GEE5303 Green and Intelligent Building

http://ibse.hk/GEE5303/

Building environmental assessment

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- Assessment methods
- Current tools
  - BREEAM, LEED, CASBEE
  - GreenMark, GBI
  - China 3-star, Taiwan GBL
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Environmental performance

- **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

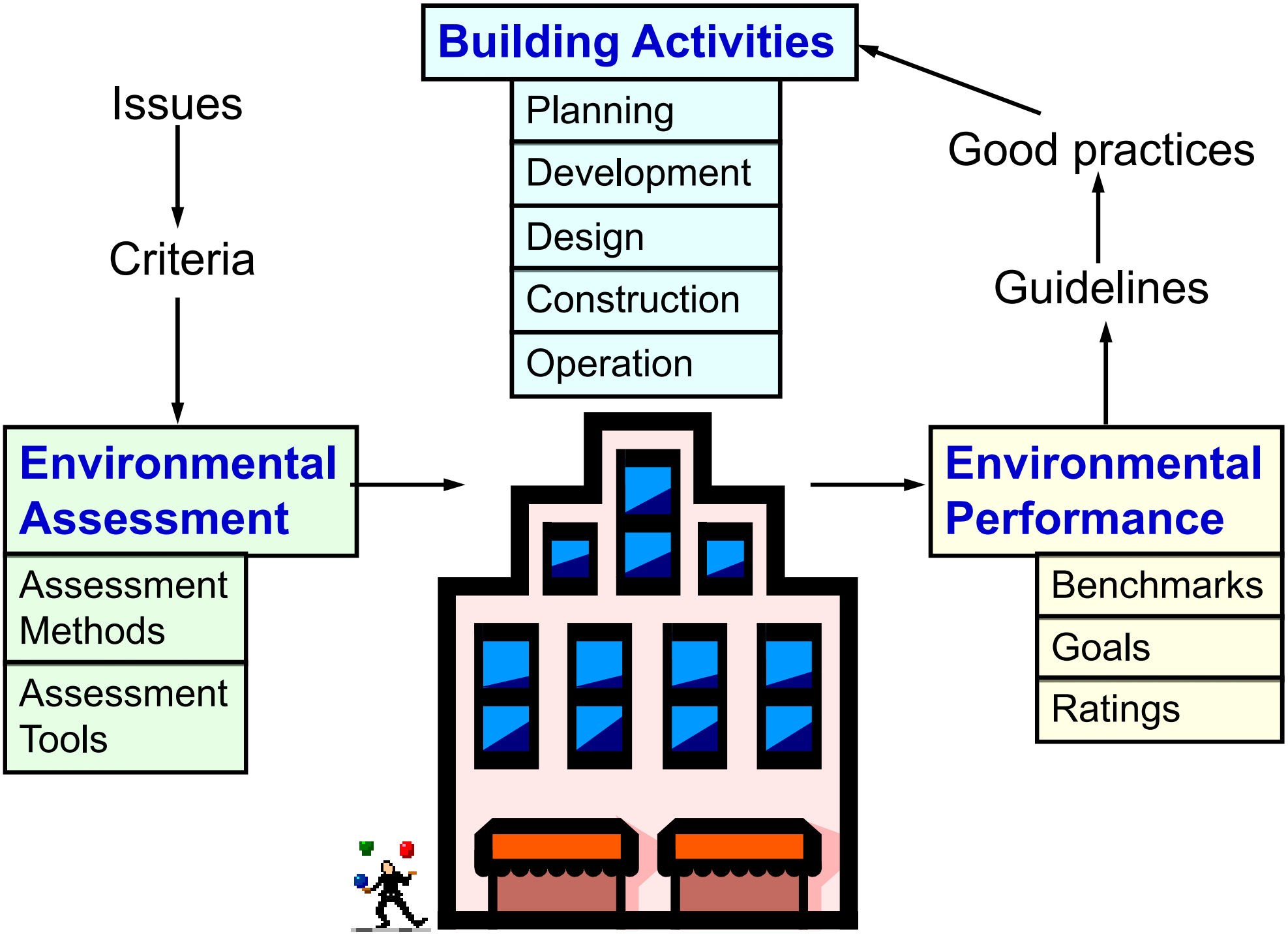
For supporting decision making

(* Also known as green building assessment.)

Environmental performance

- 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 of building environmental assessment

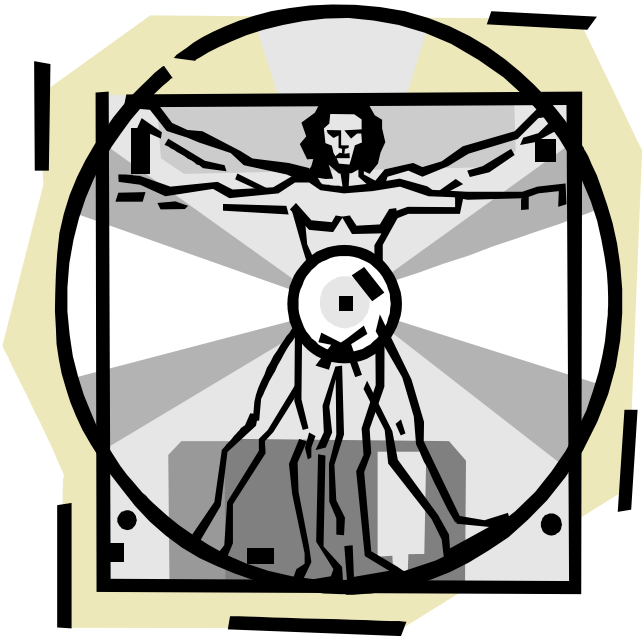


Environmental performance

- 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)

Environmental performance

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



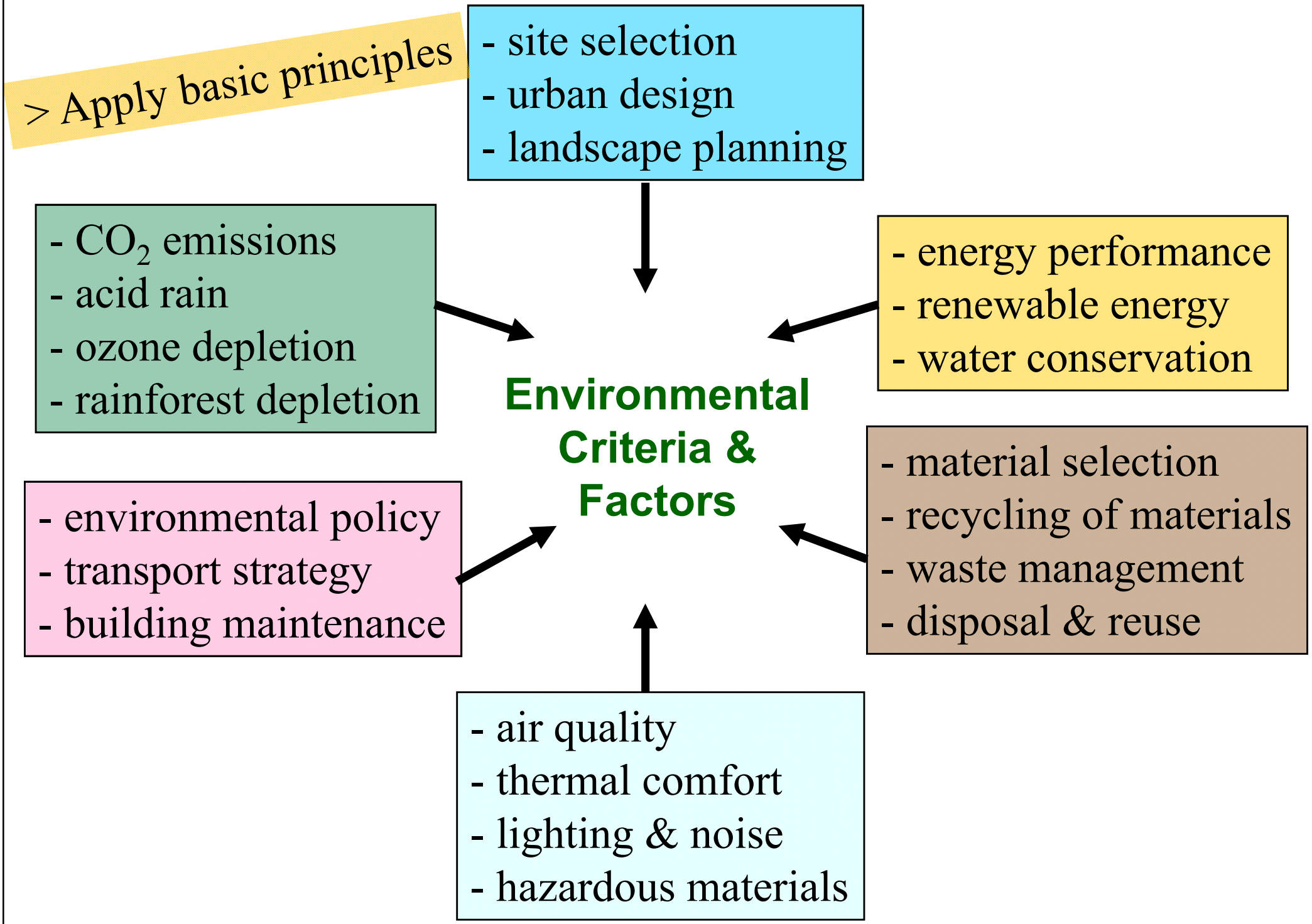
- Building types: new, existing & refurbished

Assessment methods

- 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

How to select and evaluate the criteria?

Source: www.moew.gov.ae


> Apply basic principles
- site selection
- urban design
- landscape planning
- CO_2 emissions
- acid rain
- ozone depletion
- rainforest depletion
- energy performance
- renewable energy
- water conservation
Environmental Criteria & Factors
- material selection
- recycling of materials
- waste management
- disposal & reuse
- environmental policy
- transport strategy
- building maintenance
- air quality
- thermal comfort
- lighting & noise
- hazardous materials

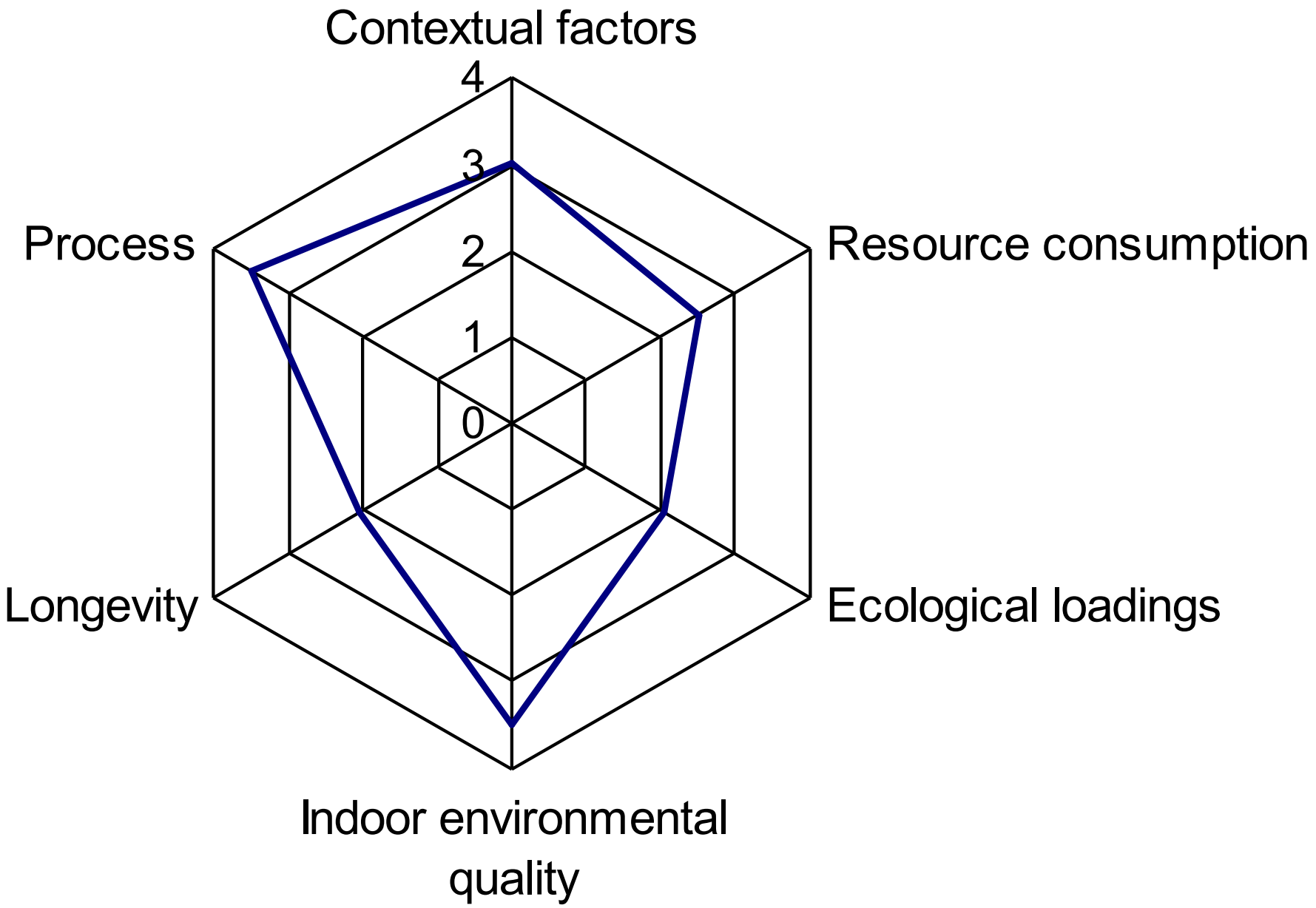
Assessment methods

- 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 methods

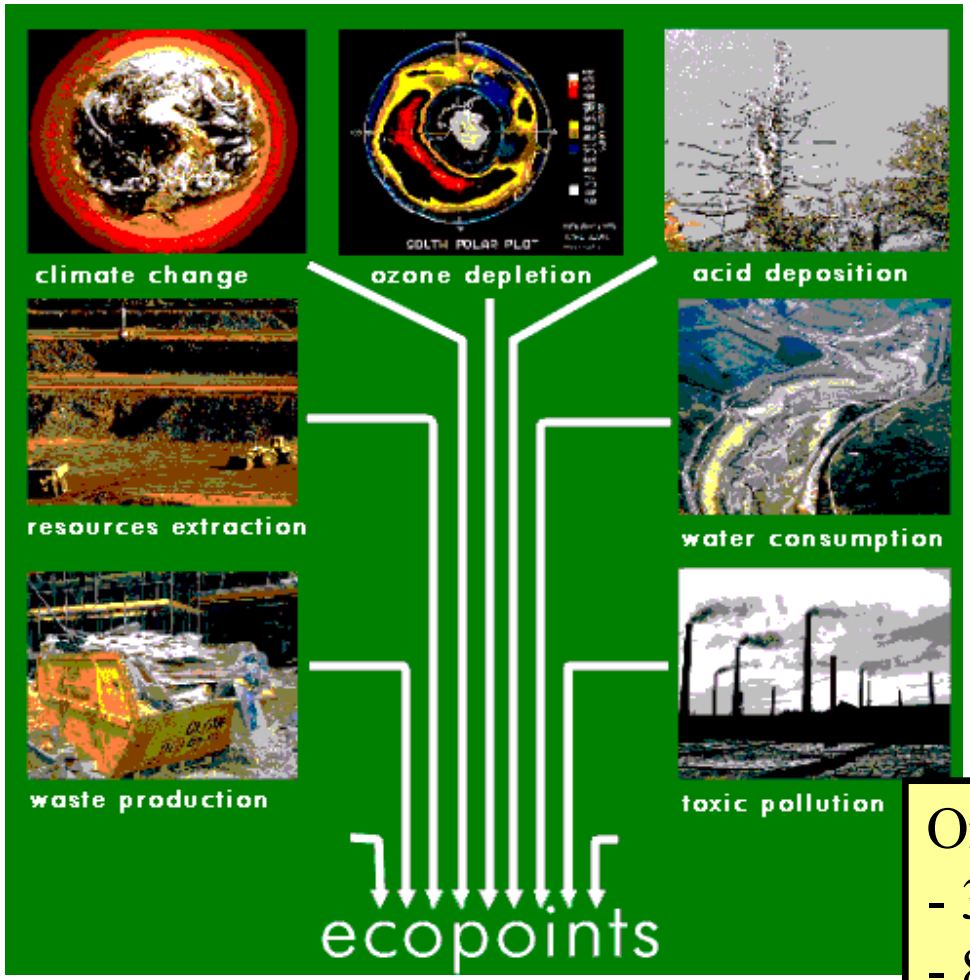
- Assessing multiple criteria
  - Indicate the ‘best’ overall performance
  - Methodology
    - Cost (or monetary value $)
    - Equivalence method (e.g. air/water pollution index)
    - EcoCost (in common Gaia scale 0-1)
    - EcoPoint or EcoProfile
- Weighting system
  - To show relative importance,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

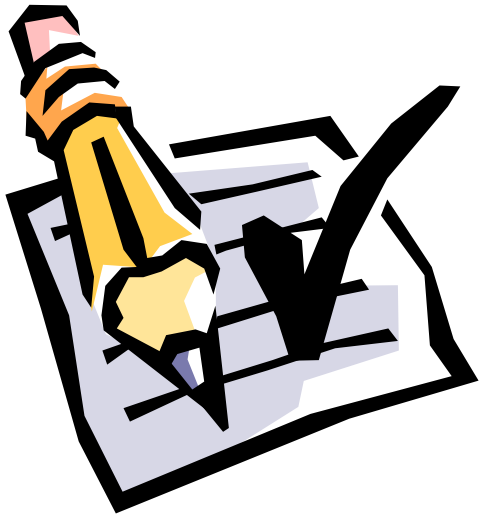
One "**ecopoint**" is equivalent to:
- 320 kWh electricity
- 83 m^2 Water: enough to fill 1,000 baths
- 65 miles by articulated truck
- landfilling 1.3 tonnes of waste
- manufacturing 3/4 tonnes brick (250 bricks)
- 540 tonne kms by sea freight
- 1.38 tonnes mineral extraction
- 300 miles of urban driving in new petrol car

envest

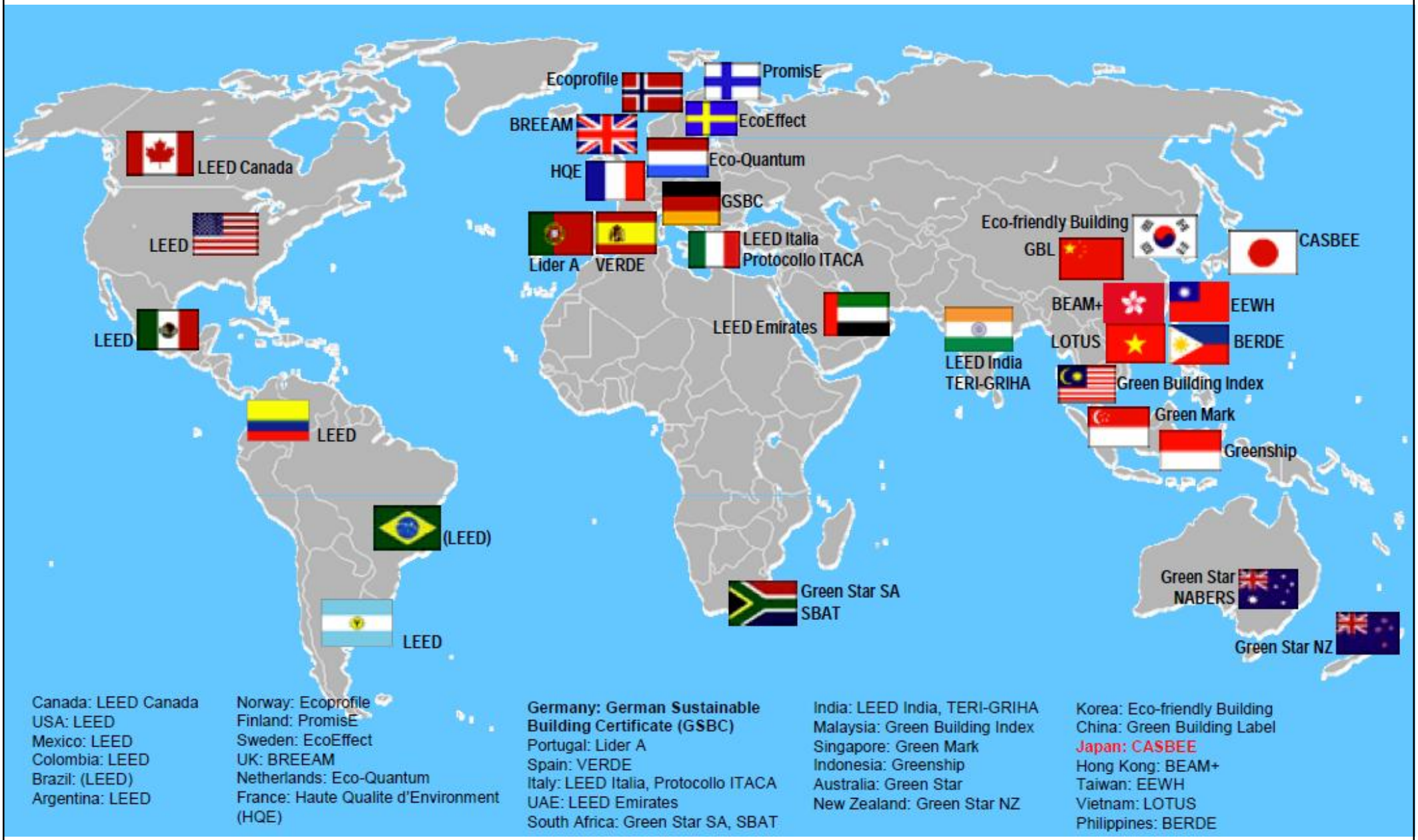
(Source: UK BRE)

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



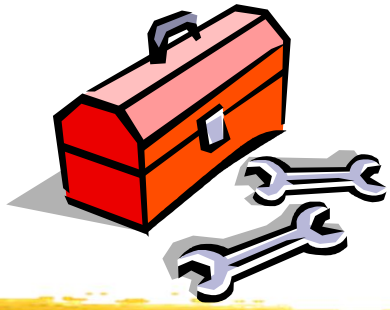
Rating tools of building environmental performances around the world



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

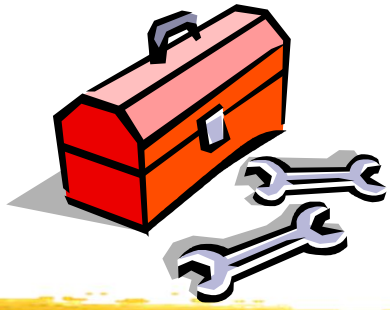
(Adapted from *CASBEE in Progress for Market Transformation in Japan*, by Prof. Kazuo Iwamura, Tokyo City University)

Current tools



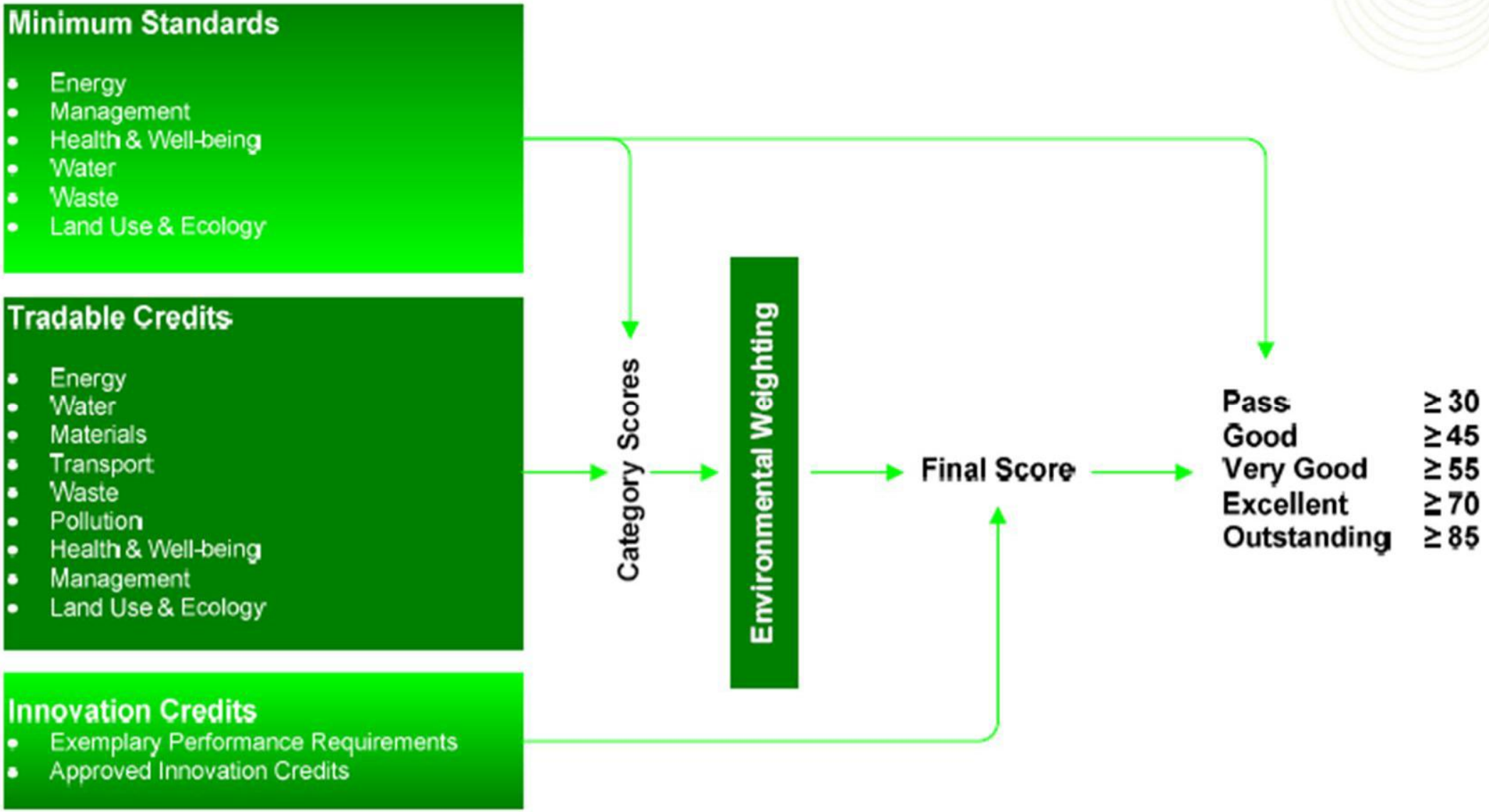
- BREEAM – UK (since 1990)
  - **B**uilding **R**esearch **E**stablishment **E**nvironmental **A**ssessment **M**ethod
    - Used as a reference in many countries
  - BREAM family of assessment methods & tools
    - Any types of buildings (new and existing)
    - BREEAM International (outside of UK)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

Current tools



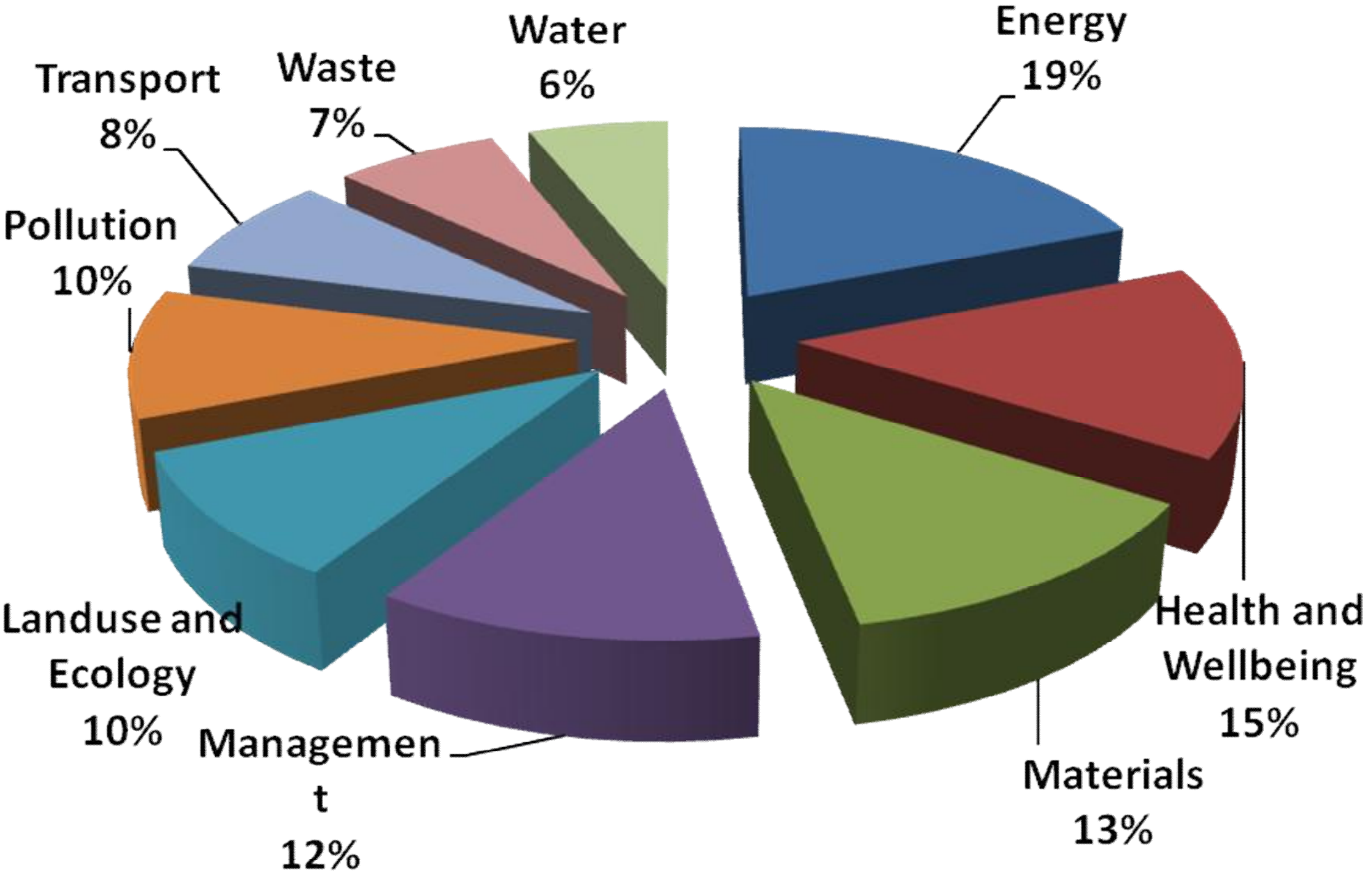
- BREEAM – UK (cont'd)
  - Credits awarded for a set of performance criteria
    - Energy, water, pollution, materials, transport, ecology and land use, health and well being
    - Construction & building operational management
    - A weighting system is applied to determine final rating
  - Stages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

Assessment areas of BREEAM-UK



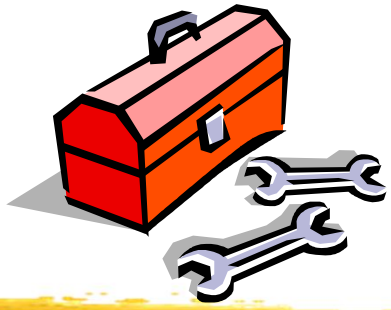
(Source: BRE, UK)

Assessment weightings of BREEAM-UK



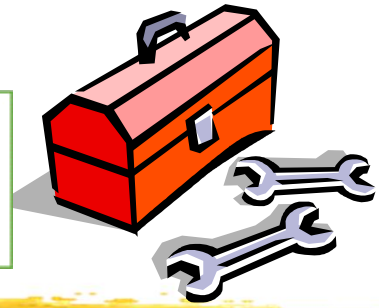
(Source: BRE, UK)

Current tools



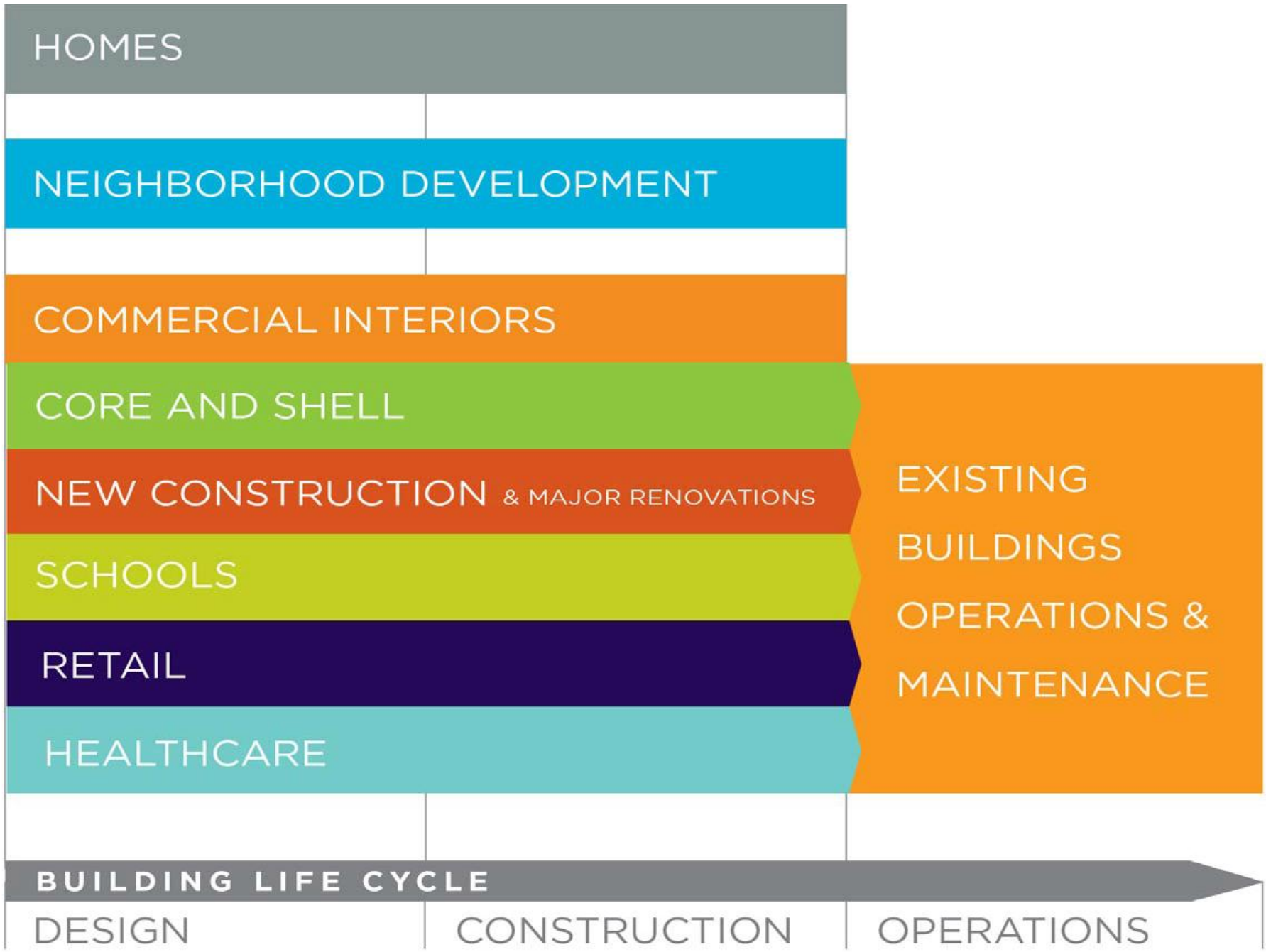
- BREEAM – UK (cont'd)
  - Overall score rating:
    - Pass, Good, Very Good, Excellent, Outstanding
  - BREEAM Assessors
  - BREEAM Accredited Professional (BREEAM AP) and examination/training
  - Up to 3 credits if a BREEAM AP is engaged (BREEAM 2011)

Current tools



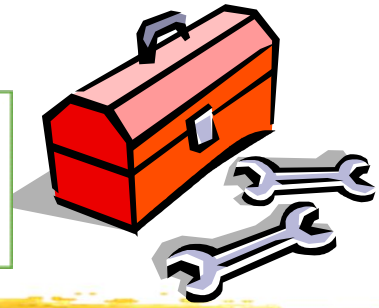
- LEED Green Building Rating System
  - **L**eadership in **E**nergy & **E**nvironmental **D**esign
    - By US Green Building Council
  - Current LEED systems:
    - New construction (LEED-NC) or Building design and construction (BD+C)
    - Existing buildings operations & maintenance (LEED-EBOM) (O+M)
    - Commercial interiors (LEED-CI)
    - Core and shell (LEED-CS)
    - Homes, Schools, Healthcare, Retail
    - Neighborhood development (LEED-ND)

LEED Green Building Rating



(Source: USGBC http://www.usgbc.org/leed)

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: http://www.usgbc.org/leed

(See also: Intro To LEED Certification - GreenEDU.com (3:53) http://www.youtube.com/watch?v=DTIZBFeF2Nc)

(Source: Green Building Academy)

Phillip Merrill Environmental Center
Headquarters
Annapolis, Maryland

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*

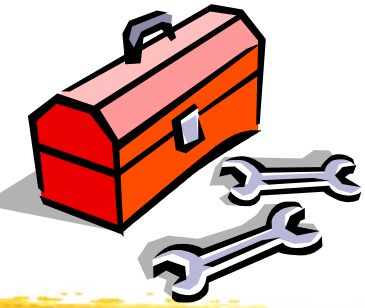
(Source: USGBC)

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:** *CO_2 and VOC monitors.*
  - **Furniture:** *Small, open offices allow for communal space. Systems furniture allows flexible layout to accommodate "churn"*

Current tools

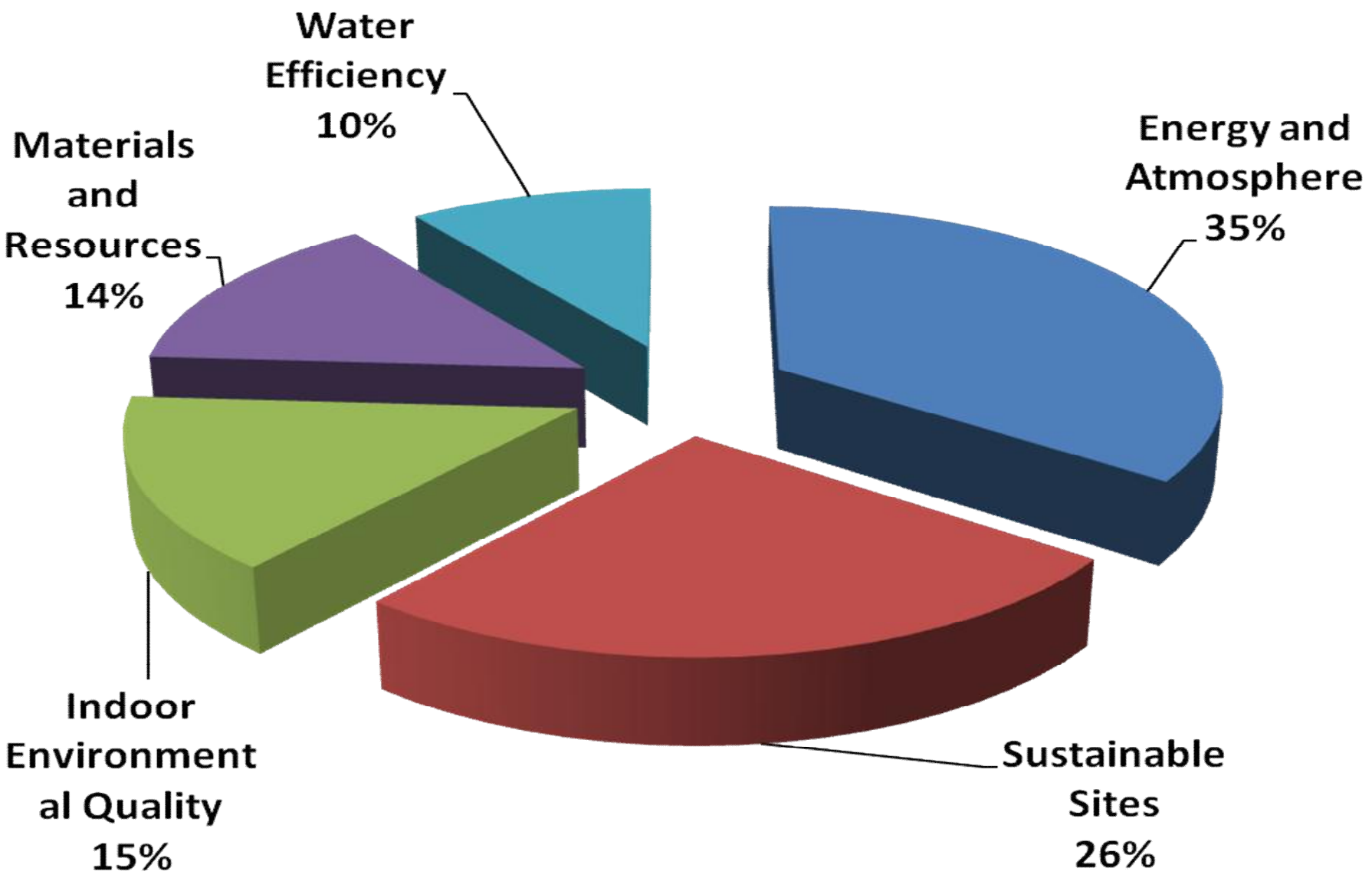


- LEED version 3 and new schemes
  - Include other criteria
    - Locations & linkages
    - Awareness & education
    - Regional priority
  - LEED Professionals
    - LEED Green Associate
    - LEED AP (different types)
      - Bldg design & construction, O&M, Homes, Interior design, Neighborhood development

(Source: USGBC)

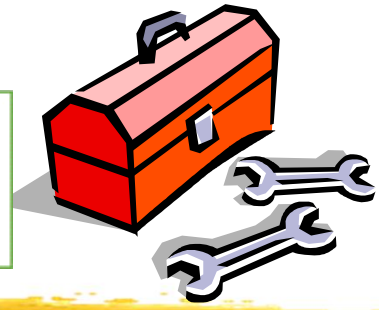
For LEED version 3

LEED NC point distribution (version 2009)



(Source: USGBC)

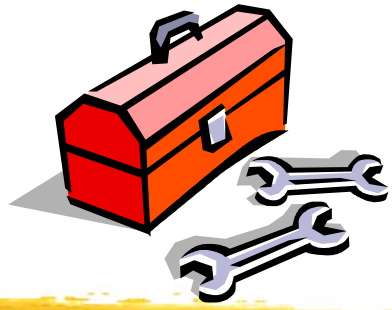
Current tools



- LEED v4 (launched in 2014)*
  - Location & Transportation (LT)
  - Sustainable Site (SS)
  - Water Efficiency (WE)
  - Energy and Atmosphere (EA)
  - Materials and Resources (MR)
  - Indoor Environmental Quality (EQ)
  - Innovation (IN)
  - Regional Priority (RP)

(* See also http://new.usgbc.org/leed/v4)

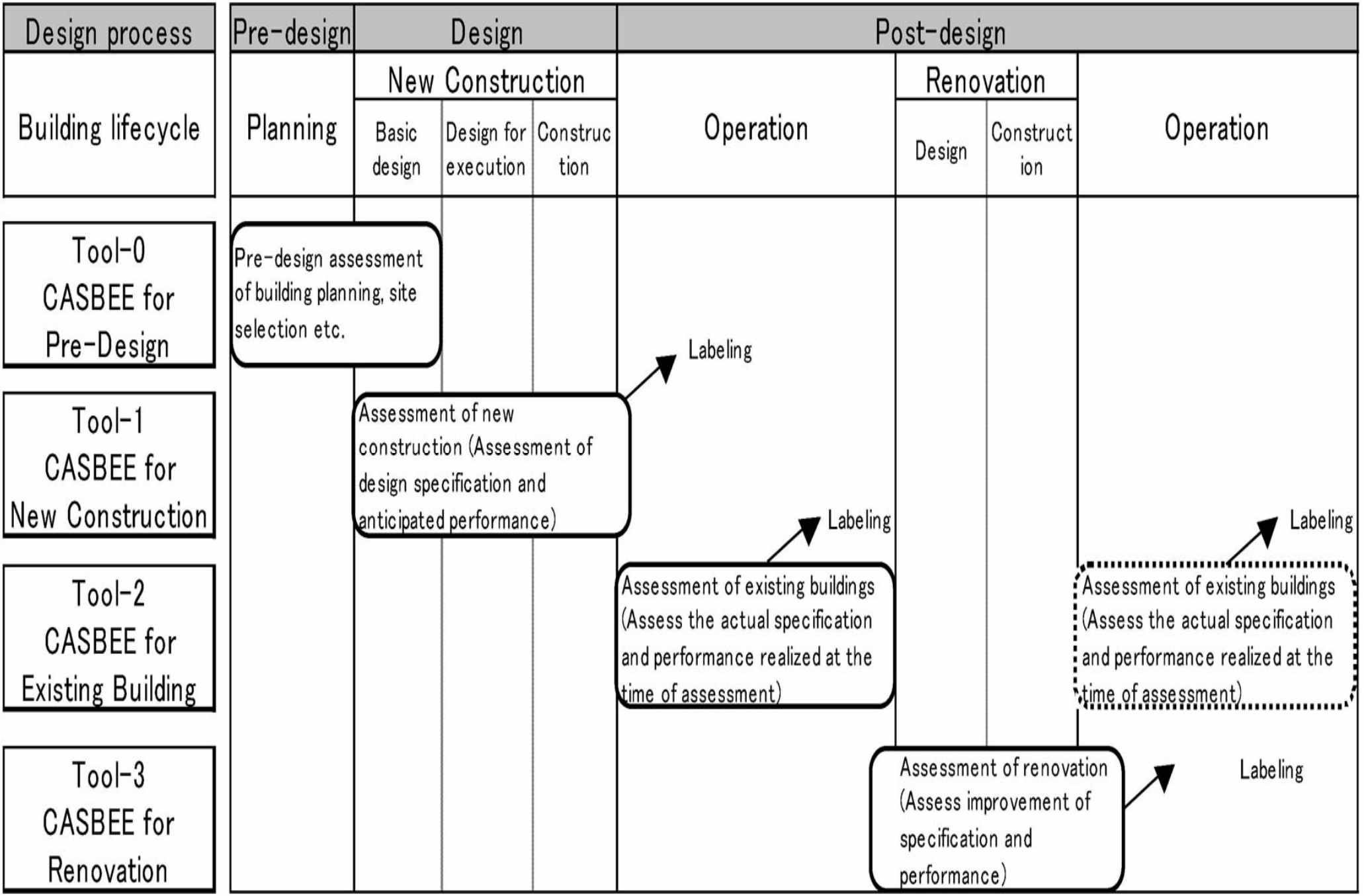
Current tools: CASBEE



- 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/

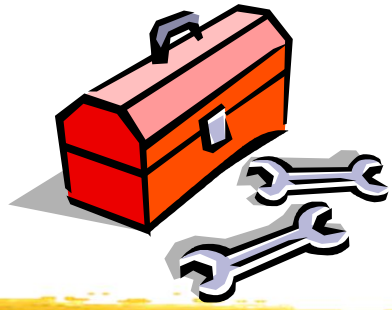
CASBEE® 建築環境総合性能評価システム
Comprehensive Assessment System for Built Environment Efficiency

CASBEE Building Lifecylce and Four Assessment Tools



(Source: IBEC, Japan)

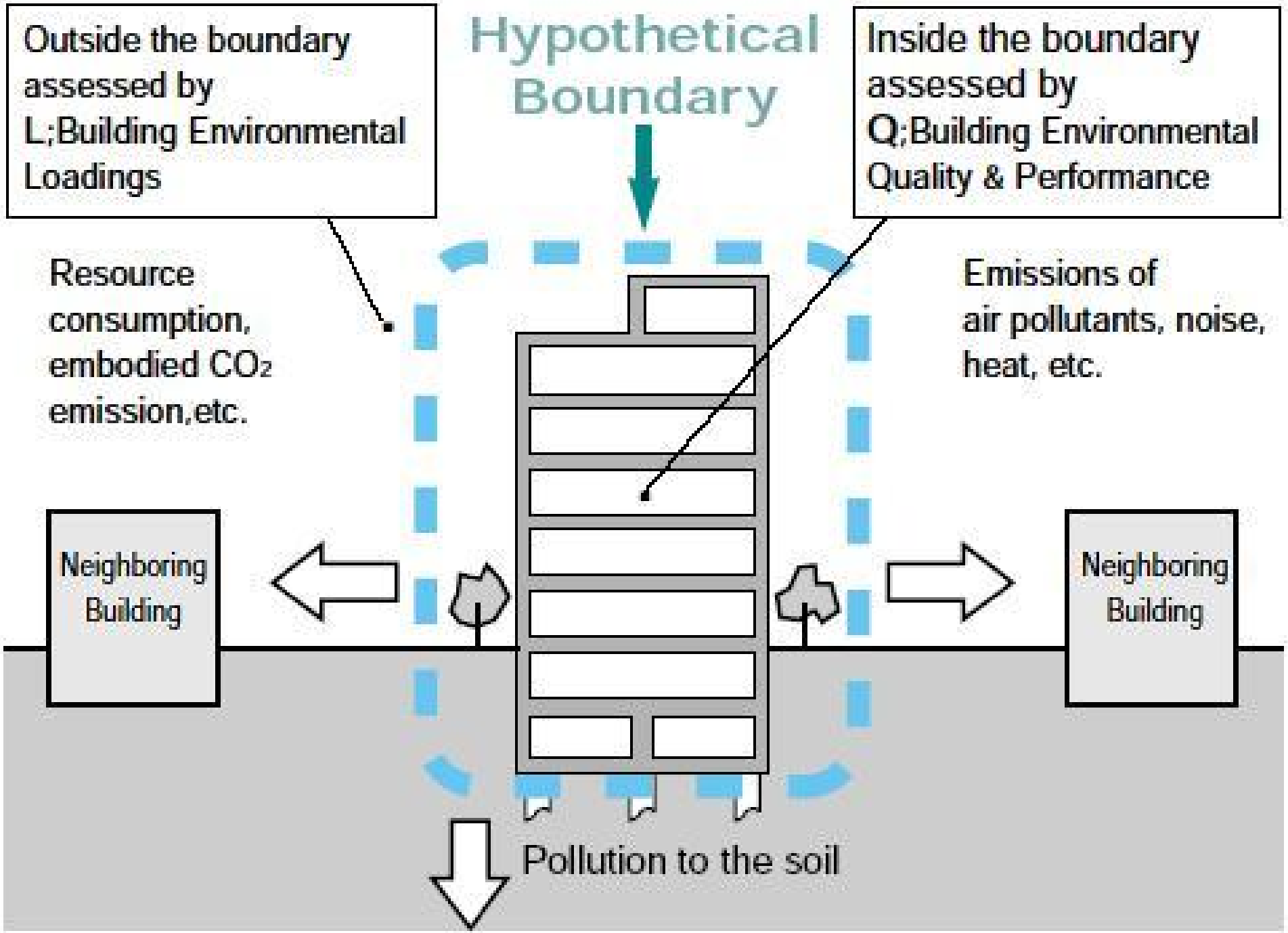
Current tools: CASBEE



- 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:

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

Definition of BEE in CASBEE:

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

Building Environmental Efficiency (BEE)

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

(Source: IBEC, Japan)

(1) Energy efficiency

(2) Resource efficiency

(3) Local environment

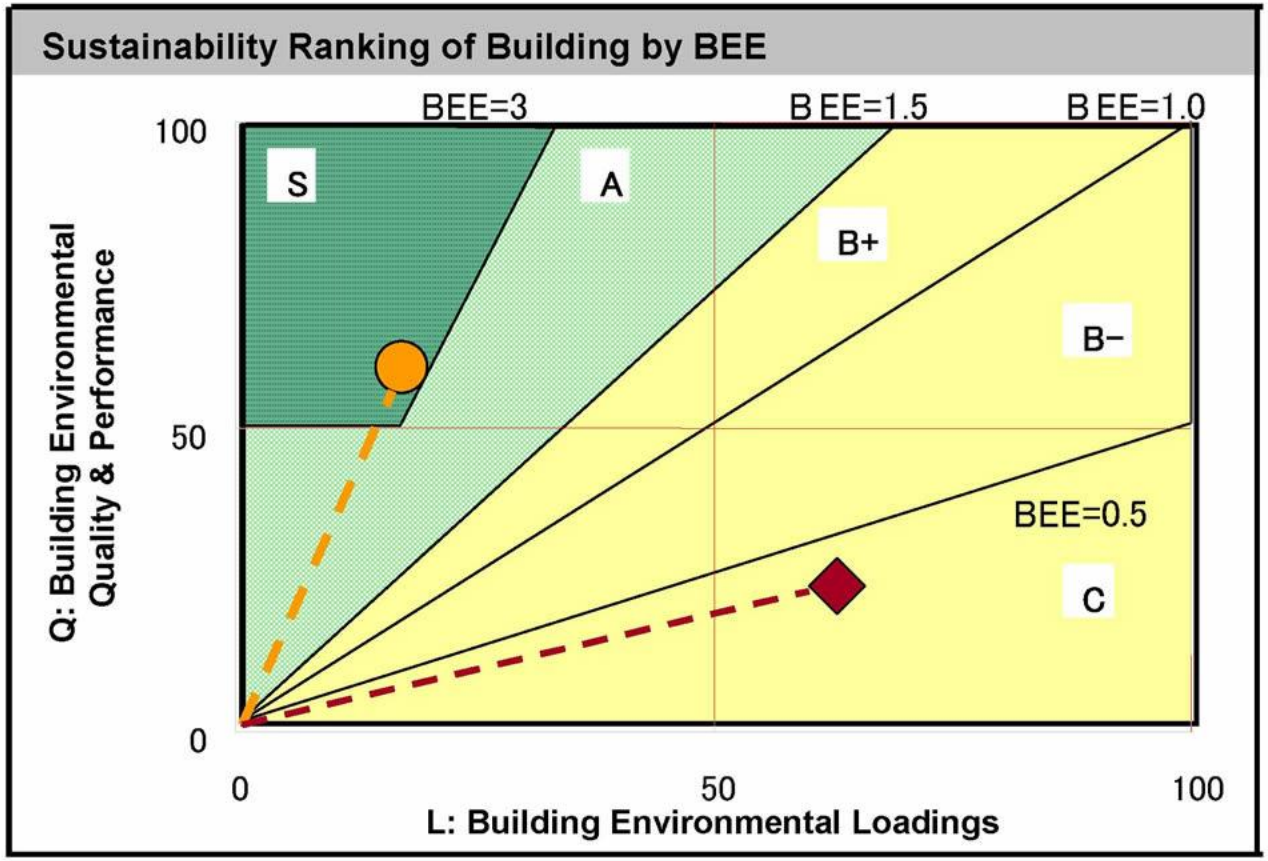
(4) Indoor environment

(Approx. 80 sub-items in total)

Recategorized into Q (Quality) and L (Loadings)

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

Denominator of BEE:
- L-1 Energy
- L-2 Resources and materials
- L-3 Off-site environment



: Ordinary Building

: Sustainable building (Sample)

CASBEE Ranking:

S = ★ ★ ★ ★ ★

A = ★ ★ ★ ★

B+ = ★ ★ ★

B– = ★ ★

C = ★

(Source: IBEC, Japan)

CASBEE®評価内容

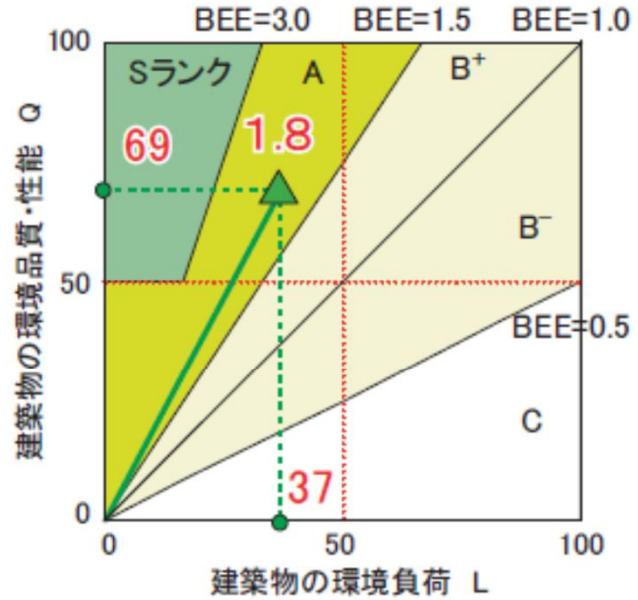
CASBEE-新築(簡易版)

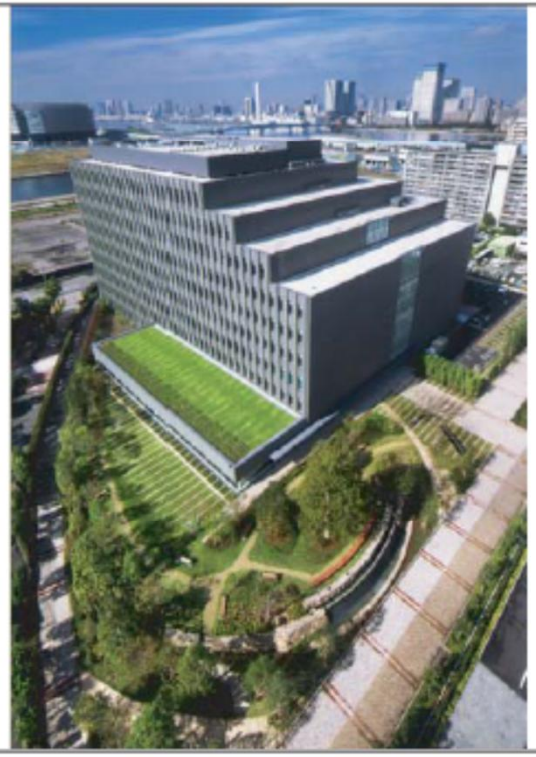
評価ツール　CASBEE-NCb_2006v1.2
認証番号　IBEC-C0046-NCb(c)
交付日　2009年3月10日

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	ー	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	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)

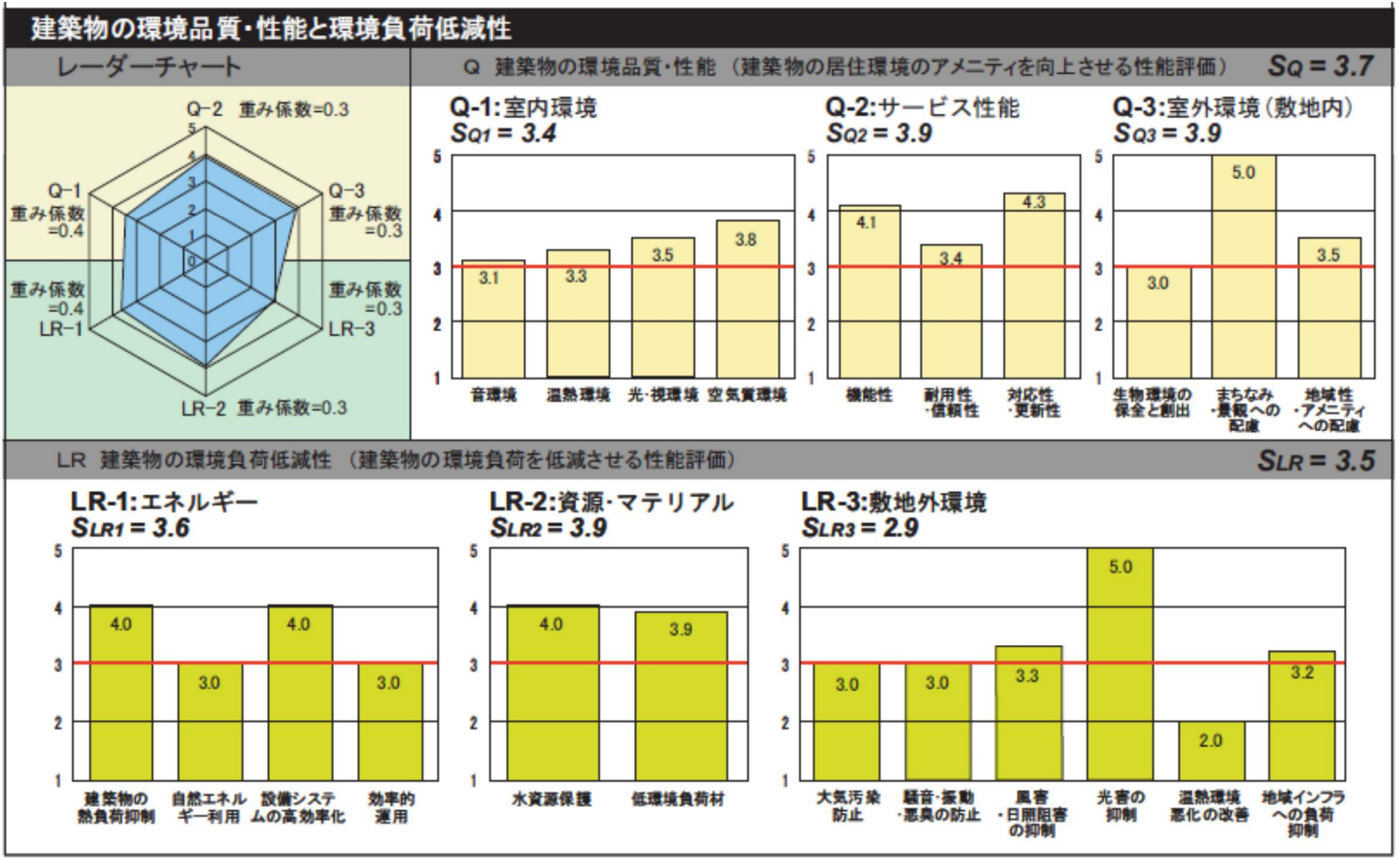
BEEによる建築物のサステナビリティランキング





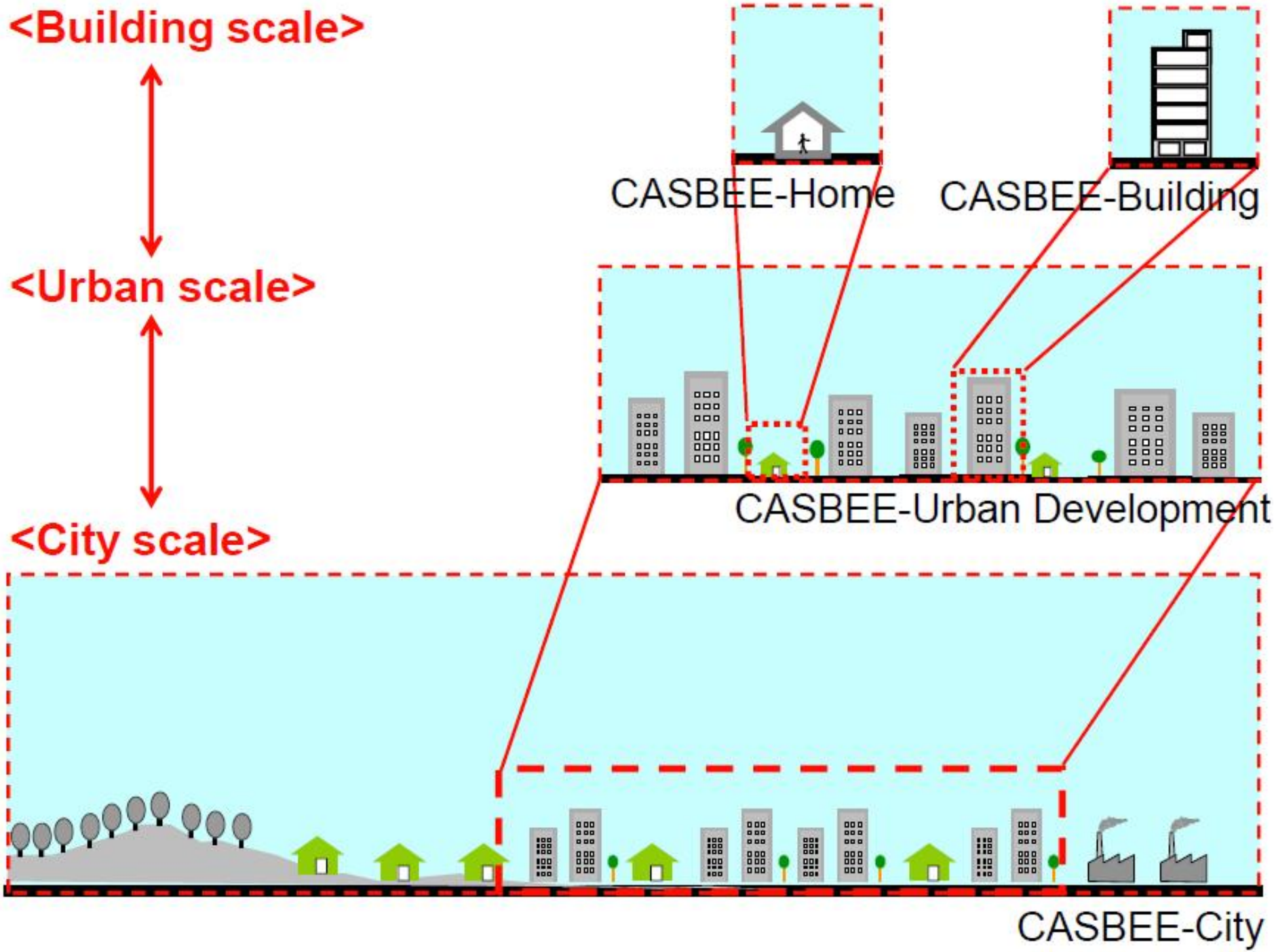
$$BEE = \frac{\text{建築物の環境品質・性能 Q}}{\text{建築物の環境負荷 L}} = \frac{25 \times (S_Q - 1)}{25 \times (5 - S_{LR})} = \frac{69.0}{37.0} = 1.8$$

(Source: IBEC, Japan)



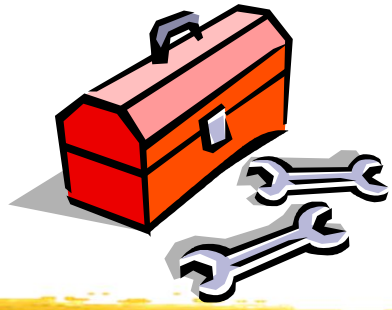
(Source: IBEC, Japan)

CASBEE from Home/Building to City Scale



(Adapted from *CASBEE in Progress for Market Transformation in Japan*, by Prof. Kazuo Iwamura, Tokyo City University)

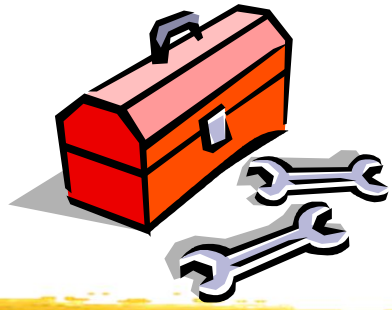
Current tools: Green Mark



- Green Mark (GM) Scheme, Singapore
  - Started 2005 (mandatory)
    - 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

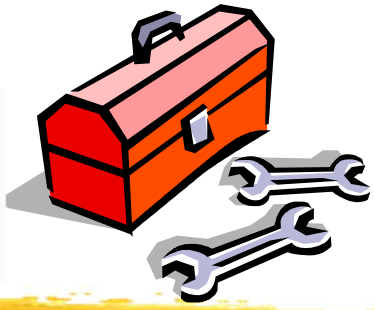
Current tools: Green Mark



- 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

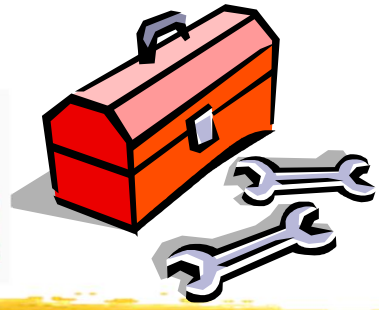
BCA GREEN MARK

Current tools



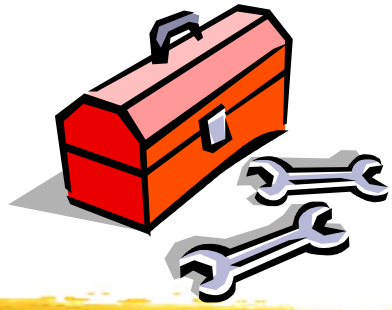
- Green Building Index (GBI), Malaysia
  - Started 2009 (www.greenbuildingindex.org)
  - New Construction (NC)
    - Non-residential (NRNC) and residential (RNC)
  - Procedures:
    - Stage 1. Application & Registration
    - Stage 2. Design Assessment
    - Stage 3. Completion & Verification Assessment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



- 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 for Beijing Olympic Games in 2008

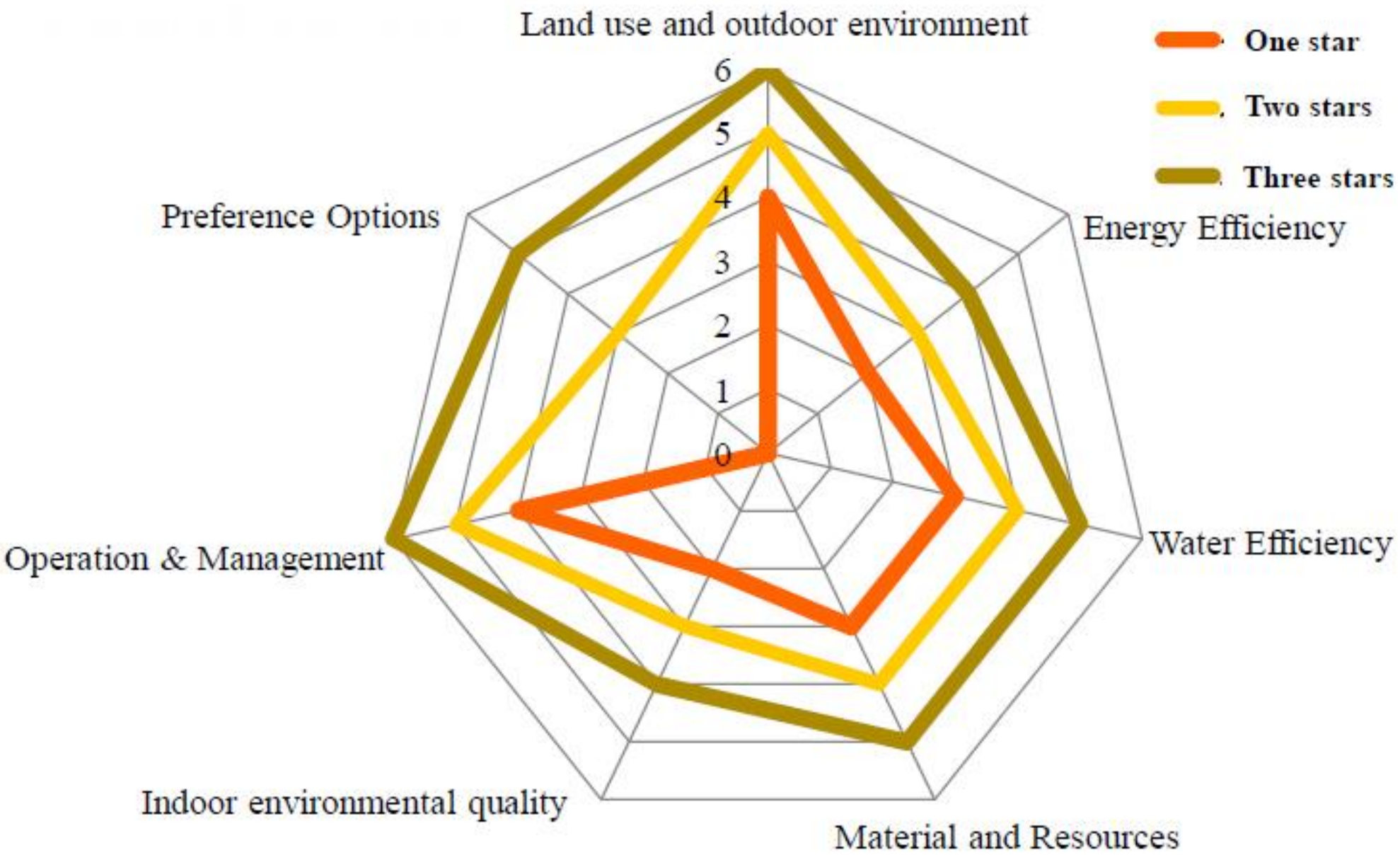
Evaluation Standard for Green Building – China (Three Star System)

		General Items (40)						Preference Options
	Grade	Land Use and Outdoor Environment (8)	Energy Efficiency (6)	Water Efficiency (6)	Material and Resources (7)	Indoor Environmental Quality (6)	Operation & Management (7)	(9)
Residential Building	★	4	2	3	3	2	4	-
	★★	5	3	4	4	3	5	3
	★★★	6	4	5	5	4	6	5
		General Items (43)						Preference Options
Public Building	Grade	Land use and outdoor environment (8)	Energy Efficiency (6)	Water Efficiency (6)	Material and Resources (8)	Indoor Environment Quality (6)	Operation & Management (7)	(14)
	★	3	4	3	5	3	4	-
	★★	4	6	4	6	4	5	6
	★★★	5	8	5	7	5	6	10

(See also: Trends in the application of China 3-star System 2008-2014 http://www.chinagbc-macau.org/latest-news2.html)

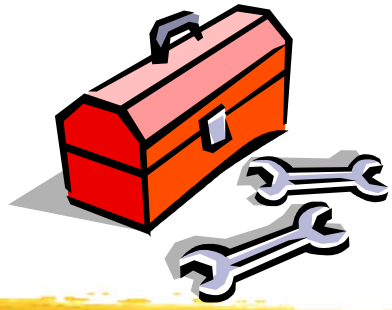
(Source: Dr. JIANG Wei)

Evaluation Standard for Green Building – China
Assessment categories and weighting



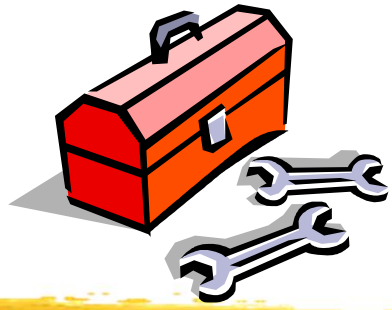
(Source: Dr. JIANG Wei)

Current tools: China



- Evaluation Standard for Green Building (Hong Kong version) 綠色建築評價標準(香港版)
  - Website: http://www.cgbchk.org
  - CSUS/GBC 1-2010
    - http://www.csus-gbrc.org/gbrc/news/news/download/1304562387546.doc
- Evaluation Standard for Green Building (Macau version) 綠色建築評價標準(澳門版)
  - 2015 first edition
  - Website: http://www.chinagbc-macau.org

Current tools: Taiwan



- Taiwan Green Building Label (EEWH)
  - Nine sets of assessment criteria/indicators:

Ecology 生態
- 1. Biodiversity 生物多樣性
- 2. Greenery 綠化量
- 3. Water retention 基地保水

Energy 節能
- 4. Energy efficiency 日常節能

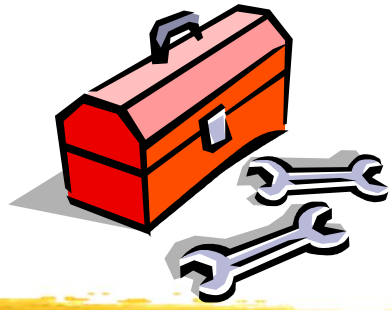
Waste reduction 減廢
- 5. Carbon dioxide reduction CO_2減量
- 6. Waste reduction 廢棄物減量

Health 健康
- 7. Indoor environment 室內環境
- 8. Water resources 水資源
- 9. Wastewater and garbage 污水拉圾改善

綠建築標章
GREEN BUILDING

(Sources: www.taiwangbc.org.tw, www.cabc.org.tw)

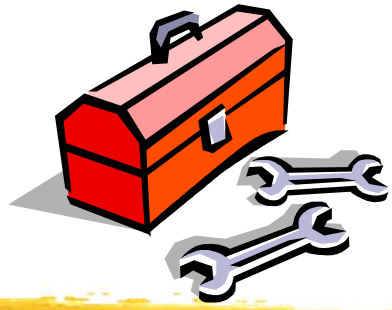
Current tools: Hong Kong



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

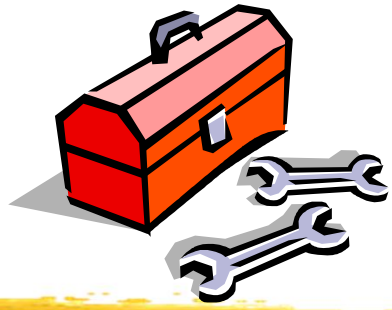
Current tools: Hong Kong



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

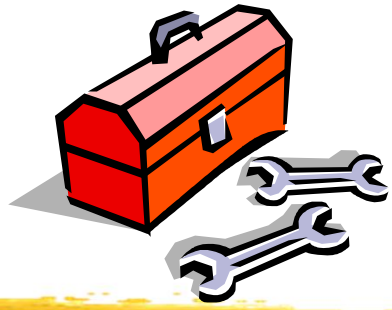


- HK-BEAM

HONG KONG BUILDING ENVIRONMENTAL ASSESSMENT METHOD
香港建築環境評估法

  - 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: Hong Kong



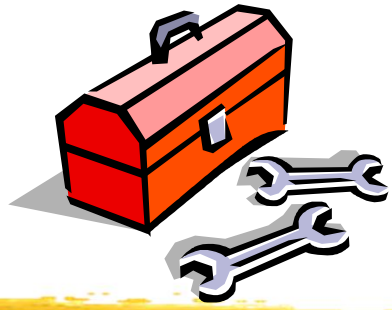
- BEAM Plus development
  - Version 2009: (Nov 2009)
    - BEAM Plus for New Buildings
    - BEAM Plus for Existing Buildings
  - Version 1.1 (Apr 2010)
    - With minor refinements
    - Introduce BEAM Professionals
  - Version 1.2 (Jul 2012)
    - Addresses issues on passive design
    - Minor amendments to other aspects
    - Starting from 1 Jan 2013, version 1.2 must be used

BEAM Society 香港環保建築協會

HKGBC 香港綠色建築議會

HKGBC BEAM Plus 綠建環評

Current tools: Hong Kong



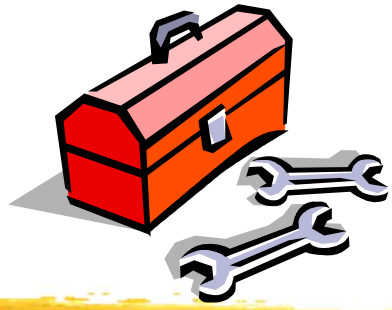
- Uptake of BEAM Plus in Hong Kong:
  - New government buildings with floor area > 10,000 m^2 will aim to obtain the second highest grade or above under BEAM Plus or LEED
  - Buildings Department has included BEAM Plus on the Practice Notes on the wholesale conversion of industrial buildings, permitting the exemption of certain regulatory provisions
  - BEAM Plus certification is required as a prerequisite for gross floor area (GFA) concessions for certain green and amenity features

BEAM Plus assessment criteria [credits] [weighting]

New Buildings	Existing Buildings
Site aspects (SA) [22+3B] [25%]	Site aspects (SA) [18+1B] [18%]
Materials aspects (MA) [22+1B] [8%]	Materials aspects (MA) [11+2B] [12%]
Energy use (EU) [42+2B] [35%]	Energy use (EU) [39+2B] [30%]
Water use (WU) [9+1B] [12%]	Water use (WU) [7+2B] [15%]
Indoor environmental quality (IEQ) [32+3B] [20%]	Indoor environmental quality (IEQ) [30+3B] [25%]
Innovations and additions (IA) [5B+1]	Innovations and additions (IA) [5B+1]

(See also: http://www.hkgbc.org.hk/eng/BEAMPlus_NBEB.aspx)

Current tools: Hong Kong



- BEAM Plus (Version 1.1 or 1.2)
  - Overall grade: (with min. for SA, EU and IEQ)

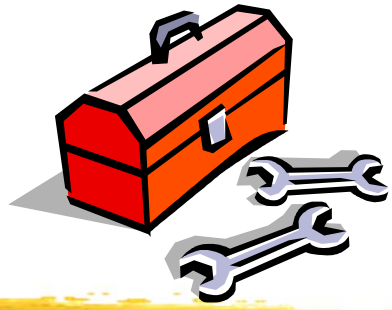
	Overall	Site Aspects	Energy Use	IEQ	Innov. & Addn.	
Platinum	75%	70%	70%	70%	3 credits	Excellent
Gold	65%	60%	60%	60%	2 credits	Very Good
Silver	55%	50%	50%	50%	1 credit	Good
Bronze	40%	40%	40%	40%	---	Above Average

Example of BEAM Plus weighting and grading

BEAM Plus for New Buildings Category	Credit Mark Earned (A)	Credit Mark Applicable (B)	% of Credit Marks Earned (C=100*A/B)	Category Weighting (D)	Weighted Category Mark (E=C*D)	Category Grade
Site Aspect	19	22	86%	0.25	22%	Platinum
Water Use	7	22	32%	0.08	3%	-
Energy Use	30	42	71%	0.35	25%	Platinum
Material Use	8	9	89%	0.12	11%	-
Indoor Environment Quality	25	32	78%	0.20	16%	Platinum
			Total Weighted Category Mark		77%	
			Innovation Credit Mark Earned		3	Platinum
			Final BEAM Credit Mark		80%	Platinum
			Overall BEAM Grade		Platinum	

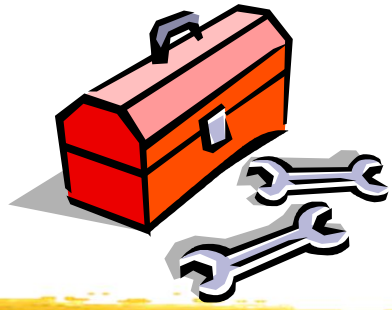
(Source: http://www.hkgbc.org.hk/)

Current tools: Hong Kong



- BEAM Plus technical analysis, such as:
  - SA8 Microclimate around Buildings
    - Wind effects, air ventilation assessment, air paths, building permeability, landscaping
  - SA9 Neighborhood Daylight Access
    - Vertical daylight factor, unobstructed vision area
  - EU1 Reduction of CO_2 Emissions
    - Performance-based Building Energy Code or Appendix G of ASHRAE 90.1 (performance rating method)
  - IEQ15 Natural Lighting
    - Average daylight factor >= 2%

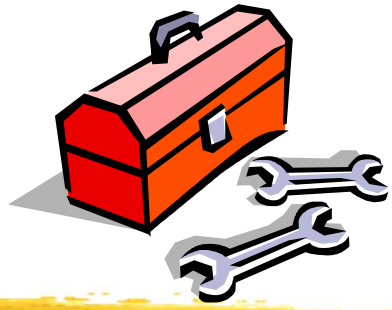
Current tools: Hong Kong



- BEAM Plus Interior (Aug 2013)
  - Used by occupants or tenants of new or existing buildings (fit-out, renovation and refurbishment)
  - Include 7 aspects:
    - Green Building Attributes (GBA) [8]
    - Management (MAN) [1p, 10]
    - Materials Aspects (MA) [3p, 26]
    - Energy Use (EU) [26]
    - Water Use (WU) [6]
    - Indoor Environmental Quality (IEQ) [24]
    - Innovations (IV) [10]

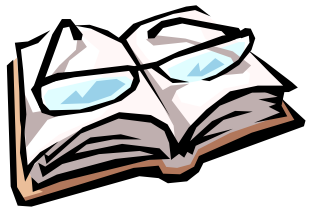
(See also: http://www.hkgbc.org.hk/eng/BI.aspx)

Current tools: Hong Kong



- BEAM Professionals (BEAM Pro)
  - Accredited by HK Green Building Council (HKGBC) (www.hkgbc.org.hk)
  - Facilitate BEAM Plus submission
- BEAM Assessors (BAS)
  - Undertake the building assessment on behalf of HKGBC
- Green Building Faculty
  - Experienced professionals to drive BEAM Plus & BEAM Professionals development and training
- BEAM Affiliate (BA)
  - Sub-professionals to support green building design, construction and operations

Further reading



- Building Environmental Assessment Tools: Current and Future Roles
  - www.sb05.com/academic/4&5_IssuePaper.pdf
- Green Building Standards and Certification Systems [WBDG]
  - http://www.wbdg.org/resources/gbs.php