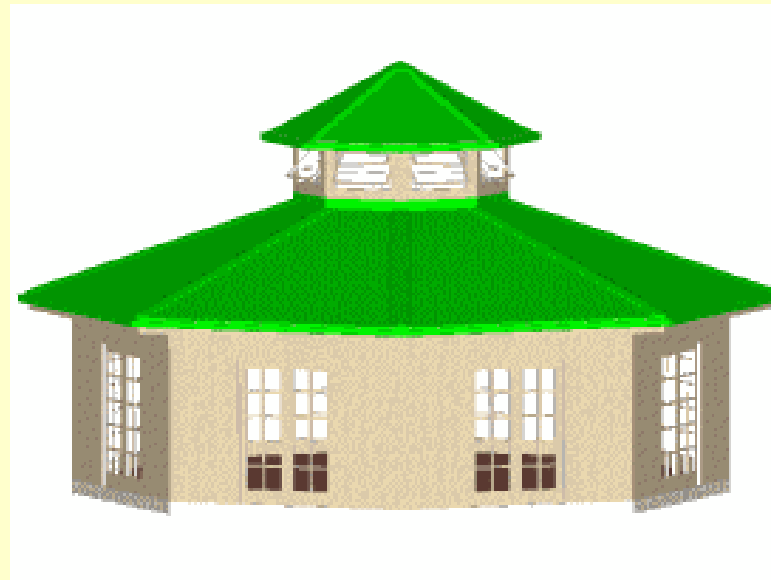


Green Building Design and Assessment



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Contents



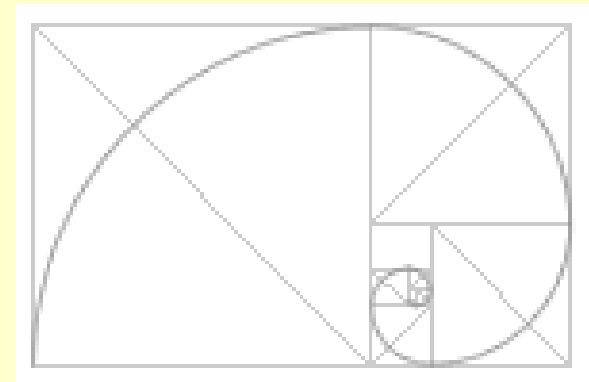
- What is green building?
- Design strategies
- Green building assessment
- Assessment tools





Kyoto Face House, 1998

**“What is
green
building?”**



What is green building?



- Green buildings are
 - Energy and resource efficient
 - Non-wasteful and non-polluting
 - Sustainable design that helps minimise broad environmental impacts (e.g. ozone depletion)
 - Highly flexible and adaptable for long-term functionality
 - Easy to operate and maintain (lower running costs)
 - Supportive of the productivity and well-being of the occupants

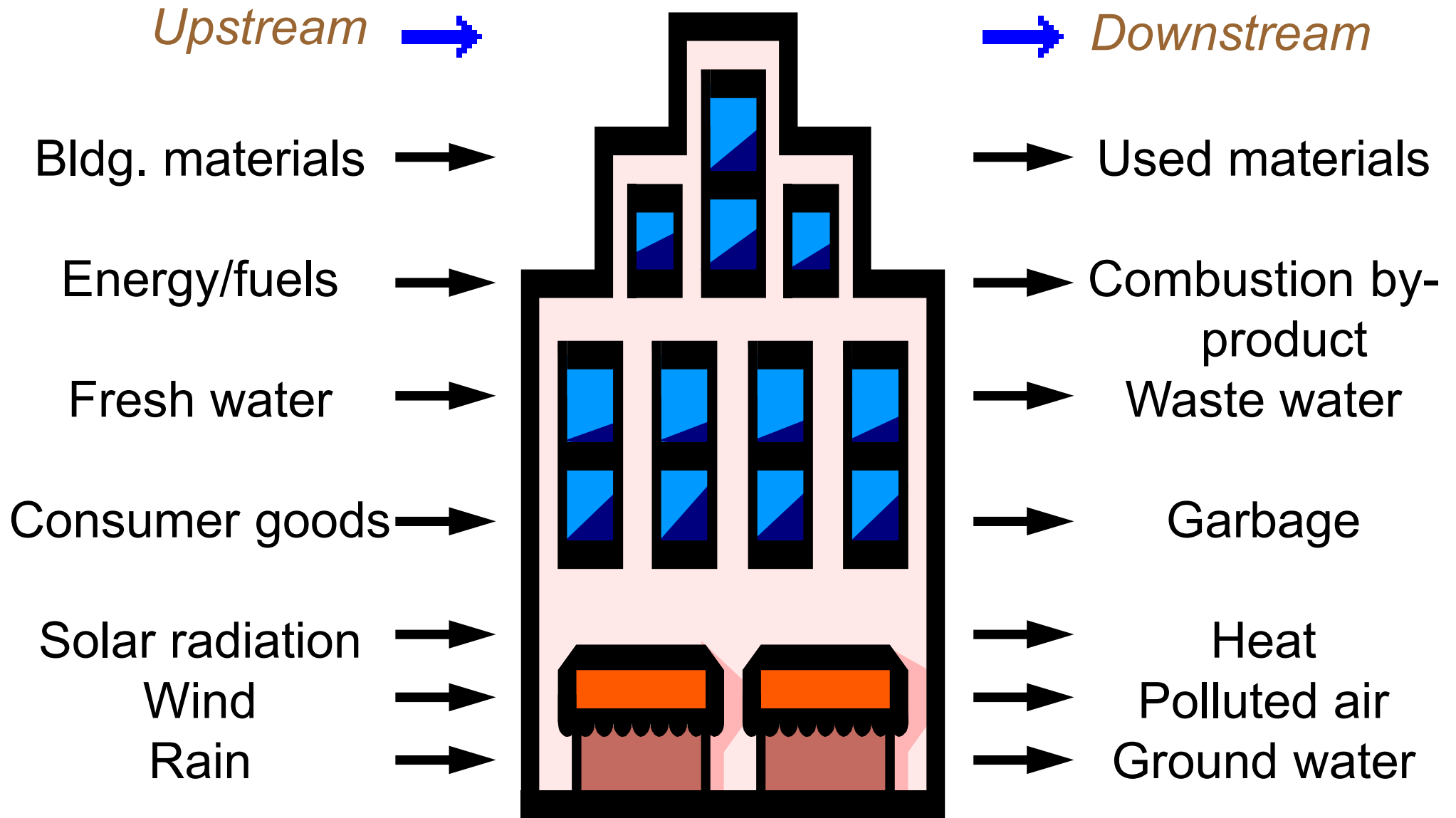


What is green building?

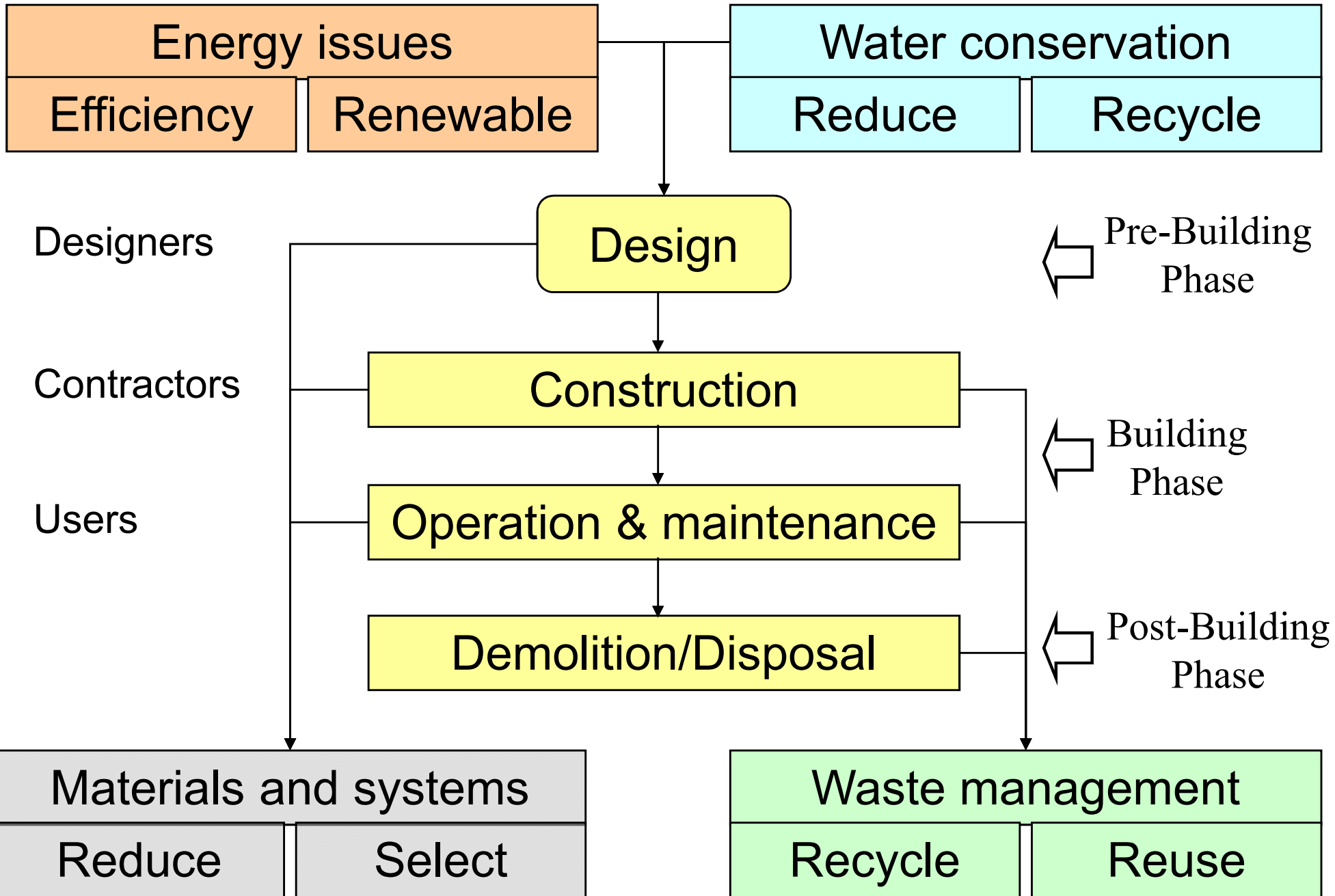


- It involves a *holistic* approach to the design and operation of buildings. It considers:
 - *1) Economy and efficiency of resources*
 - *2) Life cycle design*
 - *3) Human well-being*
- Main objectives
 - Be environmentally friendly and responsible
 - Improve the quality of built environment





Resource and material flow in the building ecosystem



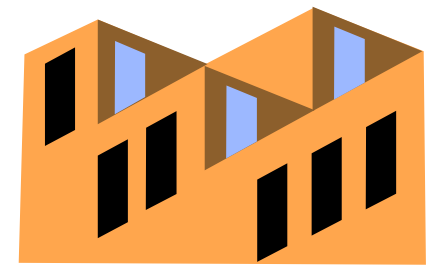
Building life cycle and sustainable construction



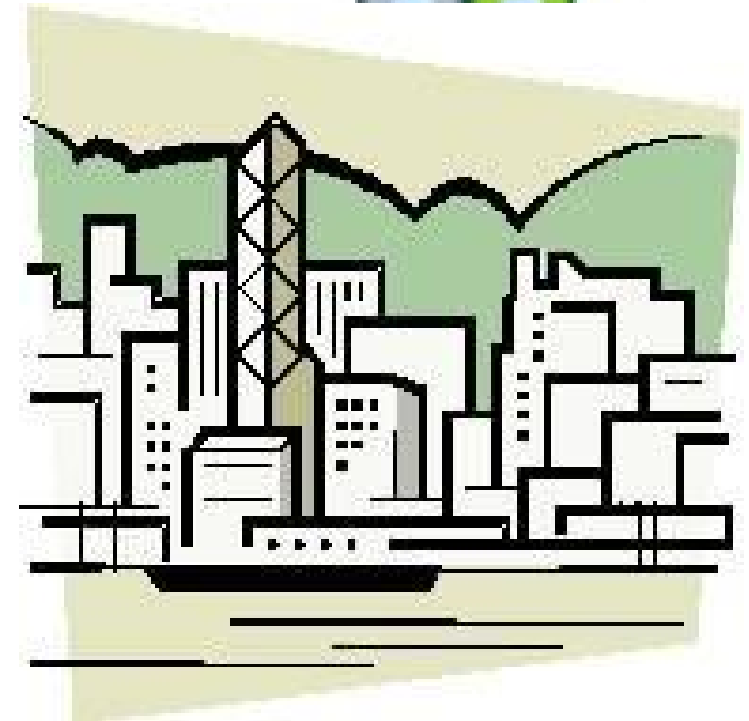
What is green building?

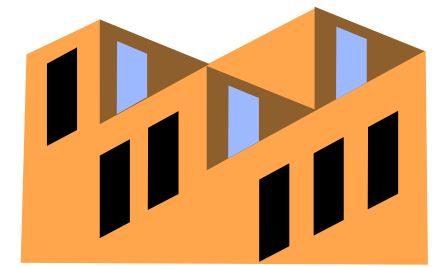
- Principles of sustainable building design
 - Optimize site potential
 - Optimize energy use
 - Protect and conserve water
 - Optimize building space and material use
 - Enhance indoor environmental quality (IEQ)
 - Optimize operational and maintenance practices
 - “If it is not maintainable, it is not sustainable”
 - Also, sustainable retrofits and adaptability

Design strategies



- Green building design strategies
 - Urban and site design
 - Energy efficiency
 - Renewable energy
 - Building materials
 - Water issues
 - Indoor environment

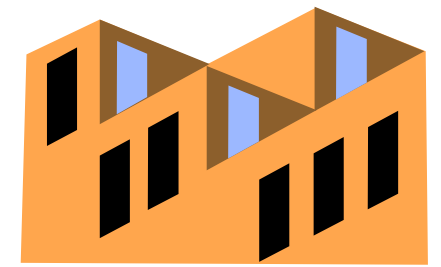




Design strategies

- Sustainable urban design should consider:
 - Spatial form
 - Movement
 - Design & development
 - Energy
 - Ecology
 - Environmental management
- Goal: to create livable cities





Design strategies

- Design issues:
 - Site selection (e.g. prefer **brownfield site***)
 - Promote efficient movement network & transport
 - Control & reduce noise impacts
 - Optimise natural lighting & ventilation
 - Design for green space & landscape
 - Minimise disturbance to natural ecosystems
 - Enhance community values

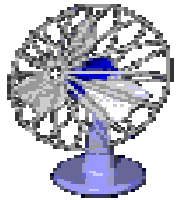
棕地，指被棄置的工業或商業用地而可以被重複使用的土地

[* Brownfield sites are abandoned or underused industrial and commercial facilities available for re-use.]

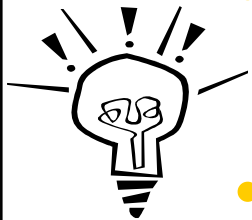


Design strategies

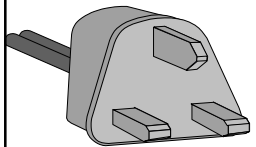
- Energy efficiency strategies:



- Minimise thermal loads & energy requirements
 - e.g. by reducing heat gains from equipment



- Optimise window design & fabric thermal storage
 - Integrate architectural & engineering design



- Promote efficiency in building services systems

- Use of heat recovery & free cooling methods
- Energy efficient lighting design & control
- High-efficiency mechanical & electrical systems

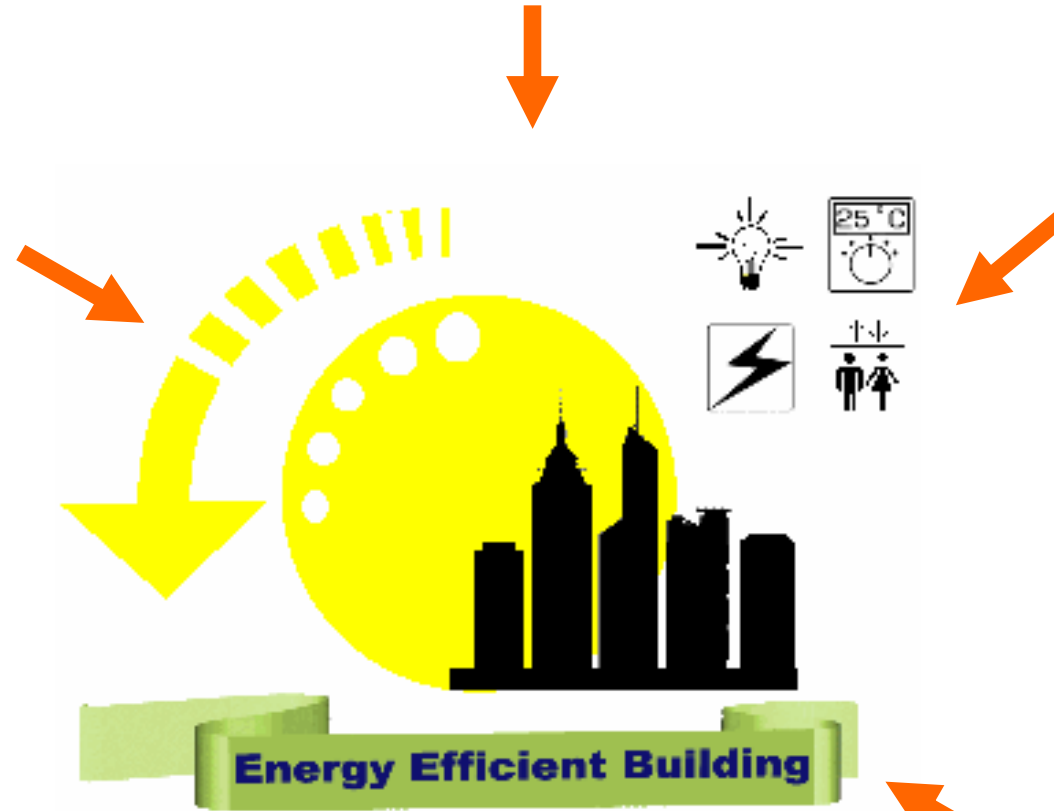


- Adopt total energy approach (e.g. district cooling, combined heat & power)

Good design practices

Integrated &
total energy
approach

Efficient
systems



Energy Efficient Building

Good house-
keeping

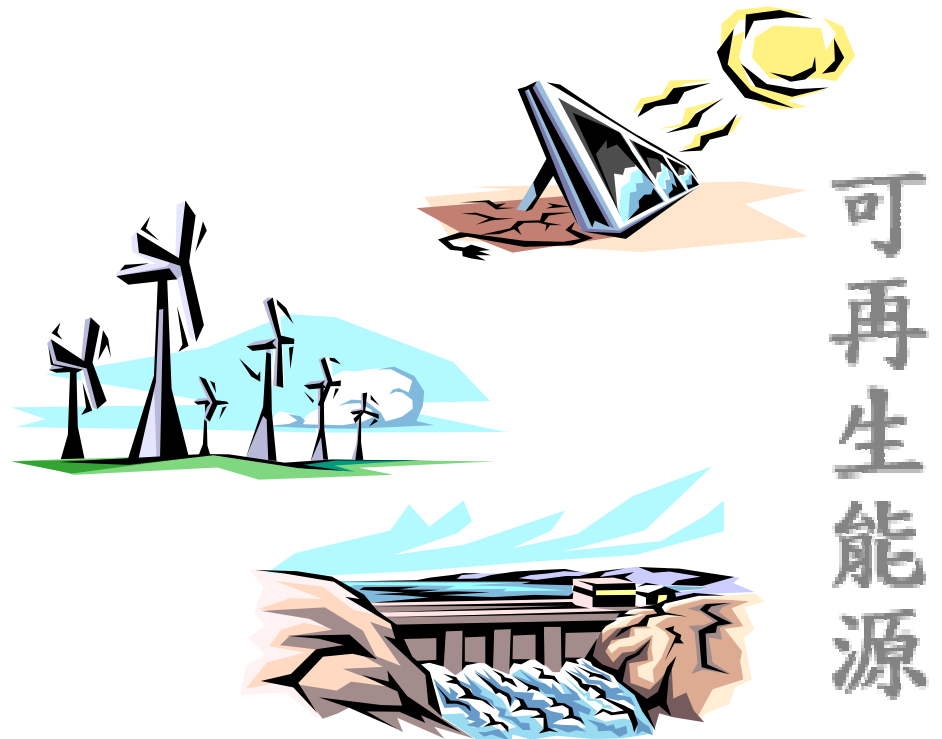
User education
& awareness

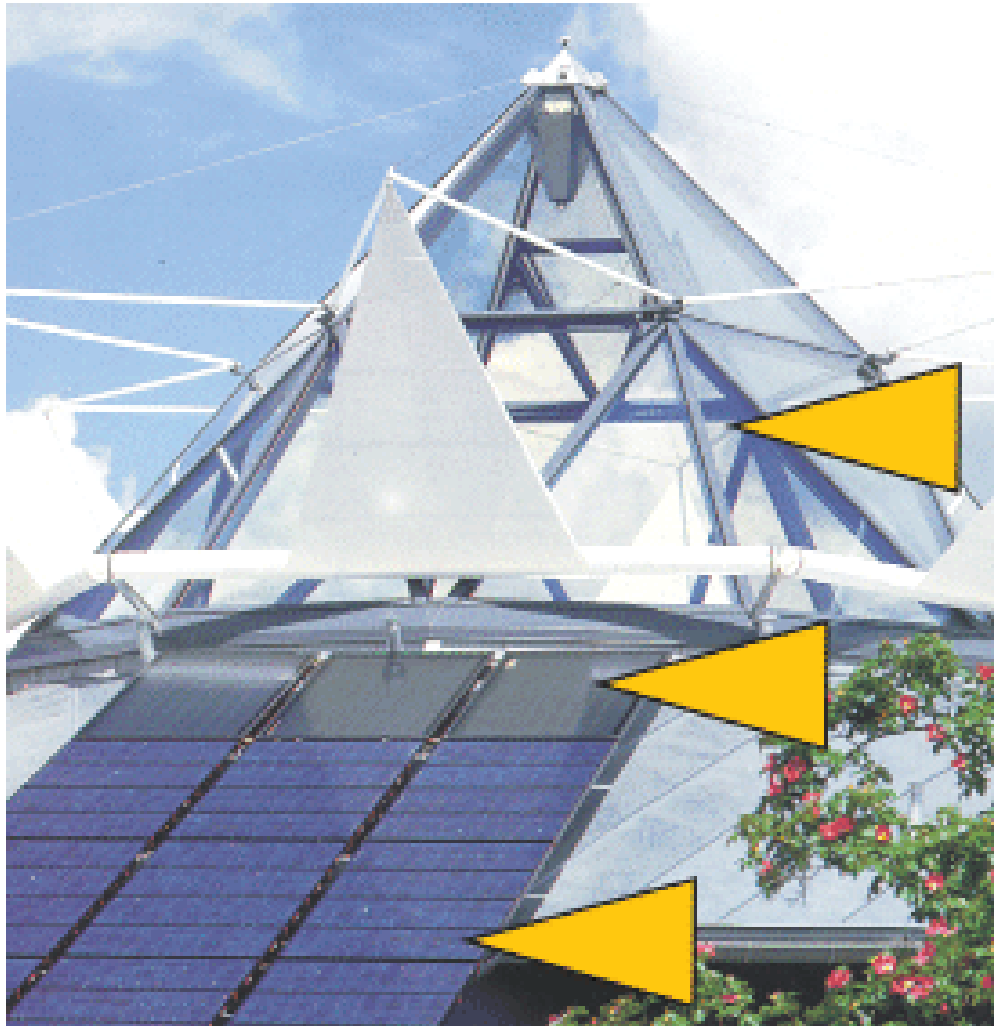
Efficient
operation



Design strategies

- Renewable Energy
 - Energy that occurs naturally and repeatedly on earth and can be harnessed for human benefit
- Common applications
 - Solar hot water
 - Solar photovoltaic
 - Wind energy
 - Geothermal
 - Small hydros





Passive solar (e.g. skylight)

Active solar (solar hot water)

Photovoltaics

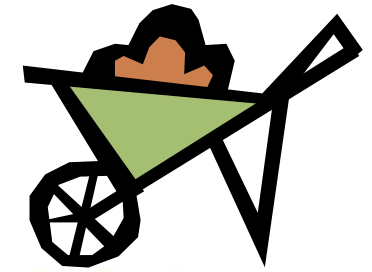
Integration of solar energy systems in buildings



Design strategies

- Renewables for buildings
 - Solar energy
 - Passive (low energy architecture)
 - Active (solar thermal)
 - Photovoltaics
 - Other renewables
 - Wind (using buildings to harvest wind energy)
 - Geothermal (e.g. hot springs)
 - Small hydros (e.g. water wheels)
 - Hybrid systems (e.g. PV + wind + diesel)

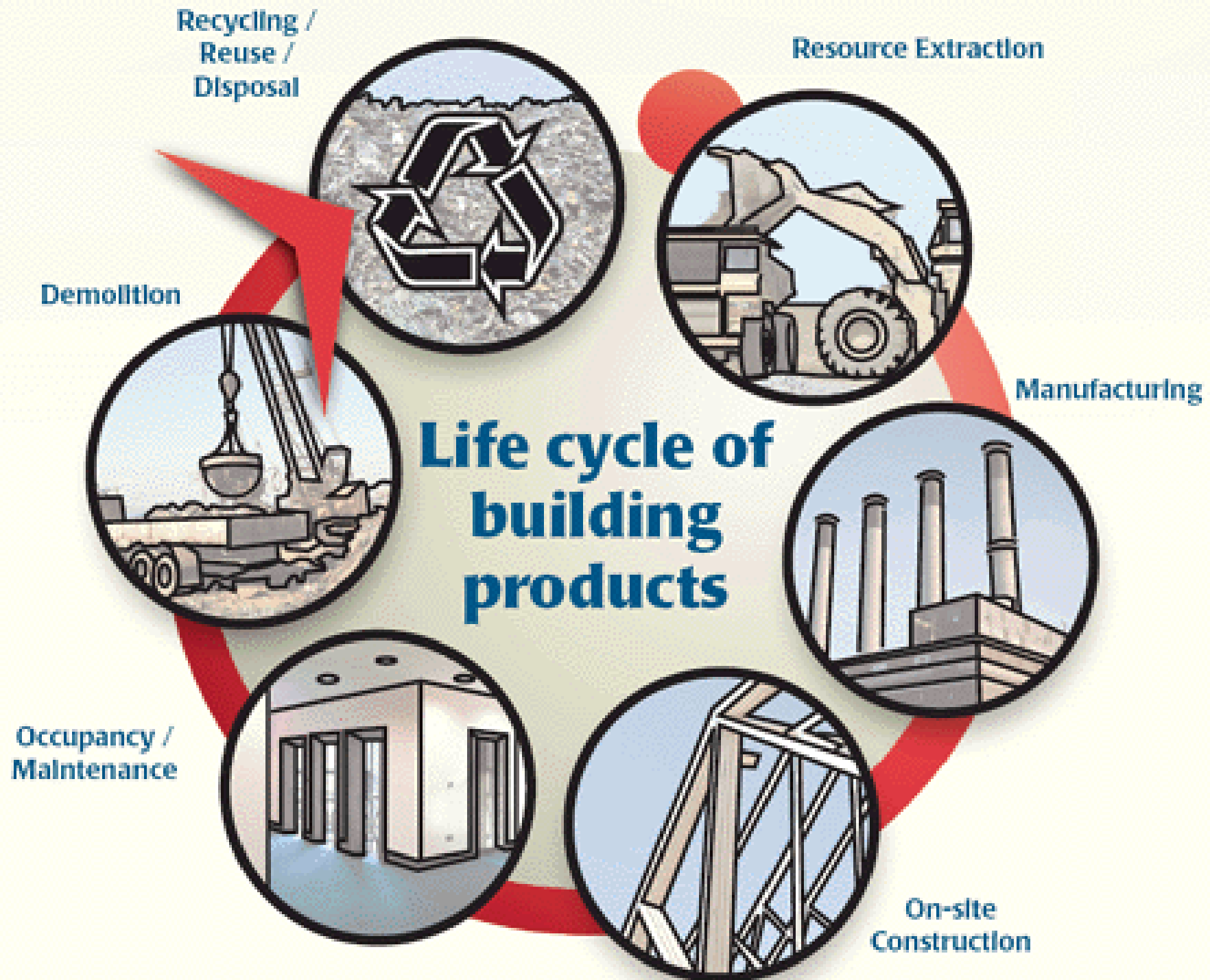
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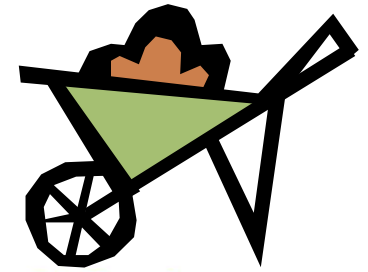
Design strategies

- What makes a product/material **green**?
 - Measured by their environmental impact
 - Life cycle of a sustainable material
 - Using local, durable materials
- Embodied energy* 能源含量
 - ‘Lifetime’ energy requirement of a material
 - Energy input required to quarry, transport and manufacture the material, plus the energy used in the construction process

[* http://en.wikipedia.org/wiki/Embodied_energy]



Design strategies



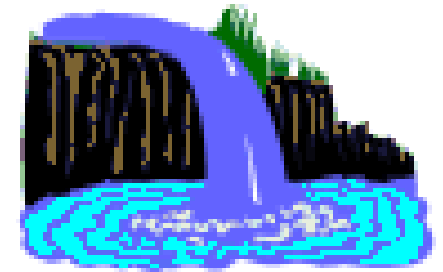
- Material conservation
 - Adapt existing buildings to new uses
 - Material conserving design & construction
 - Size buildings & systems properly
 - Incorporate reclaimed or recycled materials
 - Use environment-friendly materials & products
 - Design for deconstruction (“close the loop”)
- Life cycle assessment (LCA) is often used to evaluate the environmental impact of building materials and products



Design strategies



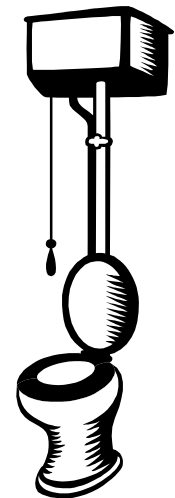
- Stormwater or watershed protection
 - Control rainwater runoff, flooding and erosion
 - Preservation of soils and drainage ways
 - Porous paving materials
 - Drainage of concentrated runoff
 - Avoid pollution and soil disturbance
- Water efficiency and conservation
 - Saving of water and money: water-use charge, sewage treatment costs, energy use, chemical use



Design strategies

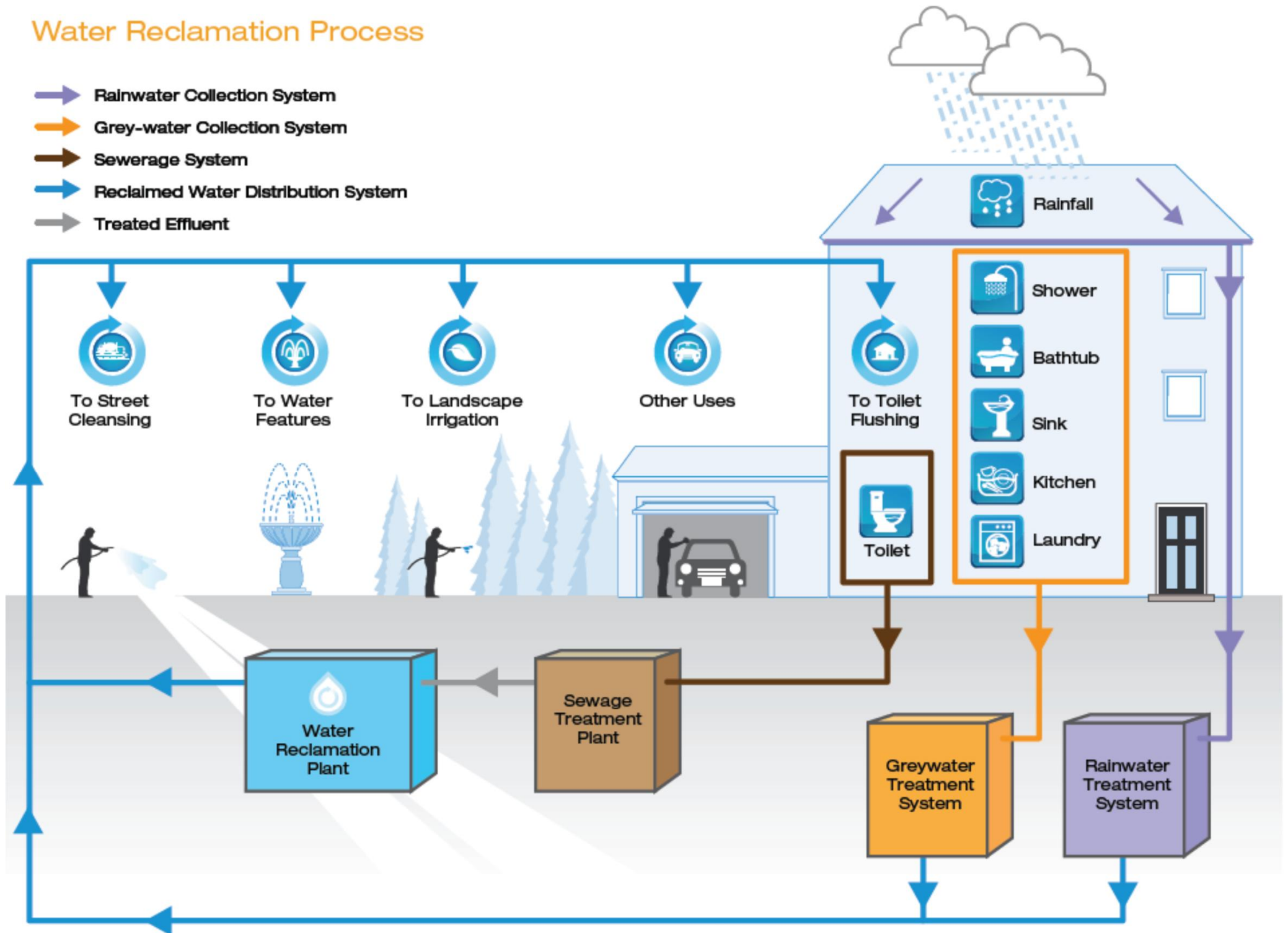


- Design strategy for water efficiency
 - Reduce water consumption
 - Low-flush toilets & showerheads
 - Leak detection & prevention
 - Correct use of appliances (e.g. washing machine)
 - Reuse and recycle water onsite
 - Rainwater collection & recycling
 - Greywater recycling (e.g. for irrigation)
 - No-/Low-water composting toilet



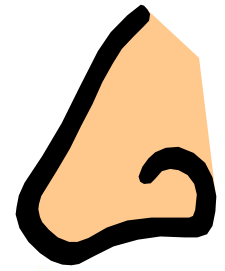
Water Reclamation Process

- ➔ Rainwater Collection System
- ➔ Grey-water Collection System
- ➔ Sewerage System
- ➔ Reclaimed Water Distribution System
- ➔ Treated Effluent



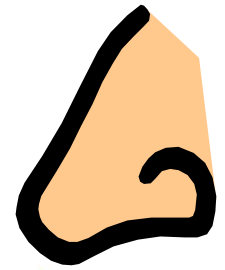
(Source: Water Supplies Department, www.wsd.gov.hk)

Design strategies



- Indoor environmental quality (IEQ)
 - Indoor air quality
 - Ensure health & well-being
 - Visual quality
 - Provide daylight & comfortable conditions
 - Acoustic quality
 - Noise control
 - Controllability
 - Allow occupant control over thermal & visual

Design strategies



- Indoor air quality (IAQ)
 - People spend most of their time indoors
 - Pollutants may build up in an enclosed space
 - Effects on health and productivity
- Control methods
 - Assess materials to avoid health hazards
 - Such as volatile organic compounds (VOC)
 - Ensure good ventilation & building management



Four principles of indoor air quality design

1. Source Control

+

2. Ventilation Control

+

3. Occupant Activity Control

+

4. Building Maintenance

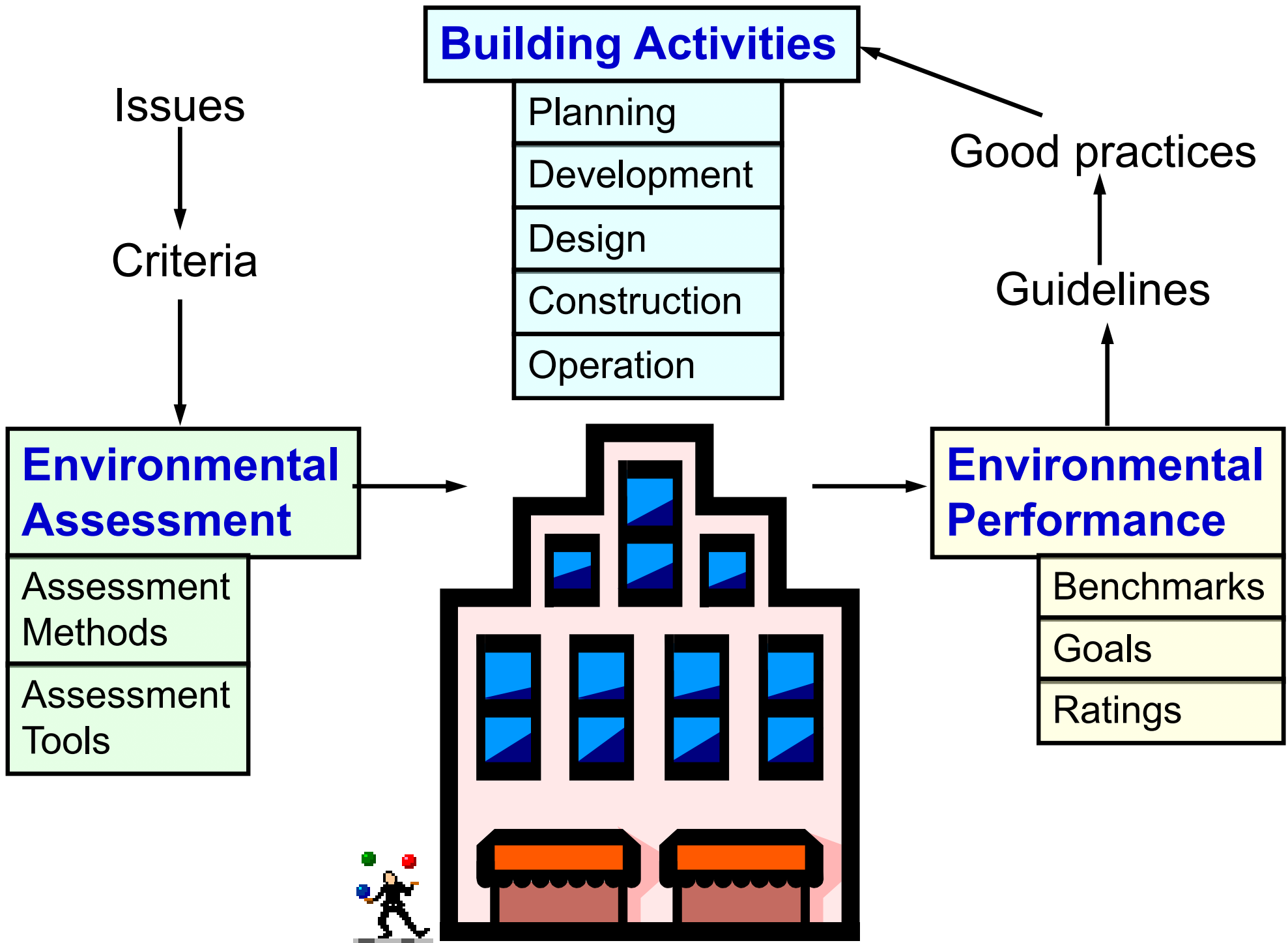
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*Total
Indoor
Air
Quality*

Green building assessment



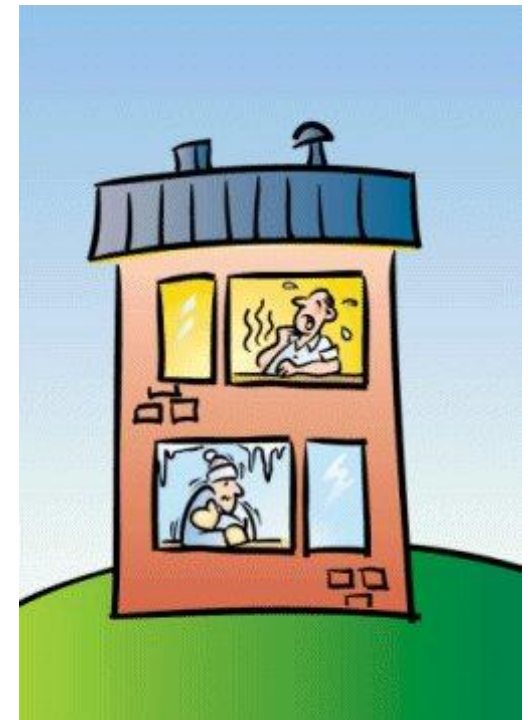
- Design guidelines provide a broader range of issues; Assessment methods give structure and priority, and provide strategic advice
 - Enhance environmental knowledge
- Enable *building performance* to be described
 - Performance-based indicators
 - Declared benchmarks
 - Prescriptive requirements (proxies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



Green building assessment



- 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

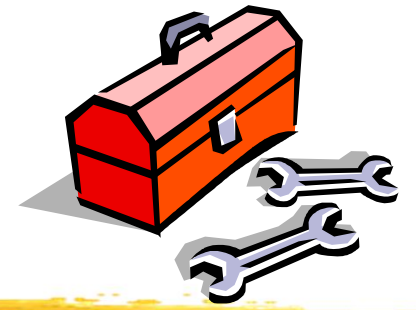
- material selection
- recycling of materials
- waste management
- disposal & reuse

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

Rating tools of building environmental performances around the world



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



Assessment tools

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



LEED Green Building Rating



(Source: USGBC)

(See also: Introducing LEED v4 (1:34) <http://www.youtube.com/watch?v=UJzdnykumTU>)

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

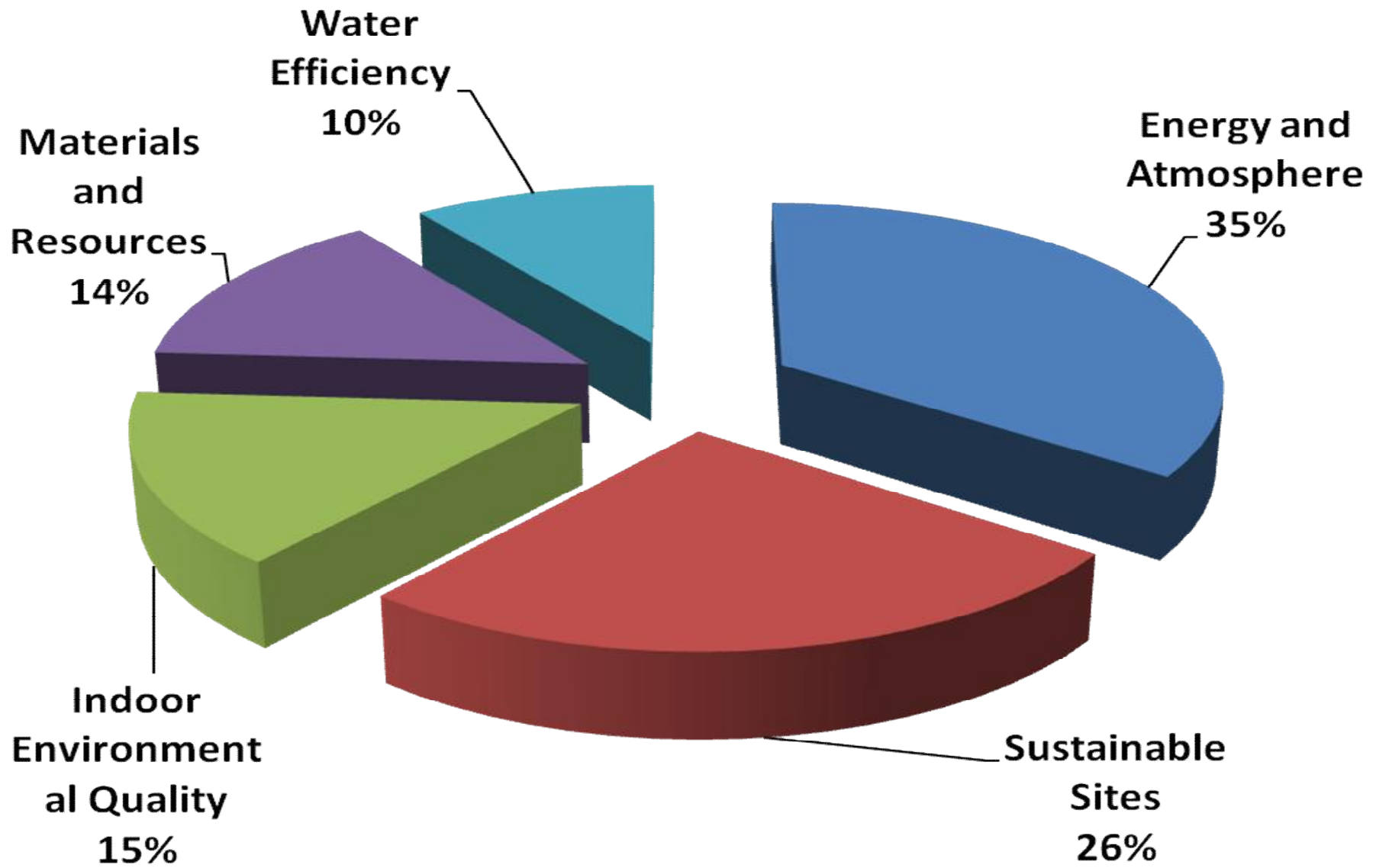
** Certified 40+ points, Silver 50+ points, Gold 60+ points, Platinum 80+ points

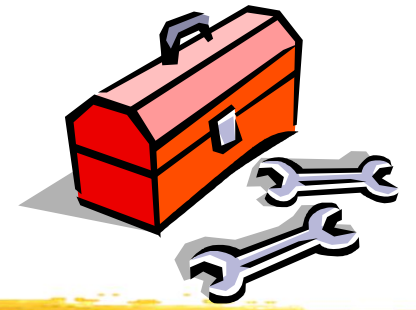
 Innovation in Operations	6
 Regional Priority	4

(Source: USGBC)

For LEED version 3

LEED NC point distribution (version 2009)





Assessment tools

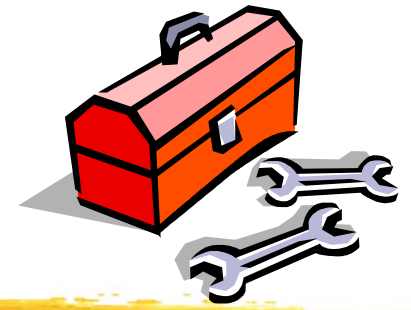
- LEED v4 (launched in 2014)*
 - Location & Transportation (LT)
 - Sustainable Site (SS)
 - Water Efficiency (WE)
 - Energy and Atmosphere (EA)
 - Materials and Resources (MR)
 - Indoor Environmental Quality (EQ)
 - Innovation (IN)
 - Regional Priority (RP)



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

LEED v4





Assessment tools

- The BEAM Plus Family

- <http://www.hkgbc.org.hk/eng/BEAMPlus.aspx>



- Neighbourhood (ND): Masterplanning stage of building development projects



- New Buildings (NB): New building projects and major renovation/alteration works on existing buildings



- Existing Buildings (EB): Operation and maintenance performance of existing buildings



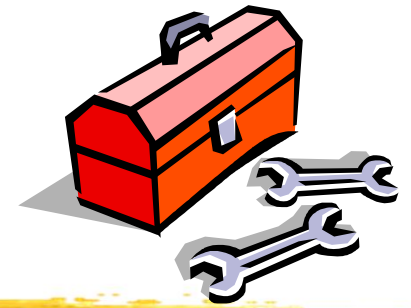
- Interiors (BI): Fit-out works of non-domestic premises

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]



Assessment tools



- 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	32



Site Aspects



Materials and Waste Aspects



Energy Aspects

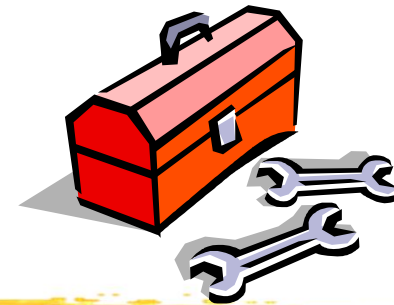


Water Aspects



Innovations and Additions

Assessment tools



- **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

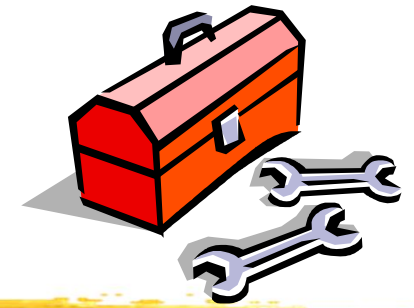
- **Green Building Faculty**

- Experienced professionals to drive BEAM Plus & BEAM Professionals development and training

- **BEAM Affiliate (BA)**

- Sub-professionals to support green building design, construction and operations



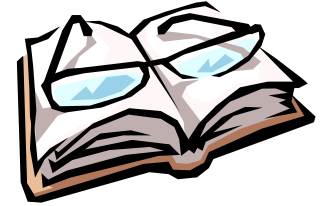


Assessment tools

- Useful information:
 - BEAM Plus Online Exhibition
 - <http://greenbuilding.hkgbc.org.hk/>
 - Statistics of BEAM Plus projects
 - <http://www.hkgbc.org.hk/eng/BEAMPlusStatistics.aspx>
- Latest developments
 - Version 2.0 of BEAM Plus NB and EB
 - BEAM Pro Specialty (starting from 1 Jan 2017)



Further Reading



- Green Building Standards and Certification Systems [WBDG]
 - <http://www.wbdg.org/resources/gbs.php>
- Introduction to LEED Rating Systems | by Green Building Academy (21:30)
 - <http://www.youtube.com/watch?v=hZoPENko-6U>
- BEAM Plus Project Assessment
 - <http://www.hkgbc.org.hk/eng/BEAMPlus.aspx>