

THEi FST Cross-discipline Seminar, 12 Apr 2019 (Fri)

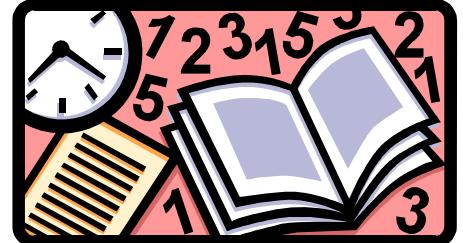
http://ibse.hk/190412_Seminar_GSB.pdf



Green and sustainable building



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About the speaker



- ***Ir. Dr. Sam C. M. Hui*** (*Building Services Engineer*)
 - PhD, BEng(Hons), CEng, CEM, BEAP, BEMP, HBDP, MASHRAE, MCIBSE, MHKIE, MIESNA, LifeMAEE, AssocAIA
 - CEng = Chartered Engineer
 - CEM = Certified Energy Manager
 - BEAP = Building Energy Assessment Professional
 - BEMP = Building Energy Modeling Professional
 - HBDP = High-performance Building Design Professional
 - LifeMAEE = Life Member, Association of Energy Engineers
 - ASHRAE Distinguished Lecturer (2009-2011)
 - 20 yrs. teaching in HKU Departments of Architecture and Mech. Engg.
 - Research interests: energy efficiency in buildings and sustainable building technologies

Contents

- What is green building?
- Why going green?
- Basic principles
- Examples





“What is
green
building?”



An example of green building in Hong Kong ?!

(A building in Pokfulam; photo taken by Dr Sam C M Hui)



Cologne

Building
+
Green



Toronto

Green building is NOT just adding a green outlook

Cave dwellings in Cappadocia, Turkey



(Photo taken during my travel to Turkey in 1992)

(Video: Cappadocia, Turkey: Inside The Cave Dwellings. National Geographic (4:30) <http://www.youtube.com/watch?v=xM-i3wCaXyw>)

Sustainable
Architecture
in ancient time
(cave dwellings)
(3500 years)

- cooperate with nature (climate, topography)
- durable and longlife are the trend



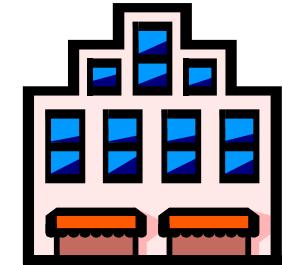
Photo credit: Renzo Piano Workshop Foundation

(See also: <http://inhabitat.com/jean-marie-tjibaou-cultural-center-inspired-by-native-architecture/>)

A modern example of **Sustainable Architecture:**

Jean Marie Tjibaou
Cultural Center
(by Renzo Piano)

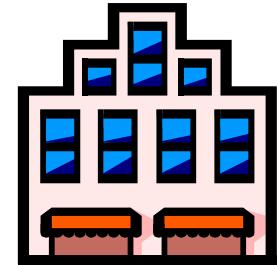
- Integration of regional materials, traditional construction methods, contemporary technology and ecological design



What is green building?

- A loosely defined collection of land-use, building design, and construction strategies that reduces the **environmental impacts**
- The term “green” is extremely wide ranging, encompassing many viewpoints and open to broad interpretation
 - Debate around green building/architecture
 - Complexity of environmental issues





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

Cradle-to-Grave

Sustainable
design requires
life cycle
thinking.



Cradle-to-grave is the full Life Cycle Assessment from resource extraction ('cradle') to use phase and disposal phase ('grave').

- site selection
- urban design
- landscape planning

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

- energy performance
- renewable energy
- water conservation

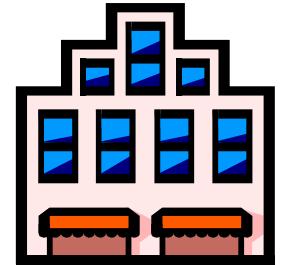
Environmental Criteria & Factors

- environmental policy
- transport strategy
- building maintenance

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

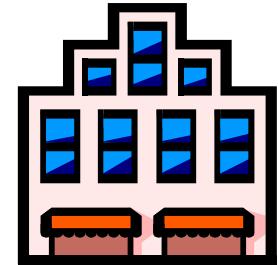
- air quality
- thermal comfort
- lighting & noise
- hazardous materials

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?

- **Definition of Sustainable Building** [by an OECD project]
 - Have minimum adverse impacts on the built and natural environment, in terms of the buildings themselves, their immediate surroundings and the broader regional and global setting
 - Apply practices which strive for integral quality (economic, social and environmental performance) in a very broad way

What is Green Building?

甚麼是綠色建築？

Energy efficiency



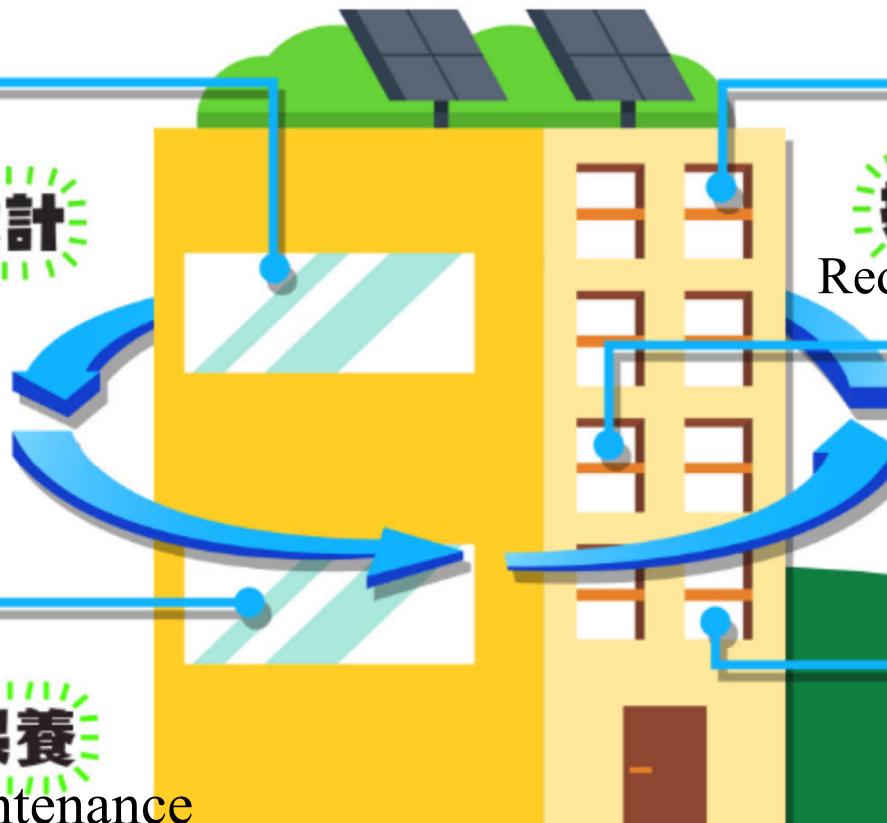
Design
設計

Construct
建造

Using green products
綠色產品使用



Operation and maintenance
運作及保養



Water efficiency



Demolish
拆除

Reduce wastes, sorting & recycle
減少廢物產生、分類及回收

Repair & renovate
維修及翻新

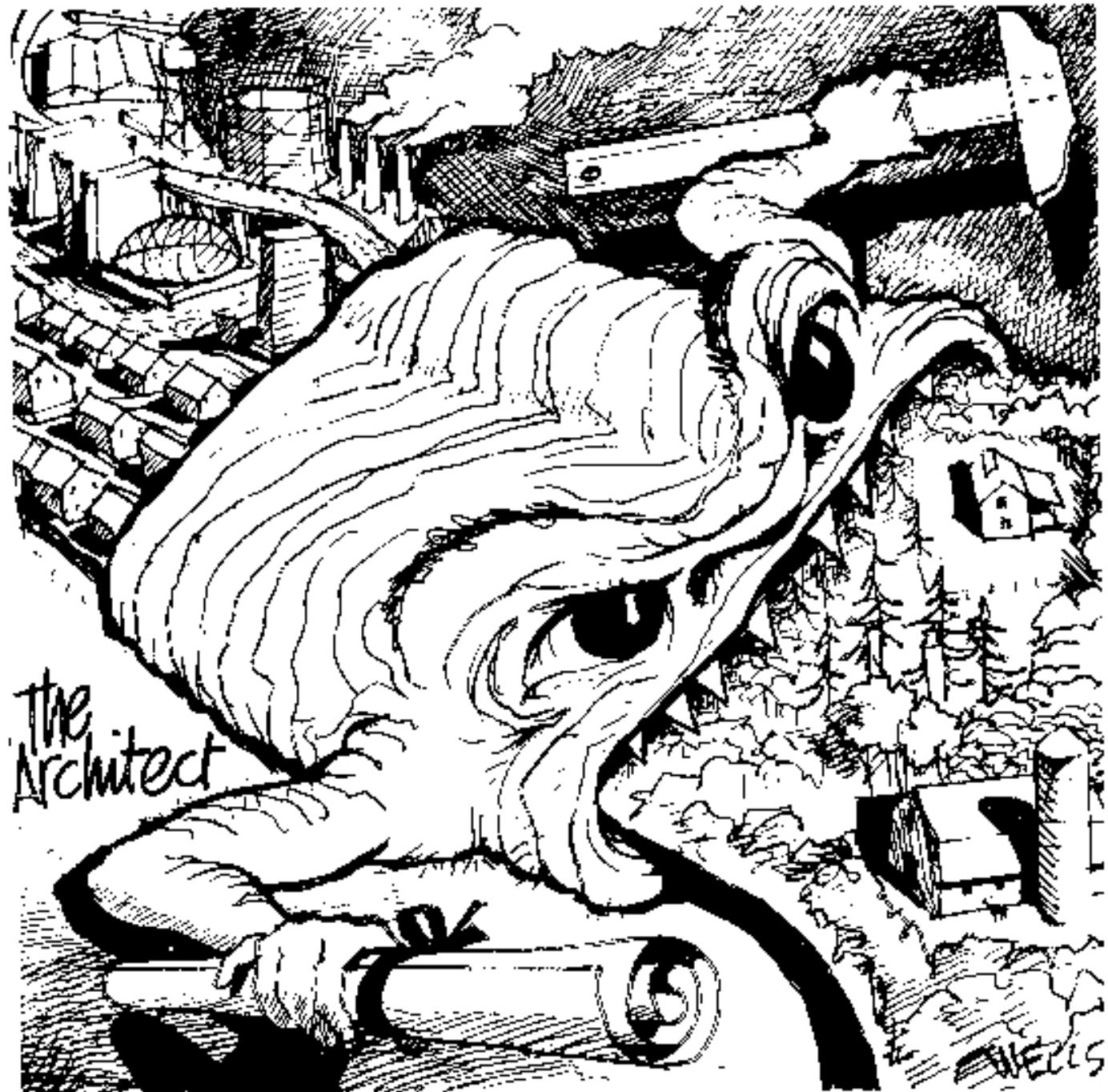


Indoor
environmental
quality

"It's not easy being green." -- Kermit the Frog, 1972.



Why going green?



Drawing by the American architect Malcolm Wells

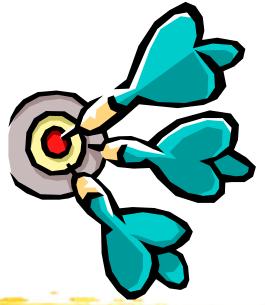
Why going green?



- Buildings consume significant resources
 - Consumption of energy & water
 - Use of building materials
 - Transport of materials & products
- Construction as the worst polluters
 - Operation on site and off site
 - Waste from construction/occupants
 - Pollutants from buildings



Why going green?



- Green buildings pay
 - Direct benefits (e.g. energy/cost savings)
 - Indirect benefits (e.g. healthier conditions)
 - Wider global benefits (e.g. reduced CO₂ emission)
- Life-cycle benefits
 - Total economic and environmental performance
 - Long-term “*sustainability*”



Average Savings of Green Buildings

ENERGY
SAVINGS
30%

CARBON
SAVINGS
35%

WATER
USE
SAVINGS
30-50%

WASTE
COST
SAVINGS
50-90%



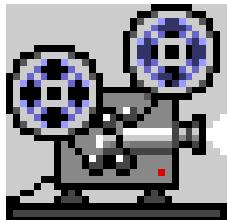
Source:
Capital E

Why going green?



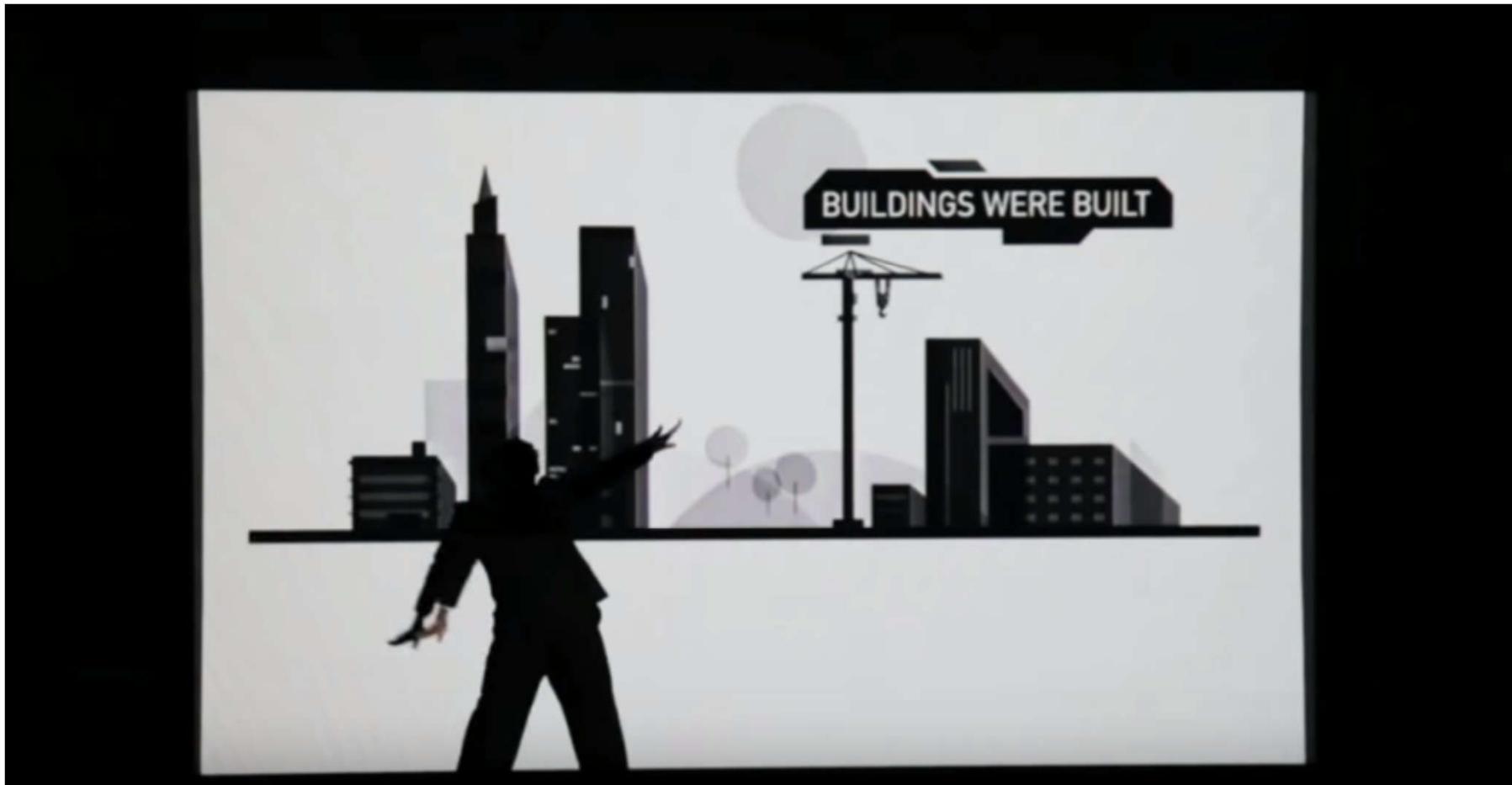
- Benefits of sustainable buildings:
 - They are designed to be cost effective
 - They boost employee productivity
 - They enhance health and well-being
 - They reduce liability
 - They create value for tenants
 - They increase property value
 - They benefit the community
 - They achieve more predictable results





Green Building Evolution (3:47)

<http://www.youtube.com/watch?v=MroerBD69bA>



WORLD
GREEN
BUILDING
COUNCIL

www.worldgbc.org

The story of the evolution of the green building movement told through image and dance. At the opening of the WorldGBC Congress/GBCSA Convention in Cape Town in 2013.



Why study green building?

- Environmental reasons:
 - The growth and development of our world has a large impact on the natural environment
 - Manufacturing, design, construction, and operation of the buildings in which we live and work are responsible for the consumption of many of the natural resources
- Personal reasons:
 - “I want to be a Green Building Professional.”
 - Green building jobs and market are red hot.

Why study green building?



- Going “Green” is the “right thing”
 - Reduce resources consumption
 - Decrease carbon or green house gas emissions
 - Enable energy independence
 - Encourage community growth and enhancement
 - Preserve and protect natural systems
 - Achieve “sustainable development (可持續發展)”

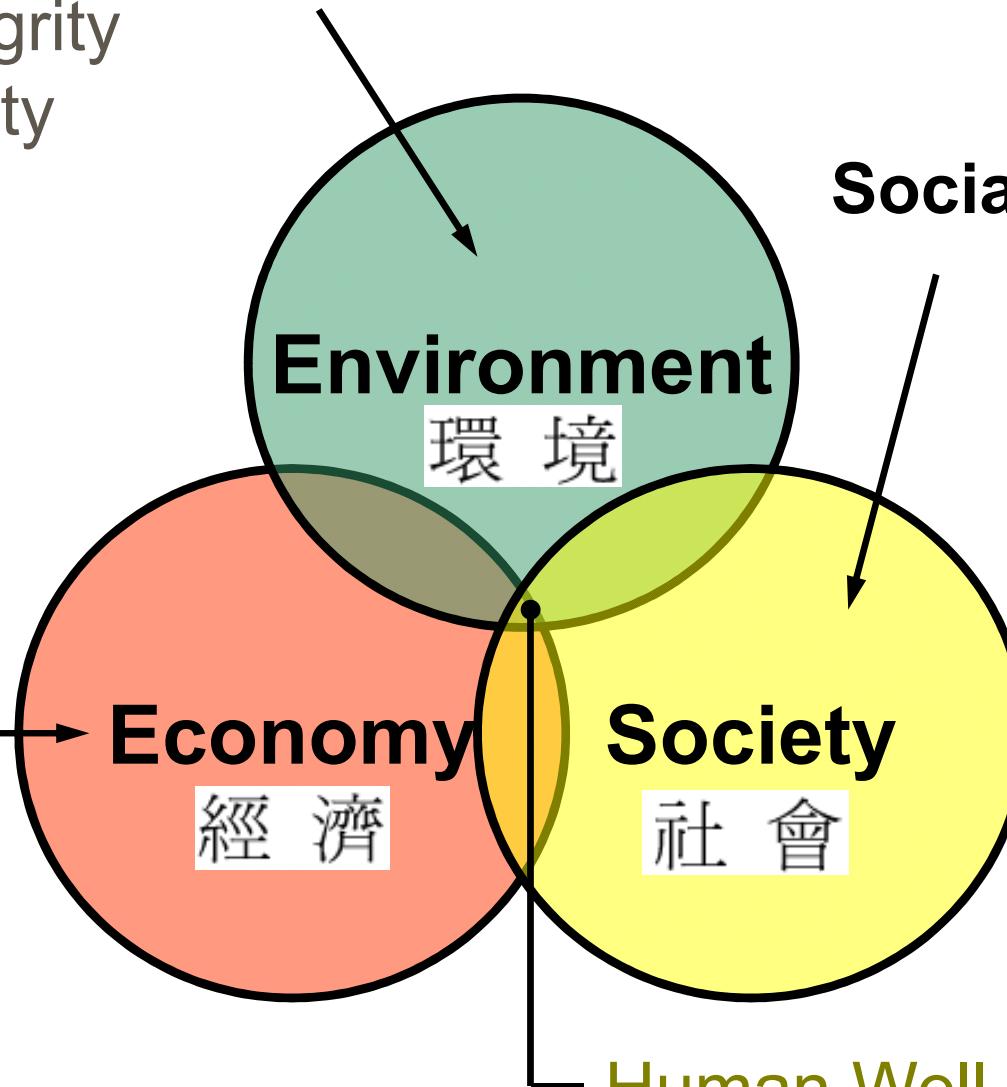




Three dimensions of sustainability

Environmental Sustainability

Ecosystem integrity
Carrying capacity
Biodiversity



Economic Sustainability

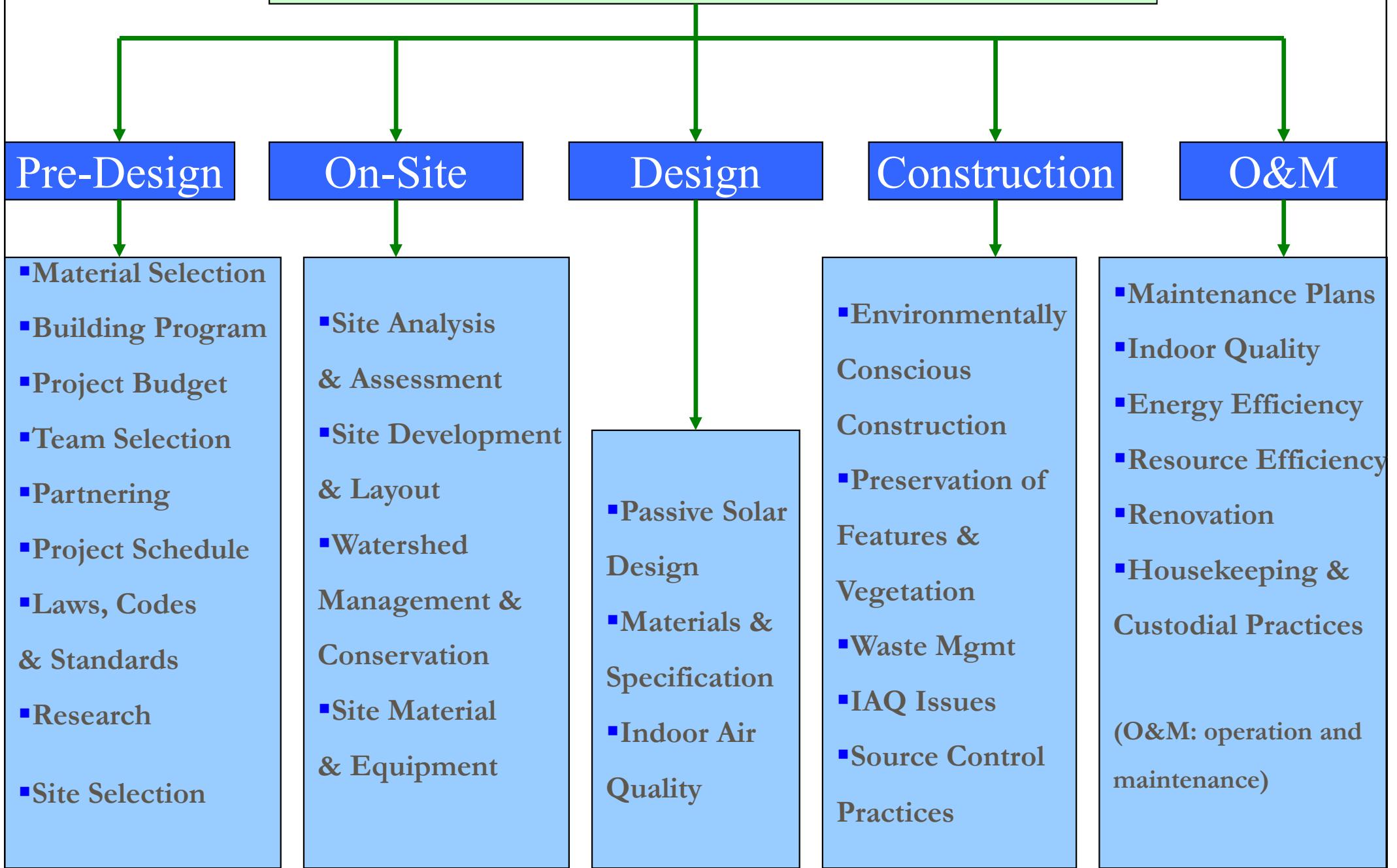
Growth
Development
Productivity
Trickle-down

Social Sustainability

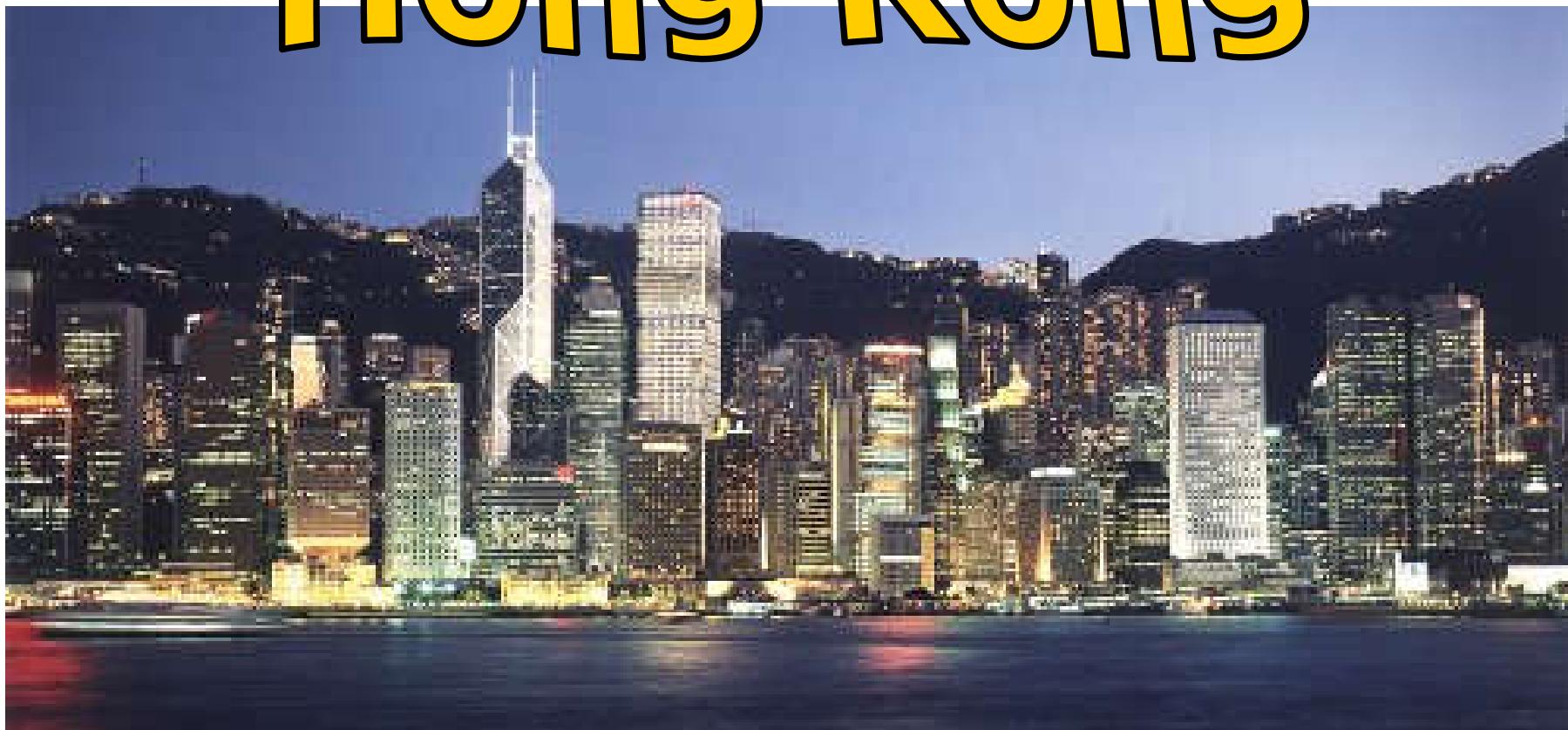
Cultural Identity
Empowerment
Accessibility
Stability
Equity



Application of Sustainability in Buildings



Hong Kong





**"We shape our buildings and
thereafter they shape us."
(Winston Churchill)**



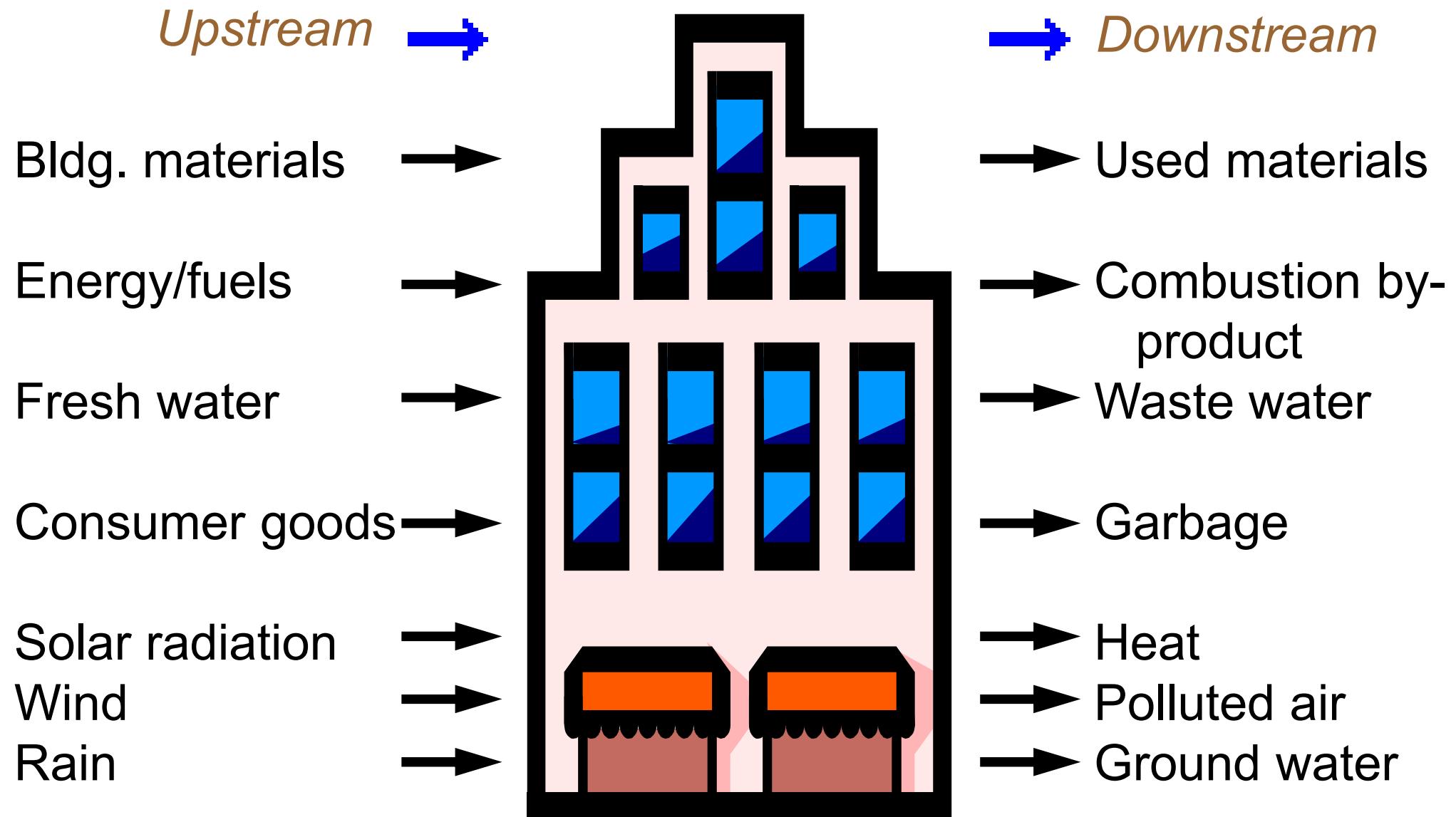
Basic Principles



Basic principles

- Aims of green building design
 - Reduce energy in use
 - Minimise external pollution & environmental damage
 - Reduce embodied energy & resource depletion
 - Minimise internal pollution & damage to health
- Green design requires resolving many conflicting issues and requirements

Resource and material flow in the building ecosystem

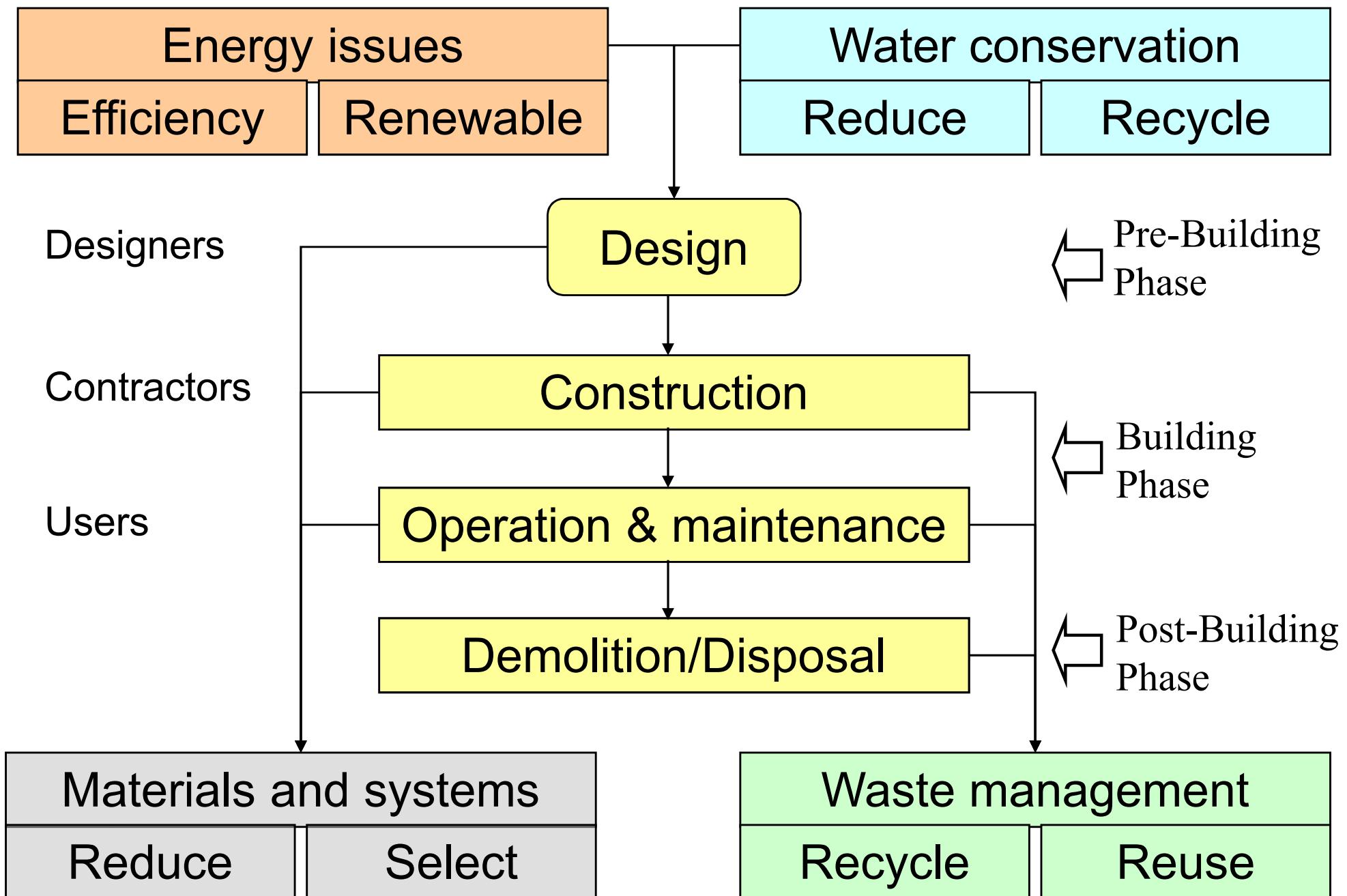




Basic principles

- Green building design involves
 - Holistic approach (whole systems thinking)
 - Each aspect is considered in relation to all others
 - Interdisciplinary efforts
 - Understanding & contribution from all involved
 - Understanding of building performance
 - Assessment & evaluation of performance
 - Caring for people
 - Well being of the occupants and users

Building life cycle and sustainable construction





Basic principles

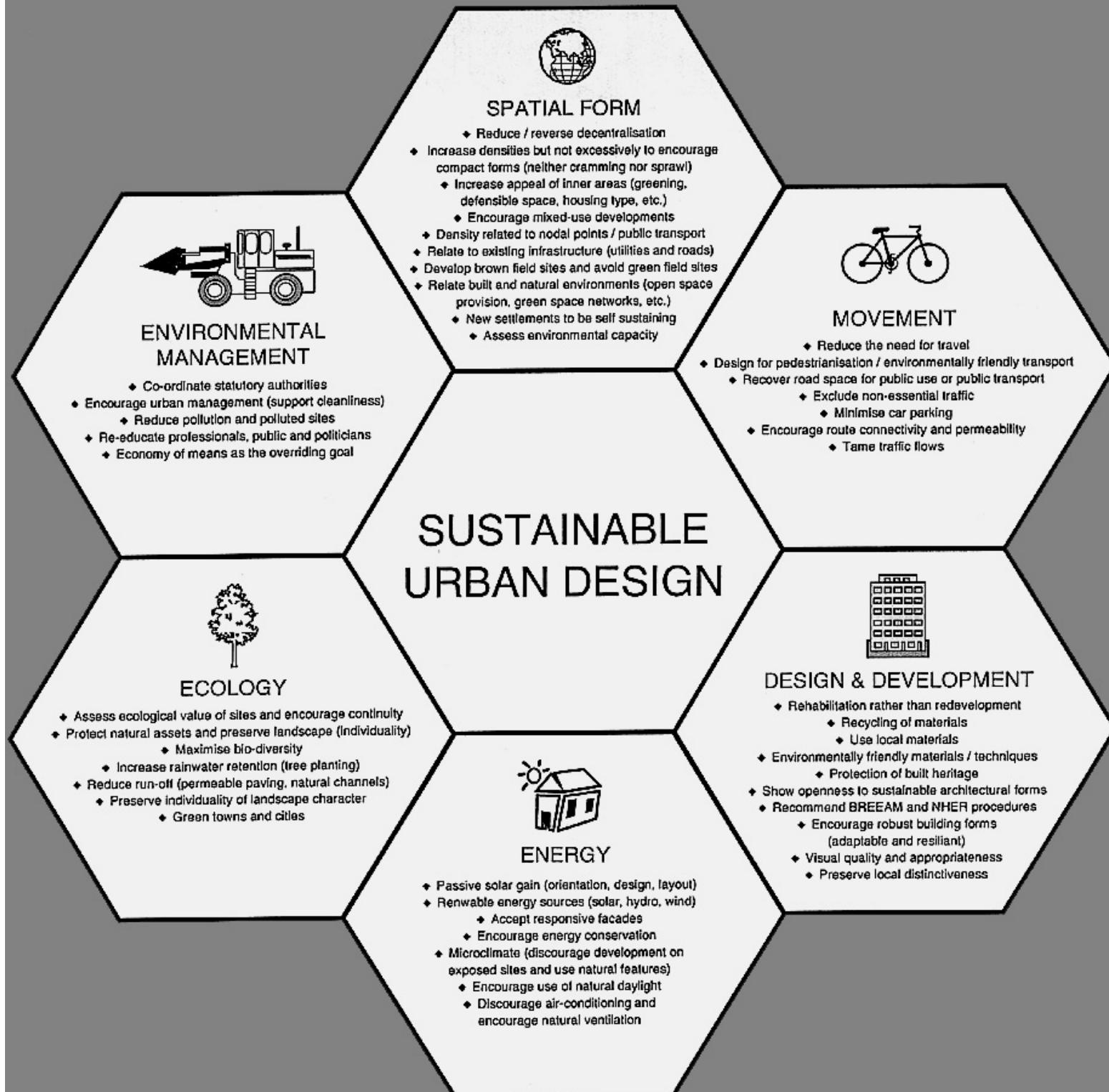
- Green strategies at different stages:
 - Inception (briefing, targets, site)
 - Design
 - Preliminary studies
 - Sketch studies
 - Pre-project
 - Basic project
 - Execution of project
 - Construction (tendering, supervision, acceptance)
 - Maintenance and Refurbishment



Basic principles

- Major concerns
 - Conserve non-renewable energy & scarce materials
 - Minimise life-cycle ecological impact
 - Use renewable energy and materials that are sustainably harvested
 - Protect & restore local air, water, soils, flora and fauna
 - Support pedestrians, bicycles and mass transit
 - Reduce human exposure to noxious materials

SUSTAINABLE URBAN DESIGN



風

Wind

水

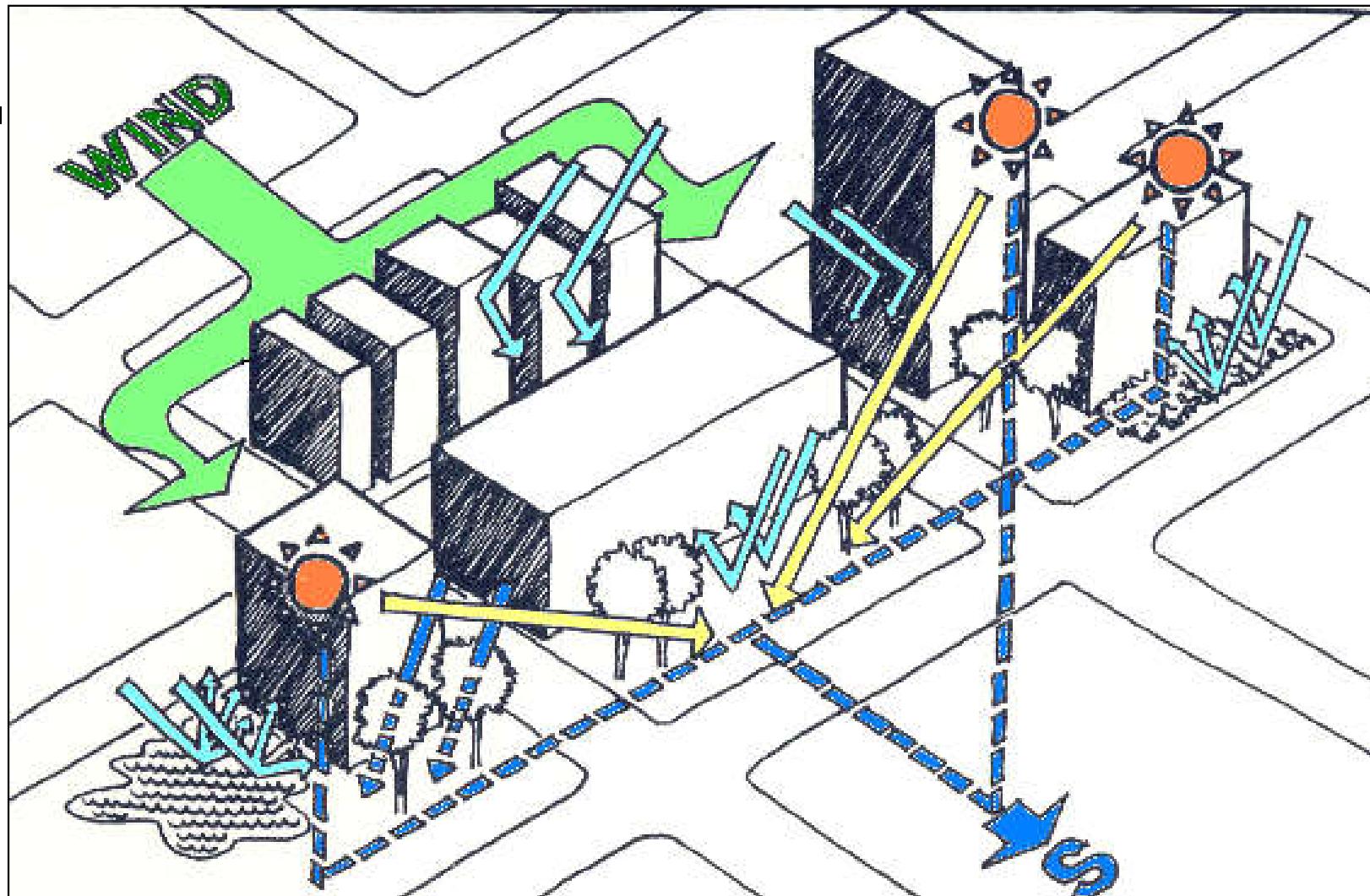
Water

光

Light

物

Matter



Site analysis and understanding of the environmental factors is important

Integrated &
total energy
approach

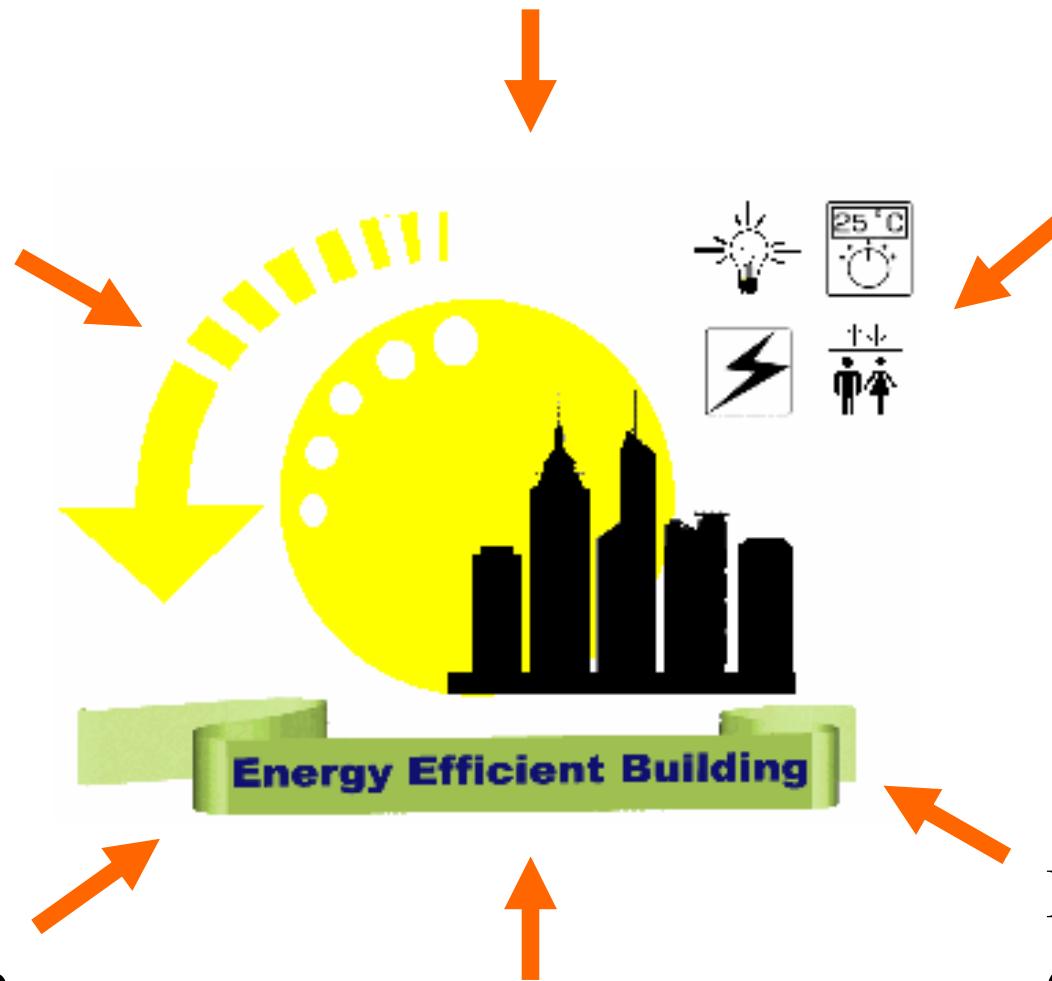
Good design practices

Efficient
systems

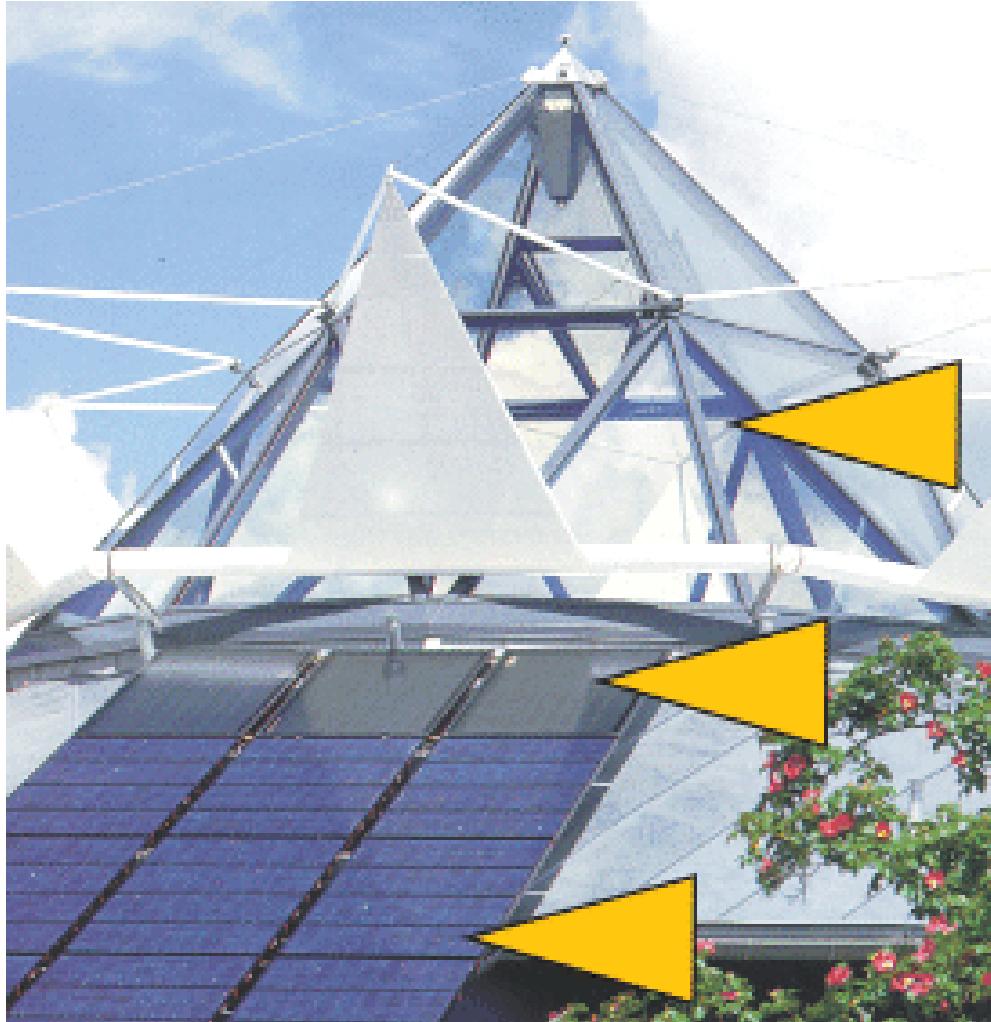
Good house-
keeping

User education
& awareness

Efficient
operation



Integration of solar energy systems in buildings



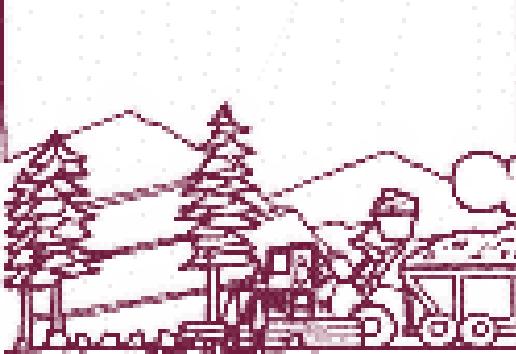
Passive solar (e.g. skylight)

Active solar (solar hot water)

Photovoltaics

Life Cycle of Building Products

Resource Extraction



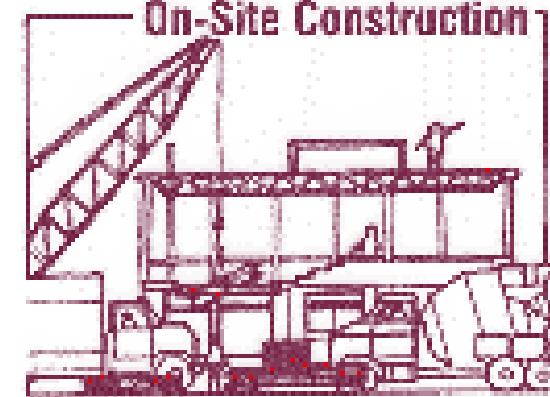
Manufacturing



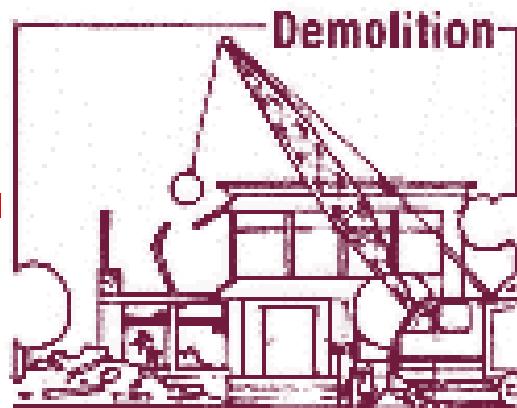
Recycling/Reuse/Disposal



On-Site Construction



Demolition



Occupancy/Maintenance

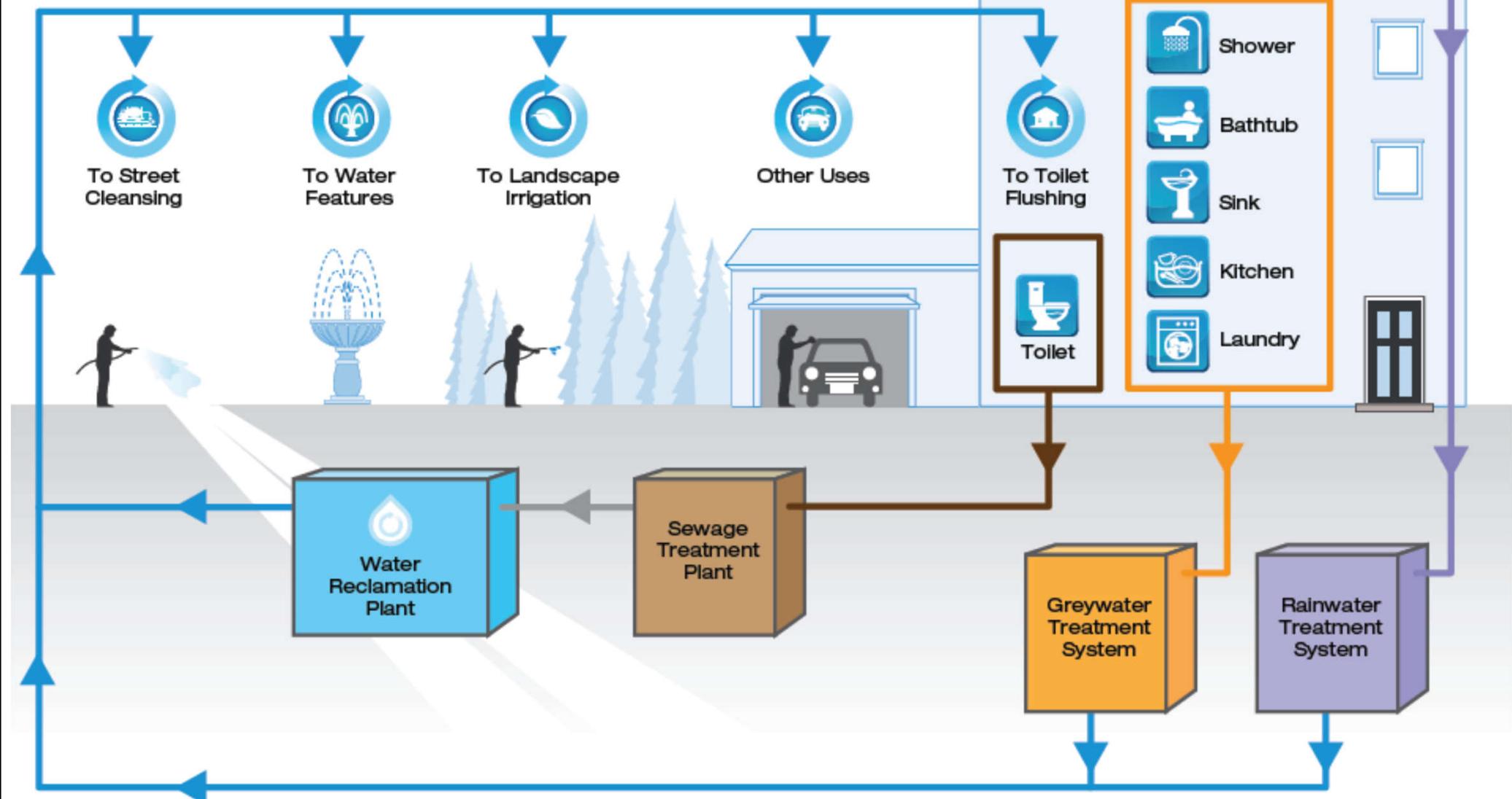


Green Features

Manufacturing Process (MP)	Building Operations (BO)	Waste Mgmt. (WM)
Waste Reduction (WR)	Energy Efficiency (EE)	Biodegradable (B)
Pollution Prevention (P2)	Water Treatment & Conservation (WTC)	Recyclable (R)
Recycled (RC)	Nontoxic (NT)	Reusable (RU)
Embodied Energy Reduction (EER)	Renewable Energy Source (RES)	Others (O)
Natural Materials (NM)	Longer Life (LL)	

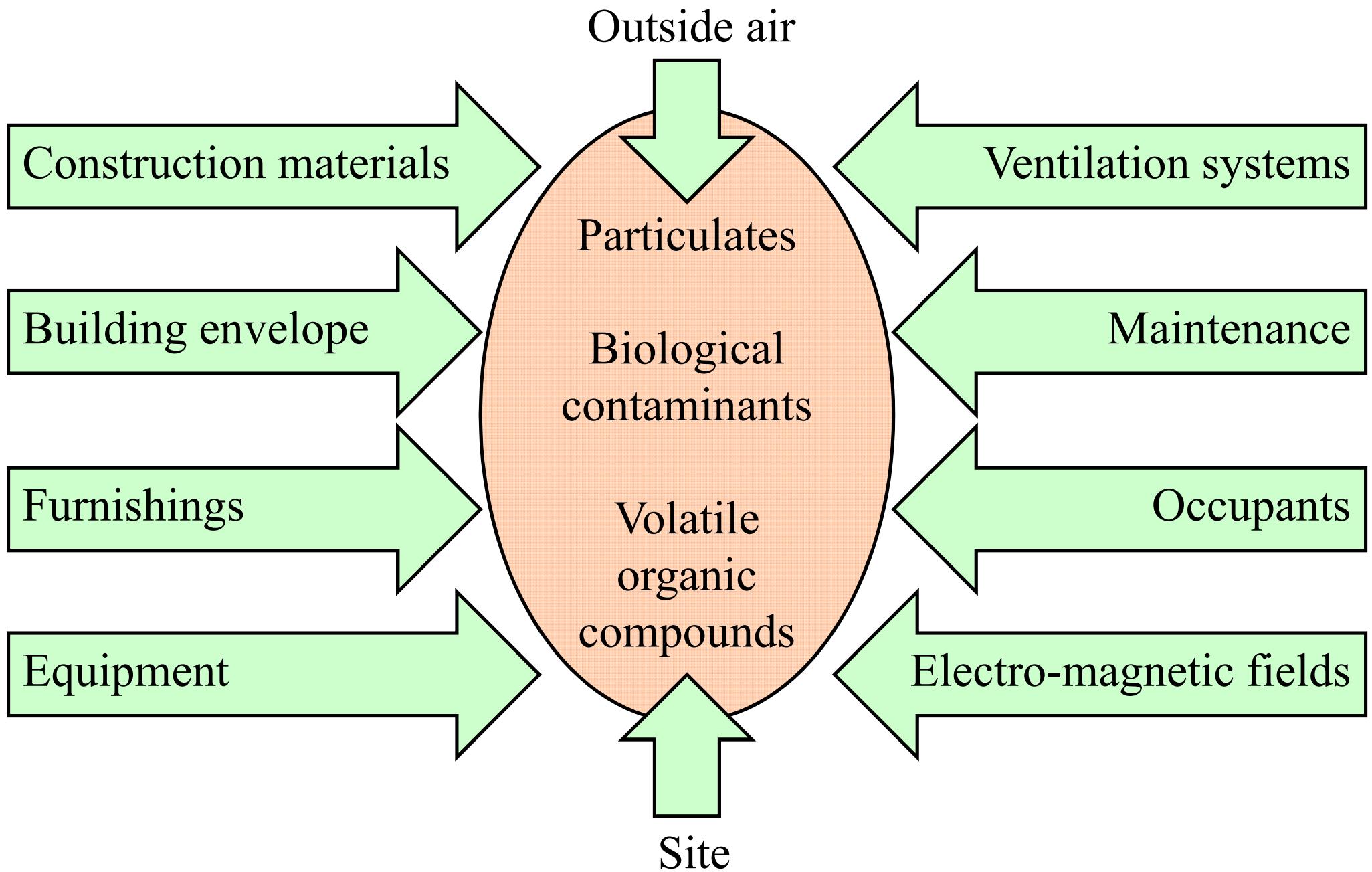
Water Reclamation Process

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

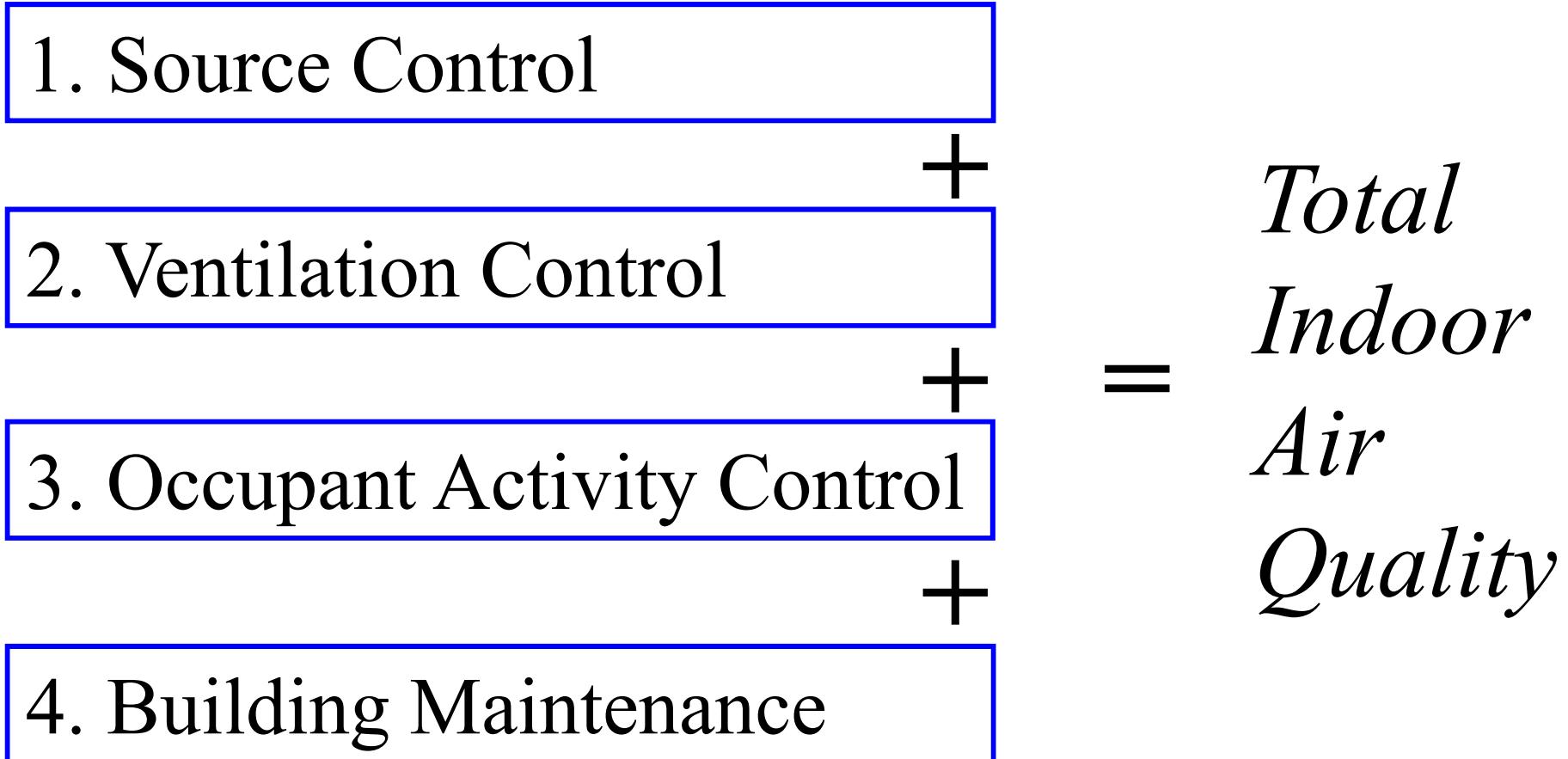


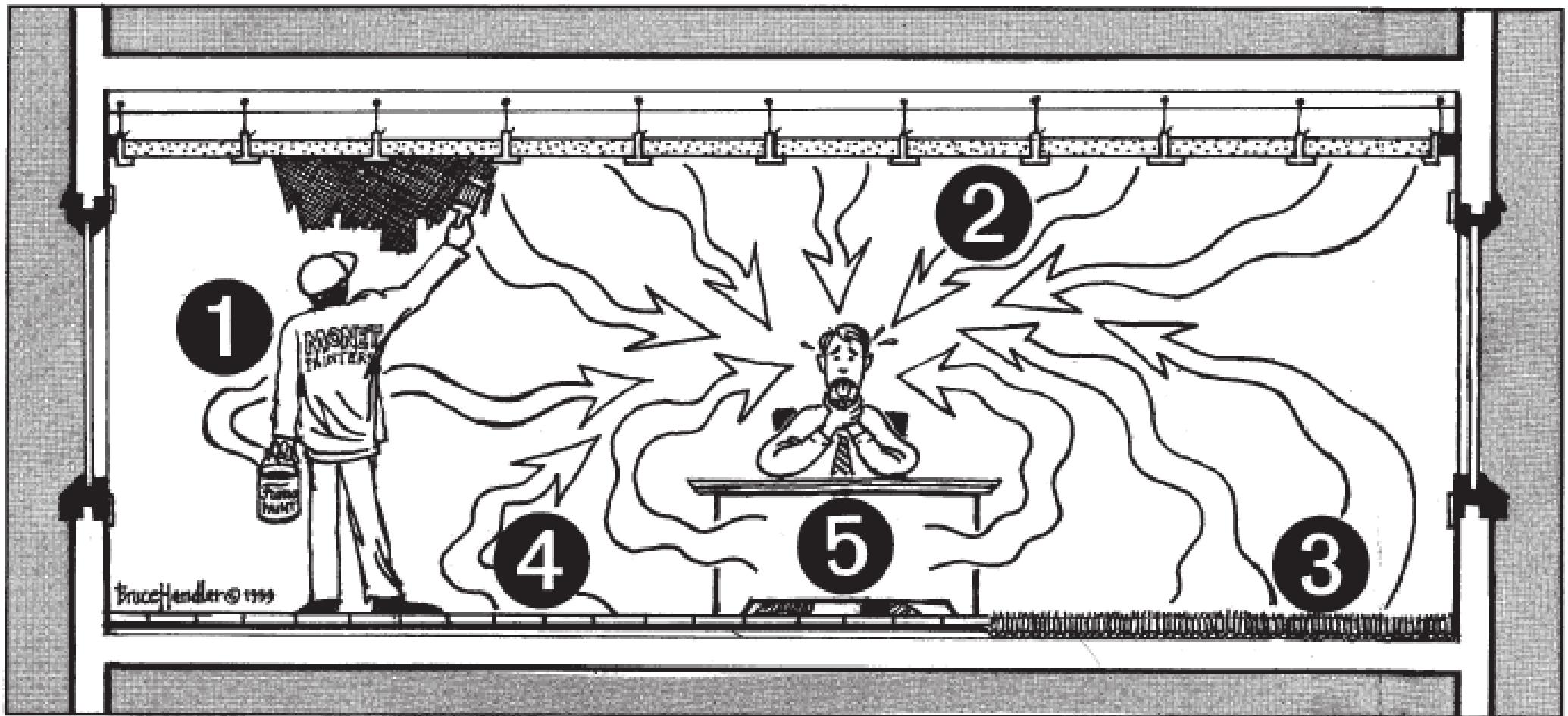
(Source: Water Supplies Department, www.wsd.gov.hk)

Major factors contributing to indoor air quality (IAQ)



Four principles of indoor air quality design





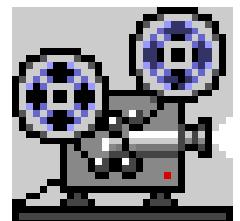
Sources of offgassing in building materials:

- 1) paints, 2) ceiling tiles, 3) carpeting, 4) VCT floor tiles
- 5) manufactured wood products



Examples

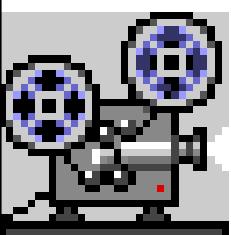
- Design of new buildings
 - MCMC Green Building (Malaysia) (5:04)
 - <http://youtu.be/mHq-oI8UijQ>
- Operation & maintenance of existing buildings
 - Taipei 101: Tallest green building (3:43)
 - <http://youtu.be/b7ShsogLZ7I>
 - Empire State Building: Leadership in American Progress in Sustainability (5:49)
 - <http://youtu.be/17i7Q5Dr3PA>





Further reading

- What is a Green Building?
 - <http://businessfeed.sunpower.com/business-feed/written-what-is-a-green-building>
- Video:
 - A Tale of Two Futures: Sustainable Buildings or Unsustainable Climate Change (3:22)
<http://youtu.be/3TioZ2sVL-E>





Further reading

- Teaching Kit: Sustainable Design for Buildings (ArchSD)
 - <http://www.archsd.gov.hk/archsd/html/teachingkits/tk1/>
 - Sustainable planning
 - Sustainable building design
 - Green procurement
 - Green construction management
 - Sustainable maintenance

