LR})} = \frac{69.0}{37.0} = 1.8$$

(Source: IBEC, Japan)

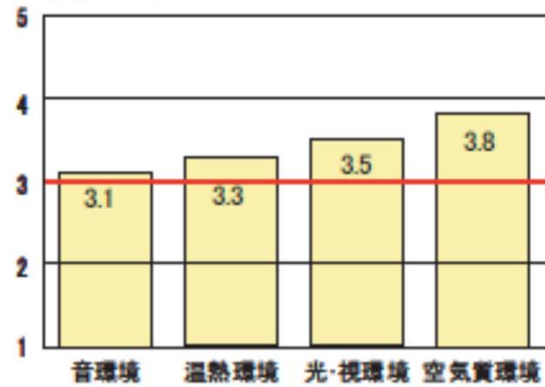
建築物の環境品質・性能と環境負荷低減性

レーダーチャート

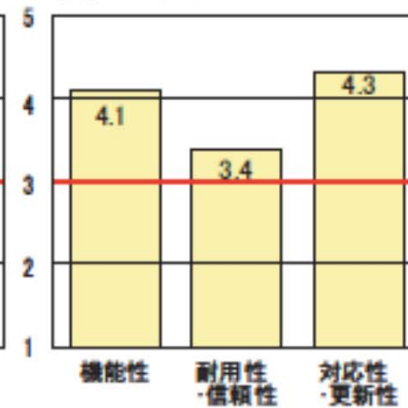


Q 建築物の環境品質・性能 (建築物の居住環境のアメニティを向上させる性能評価) $S_Q = 3.7$

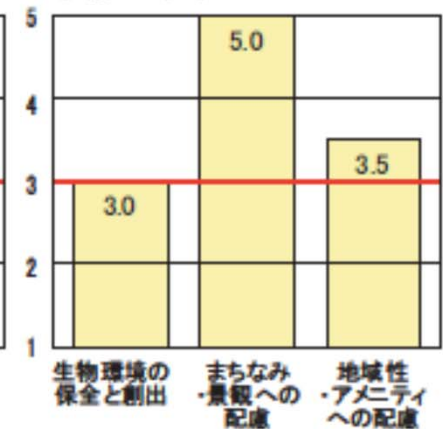
Q-1:室内環境 $S_{Q1} = 3.4$



Q-2:サービス性能 $S_{Q2} = 3.9$



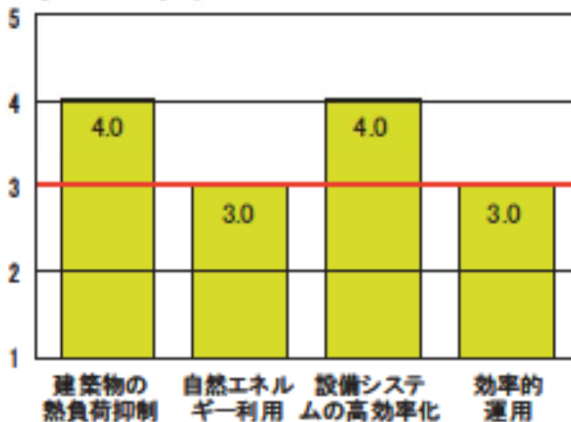
Q-3:室外環境(敷地内) $S_{Q3} = 3.9$



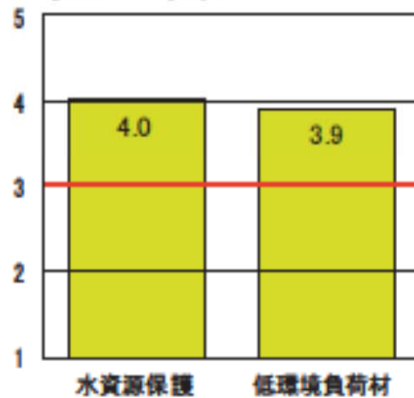
LR 建築物の環境負荷低減性 (建築物の環境負荷を低減させる性能評価)

$SLR = 3.5$

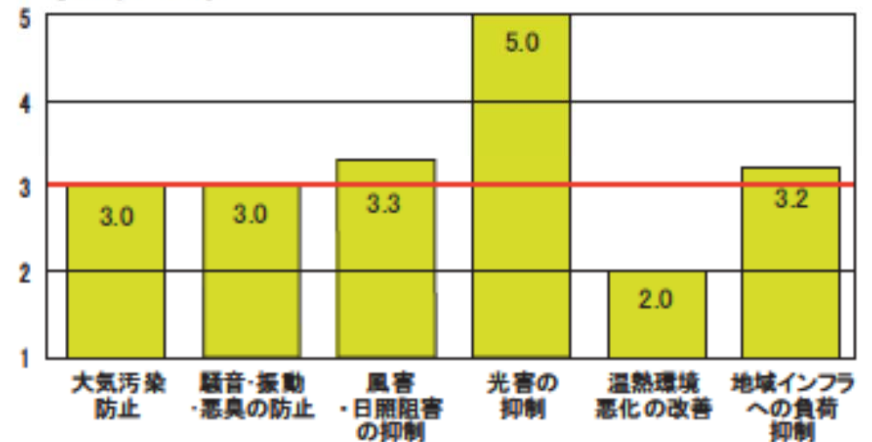
LR-1:エネルギー $SLR1 = 3.6$



LR-2:資源・マテリアル $SLR2 = 3.9$



LR-3:敷地外環境 $SLR3 = 2.9$

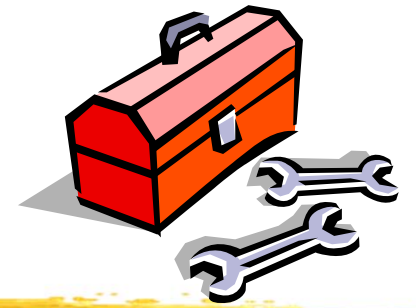


Korea's Green Building Rating System Criteria (multi-residential building)

Section	Resource Consumption	Environmental Loadings	Quality of Indoor Environ.	Longevity	Process	Contextual Factors
Criteria (Number)	- energy (8) - land (3) - water (2) - materials (7)	- airborne emissions (17) - solid waste (4) - liquid waste (4) - other loadings (2)	- air quality (10) - thermal quality (4) - visual quality (7) - noise & acoustics (3) - controllability of system (2)	- adaptability (5) - maintenance of performance (6)	- design & construction process (6) - building operations planning (7)	- location & transportation (1) - loadings on immediate surroundings (4)
Total(102)	20	27	26	11	13	5

* Source: Green Building Council of Korea (www.gbc-korea.co.kr)

Current Tools



- **Green Mark (GM) Scheme, Singapore**

- Started 2005

- http://bca.gov.sg/GreenMark/green_mark_criteria.html

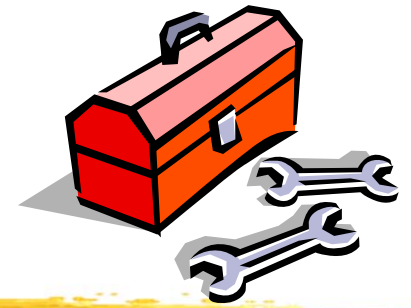
- **Categories:**

- Non-Residential New Buildings
 - Residential New buildings
 - Existing Buildings
 - Office Interior
 - Landed Houses
 - Infrastructure
 - District



BCA GREEN MARK

Current Tools



- **Green Mark (GM) Scheme, Singapore**

- Assessment criteria

- Energy Efficiency [79]
- Water Efficiency [14]
- Environmental Protection [32]
- Indoor Environmental Quality [8]
- Other Green Features and Innovation [7]

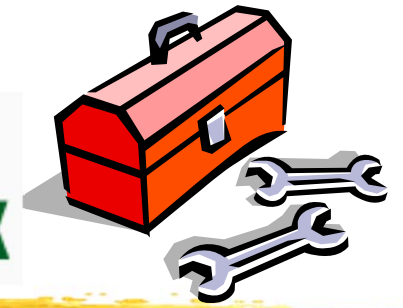
- GM ratings: max 140 + 20 bonus points

- Platinum (90+), GoldPlus (85-90), Gold (75-85) or Certified (50-75)

- Re-assess every 3 years to maintain GM status

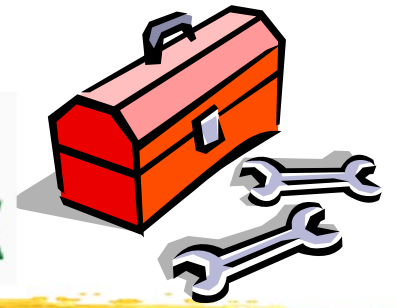


Current Tools



- **Green Building Index (GBI), Malaysia**
 - Started 2009 (www.greenbuildingindex.org)
 - New Construction (NC)
 - Non-residential (NRNC) and residential (RNC)
 - Procedures:
 - Stage 1. Application & Registration
 - Stage 2. Design Assessment
 - Stage 3. Completion & Verification Assessment
 - GBI Accreditation Panel (GBIAP)
 - GBI Certifiers and GBI Facilitators

Current Tools



- **Green Building Index (GBI), Malaysia**
 - Six main criteria: [max. point for new construction]
 - Energy Efficiency (**EE**) [35]
 - Indoor Environment Quality (**EQ**) [21]
 - Sustainable Site Planning & Management (**SM**) [16]
 - Materials & Resources (**MR**) [11]
 - Water Efficiency (**WE**) [10]
 - Innovation (**IN**) [7]
 - Total score = 100
 - GBI ratings: Certified (50-65), Silver (66-75), Gold (76-85) and Platinum (86+)

Current Tools



- Mainland China
 - GB/T 50378-2006, Evaluation Standard for Green Building (綠色建築評價標準)
 - Similar to LEED in structure and rating process
 - A three-star Green Building certificate will be awarded to the qualified buildings
 - Green Olympic Building Assessment System (GOBAS) (綠色奧運建築評核系統)
 - Developed from the Japan's CASBEE method
 - Applied mainly in Beijing

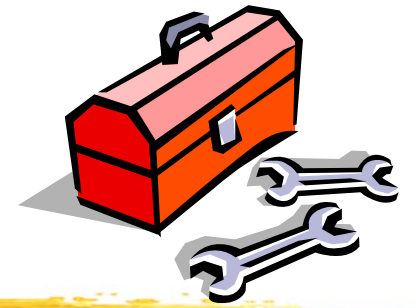
Current Tools



- Taiwan Green Building Label
 - Nine sets of assessment criteria/indicators:
 - 1. Biodiversity 生物多樣性
 - 2. Greenery 綠化量
 - 3. Water retention 基地保水
 - 4. Energy efficiency 日常節能
 - 5. Carbon dioxide reduction CO2減量
 - 6. Waste reduction 廢棄物減量
 - 7. Indoor environment 室內環境
 - 8. Water resources 水資源
 - 9. Wastewater and garbage 污水垃圾改善



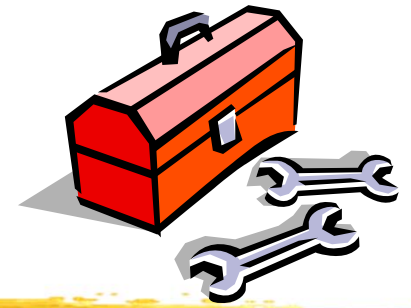
Current Tools



- Taiwan Green Building Material
 - General
 - Healthy
 - Recycling
 - High-performance
 - Ecological
- Website: www.cabc.org.tw/gbm



Current Tools

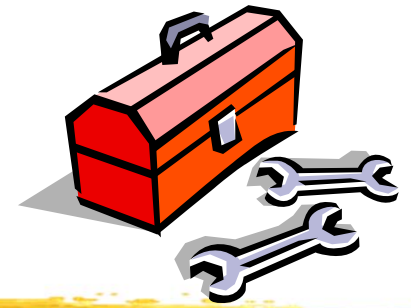


HONG KONG BUILDING ENVIRONMENTAL
ASSESSMENT METHOD

香港建築環境評估法

- HK-BEAM
 - Previous versions:
 - Version 1/96R - for new office designs
 - Version 2/96R - for existing office buildings
 - Version 3/99 - for new residential buildings
 - Hotel Building Environmental Assessment Scheme (HBEAS)
 - Issues covered:
 - Global issues & use of resources
 - Local issues
 - Indoor issues

Current Tools

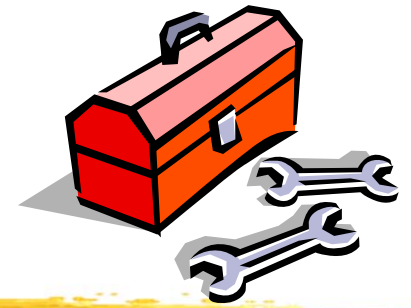


HONG KONG BUILDING ENVIRONMENTAL
ASSESSMENT METHOD

香港建築環境評估法

- HK-BEAM
 - Versions 2004:
 - HK-BEAM 4/04 New Buildings
 - HK-BEAM 5/04 Existing Building
 - Approach and criteria
 - Site aspects
 - Materials aspects
 - Energy use
 - Water use
 - Indoor environmental quality (IEQ)
 - Innovation & performance enhancements

Current Tools



HONG KONG BUILDING ENVIRONMENTAL
ASSESSMENT METHOD

香港建築環境評估法

- **HK-BEAM**

- Weighting system to reflect
 - Relative importance of criteria
 - Relative areas of the spaces
- Overall assessment grade (IEQ must meet min. %)

• Platinum	75% (Excellent)	min. IEQ 65%
• Gold	65% (Very Good)	min. IEQ 55%
• Silver	55% (Good)	min. IEQ 50%
• Bronze	40% (Above average)	min. IEQ 40%
- Website: www.hk-beam.org.hk

Current Tools



- BEAM Plus (launched 2009)
 - Version 2009: (start 1 Apr 2010)
 - BEAM Plus for New Buildings
 - BEAM Plus for Existing Buildings
 - Criteria [weighting]
 - Site aspects (SA) [25%]
 - Materials aspects (MA) [8%]
 - Energy use (EU) [35%]
 - Water use (WU) [12%]
 - Indoor environmental quality (IEQ) [20%]
 - Innovations & additions (IA) [credits 0-3]



BEAM Society
香港環保建築協會

Current Tools



- BEAM Plus (launched 2009)
 - Overall grade: (with min. for SA, EU and IEQ)

	Overall	Site Aspects	Energy Use	IEQ	Innov. & Addn.	
Platinum	75%	70%	70%	70%	3 credits	Excellent
Gold	65%	60%	60%	60%	2 credits	Very Good
Silver	55%	50%	50%	50%	1 credit	Good
Bronze	40%	40%	40%	40%	---	Above Average

Current Tools



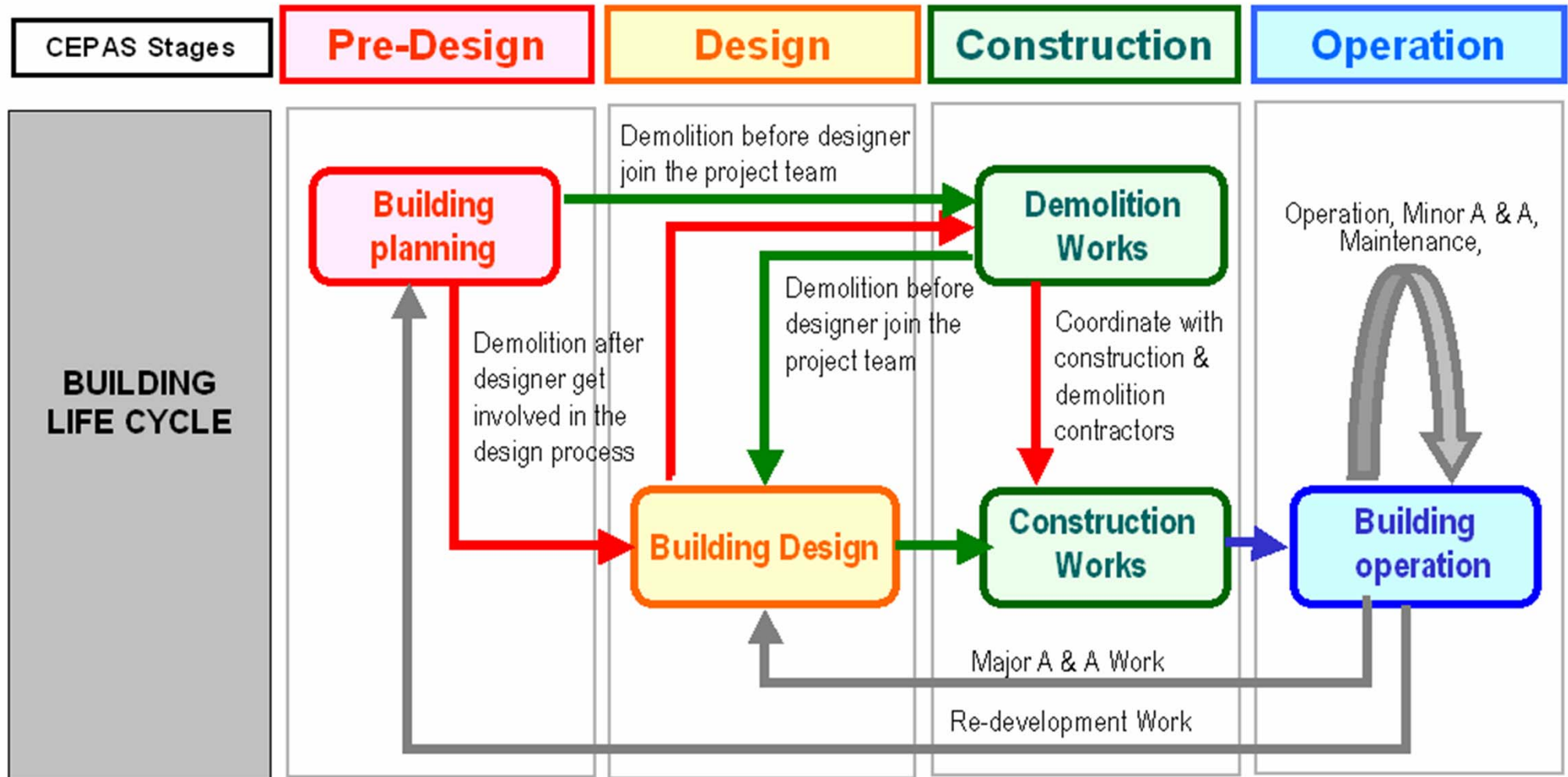
- Comprehensive Environmental Performance Assessment Scheme (**CEPAS**) for Buildings
 - A consultancy study is commissioned by Buildings Department to develop this scheme
 - Building types:
 - Residential
 - Non-residential
 - Applications: new buildings, major addition & alternation, existing buildings

Current Tools



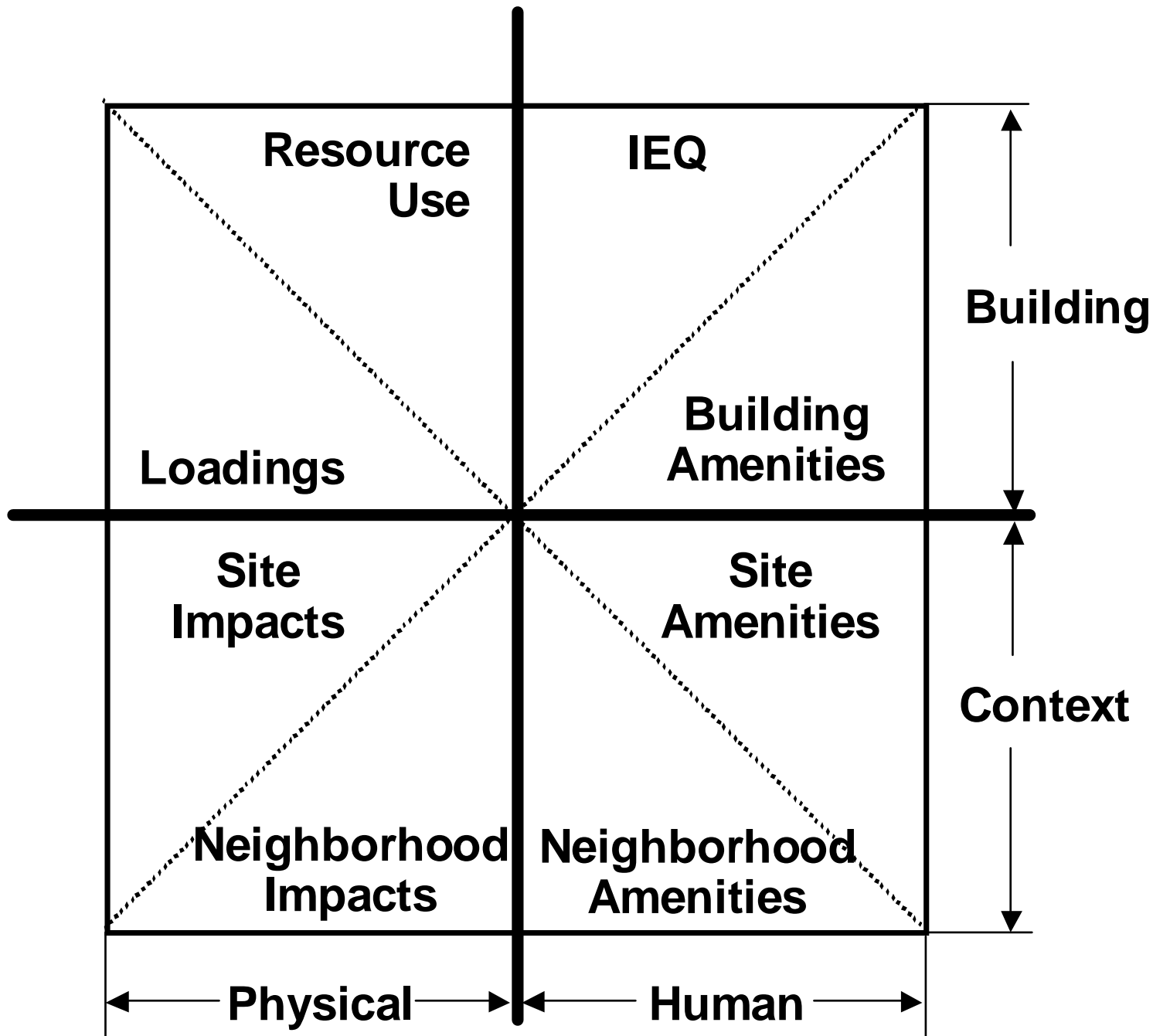
- Comprehensive Environmental Performance Assessment Scheme (**CEPAS**) for Buildings
 - Four main stages:
 - Pre-design
 - Design
 - Construction
 - Operation
 - Eight performance categories
 - Loading, Resources use, IEQ, Building amenities, Site amenities, Neighborhood amenities, Neighborhood impacts, Site impacts

Building life cycle stages for CEPAS (2006)



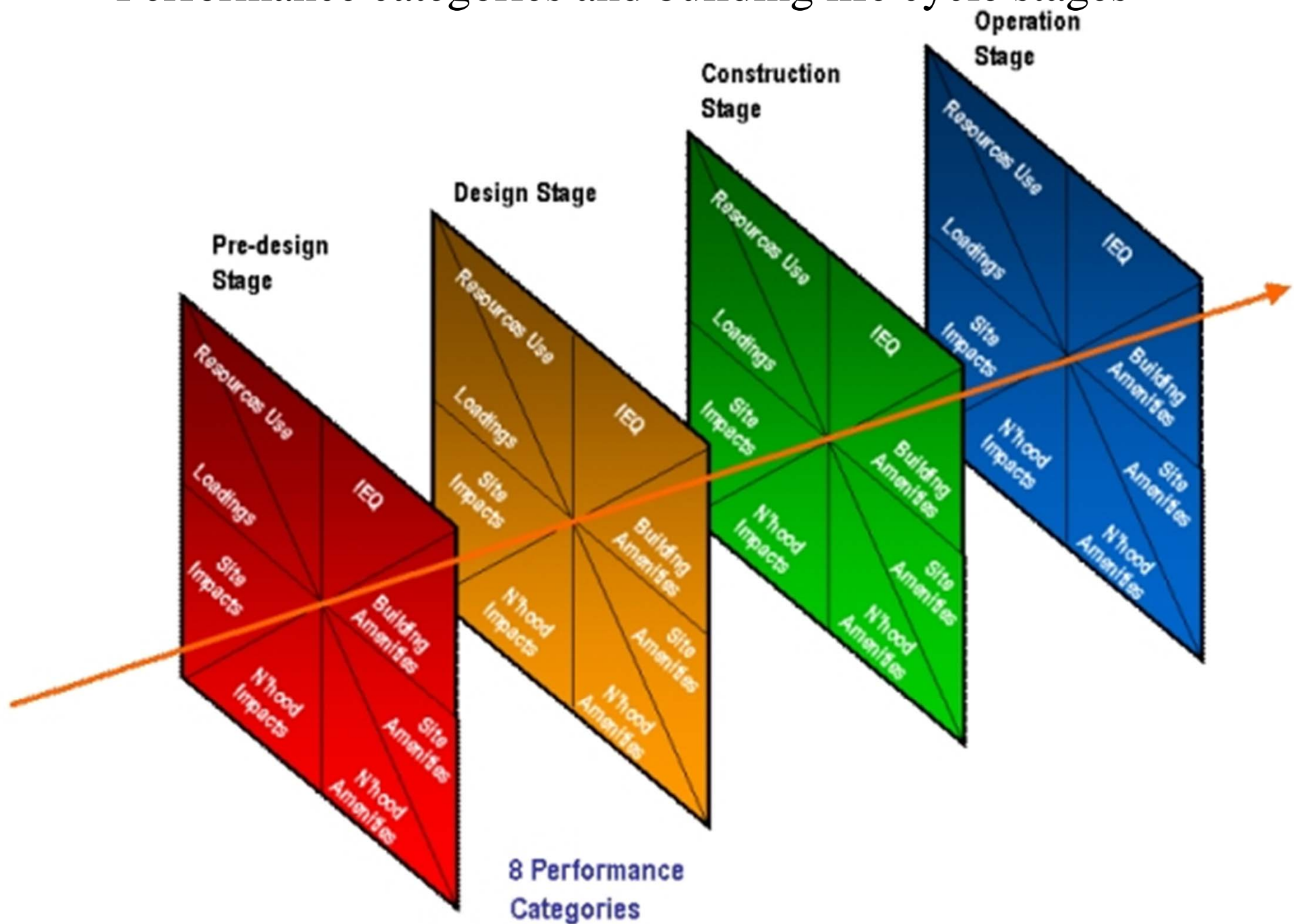
(Source: Executive Summary for CEPAS)

Performance categories for CEPAS



(Source: Executive Summary for CEPAS)

Performance categories and building life cycle stages



(Source: Executive Summary for CEPAS)

Current Tools



- GBTool
 - GBC (Green Building Challenge) for 19 countries
 - Issues considered
 - Resource consumption (**R**)
 - Environmental loadings (**L**)
 - Indoor environmental quality (**Q**)
 - Quality of service (**S**)
 - Economics (**E**)
 - Pre-operations management (**M**)
 - Architectural quality (? not included)



Performance Assessment Sheet

GBC default User default

Building Name: Mon Repos MegaCentre
Building Type: Office Building
Version: Daylit, low-energy version
City & Country: Toronto, Canada

Save Revised Weights

Office Building **Select Primary Building Type**
Multi-Unit Residential
School

Note: in both the Assessment and Content worksheets, information is available at various levels of detail. Click on the small buttons at the upper left marked 1, 2, 3, 4 or 5, to see the results.

Realized statements indicate that the parameter is theoretically relevant, but that an assessment is not possible or is impractical at this time.

Note that dummy scores have been entered into this version of the system. This means that some scores may not make sense - e.g. if a parameter is non-applicable for a certain building type but applicable to another type, there is likely to be a score entered. However, the weighted score will still make sense, since weights are automatically set to zero if the parameter is non-applicable.

Enter Score or text:	Errng fields:	
Enter Weight:		25%
Formula field:	Information fields; not for user entry	3.0
Formula field linked to other scores:		3.2
Results or weighted score field:		2.5
Hyperlink:		
Parameter or text depends on building type:		25%

Performance Relative to Appropriate Benchmarks		Scoring		Weighting and scoring					
R RESOURCE CONSUMPTION		Sub-criterion			Criterion			Category	
		Score -2 to 5	Weight	Wtd. score	Score -2 to 5	Weight	Wtd. score	Weight	Wtd. score
L LOADINGS		Sub-criterion			Criterion			Category	
		Score -2 to 5	Weight	Wtd. score	Score -2 to 5	Weight	Wtd. score	Weight	Wtd. score
Q INDOOR ENVIRONMENTAL QUALITY		Sub-criterion			Criterion			Category	
		Score -2 to 5	Weight	Wtd. score	Score -2 to 5	Weight	Wtd. score	Weight	Wtd. score
S QUALITY OF SERVICE		Sub-criterion			Criterion			Category	
		Score -2 to 5	Weight	Wtd. score	Score -2 to 5	Weight	Wtd. score	Weight	Wtd. score
E ECONOMICS		Assessor's Notes							
M PRE-OPERATIONS MANAGEMENT		Assessor's Notes							

Environmental Sustainability Indicators for Design		by area only	area & occup.
ESI-1	Net annual consumption of primary energy for building operations in MJ, normalized for net area and occupancy	860	287
ESI-2	Net area of land consumed for building and related works, normalized for net area and occupancy	0.23	5.52
ESI-3	Net annual consumption of potable water for building operations, normalized for net area and occupancy	33.1	9.2
ESI-4	Net annual GHG emissions from building operations, kg. CO ₂ equiv., normalized for net area and occupancy	1996	791
ESI-5	optional, at discretion of national teams		
ESI-6	optional, at discretion of national teams		
The results shown are for a Office Building building. To change building type go to Main worksheet			

Levels of Performance for Design at Category Level



Current Tools



- Green Building Challenge (GBC)
 - An international process, initiated by Canada
 - Examples of green buildings in the world
 - GBC 1998 (Vancouver, Canada)
 - GBC 2000 (Maastricht, the Netherlands)
 - GBC 2002 (Oslo, Norway)
 - See conference proceedings & GBC CD



Video Presentation



- Pennsylvania's First Green Building
 - Location: Pennsylvania, USA
 - Completion: 1999
 - Description: [videorecording, 27 min.]
 - <http://www.portal.state.pa.us/portal/server.pt?open=514&objID=588212&mode=2>



Pennsylvania Department of Environmental Protection Harrisburg, Pennsylvania



LEED™ 1.0 Certification:
BRONZE

Notes from the Project Team: LEED™ is an invaluable tool for Building Green in Pennsylvania projects which require an integrative design and measuring tool for High Performance Green Buildings.

Sustainable Sites

- **Site Selection:** Brownfield (once a quarry then landfill) and within the Harrisburg Area Economic Development Corridor
- **Resource Protection:** Leachate & Methane collection for remediation, indigenous plants, & Xeriscaping regenerate natural landscape

Water Efficiency

- **Water:** Complies with Energy Policy Act Of 1992, uses water saving fixtures
- **Storm/Wastewater:** Xeriscaping techniques help manage stormwater

Energy and Atmosphere

- **Energy:** Exceeds ASHRAE/IES Standard 90.1-1989 by 20%
- **HVAC:** Raised floor air plenum with individual control of air flow/temperature
- **Controls/Monitoring:** Energy and air monitoring systems measure temperature, relative humidity, and CO₂
- **Power Source:** Gas-Fired absorption chiller uses water as refrigerant
- **Lighting:** Split task indirect ambient with high reflectance ceiling tiles, T-8 lamps and light shelves enhance day lighting

Materials and Resources

- **Structure:** 94% postindustrial Nucor recycled steel frame
- **Recycled Content:** 25% of materials have substantial recycled content.

Indoor Environmental Quality

- **Low Emitting Materials:** Concrete floor with Low-VOC sealant
- **Furniture:** Conference room chairs' seat fabric made of wool & plant fiber--toxic free biodegradable. Panel fabric made of 100% post-consumer recycled plastic PET.



Owner:	New Morgan Municipal Authority
Project Team:	Architect: <i>Kostecky Group</i> Engineer: <i>Deepal Wickramasinghe & N.K. Gunawardana</i> Contractor: <i>909 Partners as GC</i> Consultant: <i>Energy Opportunities, Carnegie Mellon University, Penn Energy Project & 21 other</i>
Building Statistics:	
Completion Date:	<i>May, 1998</i>
Cost:	<i>\$5.7 M</i>
Size:	<i>73,000 gross square feet</i>
Footprint:	<i>26,770 square feet</i>
Construction Type:	<i>Three story steel frame</i>
Use Group:	<i>Business (State Government Office Building)</i>
Lot Size:	<i>13.4 acres</i>
Occupancy:	<i>240 Employees</i>