



Introduction to Sustainability and Green Buildings

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Introduction to Sustainability and Green Buildings

- *Sustainability*
- *Protecting the Environment*
- *Green Building Concepts & Assessment*
- *Green Building Design & Technologies*
- *Common Green Building Features*
- *Existing Green Building Management*

Is this sustainable development??

- 2570 BC: The Great Pyramid of Ancient Egypt



Sustainability (sustinere)

- Capacity to maintain, support or endure
- For humans: the long-term maintenance of responsibility in 3 dimensions:
 1. *Environmental*
 2. *Economic*
 3. *Social (4th dimension: culture)*
 - *the responsible management of resource use*
 - *a social challenge that entails law, urban planning, transport, local and individual lifestyles and ethical consumerism*

Sustainable Development

- *Brundtland Commission of the United Nations on March 20, 1987: "SD is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"*
- *2005 World Summit: SD requires the reconciliation of environmental, social equity and economic demands*

Sustainability



Sustainability

"Meeting the needs of the present without compromising the ability of future generations to meet their own needs"

- an attempt to merge ecology and economy into one system
- living a life of dignity in harmony with nature
- renewing resources at a rate equal to or greater than the rate at which they are consumed
- creating an economic system that provides for quality of life while renewing the environment and its resources

Source : <http://www.gcbl.org/system/files/sustainability-venn-sm.jpg>

A sustainable community is one that resembles a living system where all of the resources (human, natural and economic) are renewed and in balance for perpetuity

How about this??

- 208 BC: The Great Wall of China



老莊智慧，回歸自然

- 天長地久。天地所以能長且久者，以其不自生，故能長生。(老子) 七章
- 亂天之經，逆物之情，玄天弗成。(莊子) (在宥)
- 萬物皆出於機，皆入於機。(莊子) (至樂)

數千年中國人的智慧及渴求：

長安，永樂，太和，長青，和諧，康泰



Protecting the Environment

(source: Conrad Wong, Chairman of HKGBC)



- ❑ **Global Warning: Green House Effects**
- ❑ **Air Emissions: RSP, CO2, SO2, NO2, VOC**
- ❑ **Major Air Pollution: Power Plants, Motor vehicles**
- ❑ **Renewable energy: Solar, Wind, Tides, Geothermal heat**

Protecting the Environment

(source: Conrad Wong, Chairman of HKGBC)



- ❑ **Limited source of water resources**
- ❑ **Water Pollution affecting human living**
- ❑ **Acid rain: health issue**

Protecting the Environment

(source: Conrad Wong, Chairman of HKGBC)



❑ **Chemical pollution:** emissions from human activities enter the environment **contaminating air, water or soil** (Acid rain, greenhouse gases and ozone)

Protecting the Environment

(source: Conrad Wong, Chairman, HKGBC)



❑ **Wastage:** one of HK's most serious environmental challenges
 ❑ To reduce wastage: **Rethink, Refuse, Reduce, Reuse and Recycle**
 ❑ **Implement waste management strategy**

Protecting the Environment

(source: Conrad Wong, Chairman, HKGBC)



❑ **Ecology:** Protect our natural environment, animal extinction, biodiversity (natural landforms, rocks, animals and plants)

Protecting the Environment

(source: Conrad Wong, Chairman, HKGBC)



❑ **Noise pollution:** Over a million people in HK are exposed to excessive traffic noise
 ❑ **Light pollution:** adverse effects of artificial light (sky glow, glare, light trespass, light clutter, decreased visibility at night)

Real Estate Sector Impacts Globally!

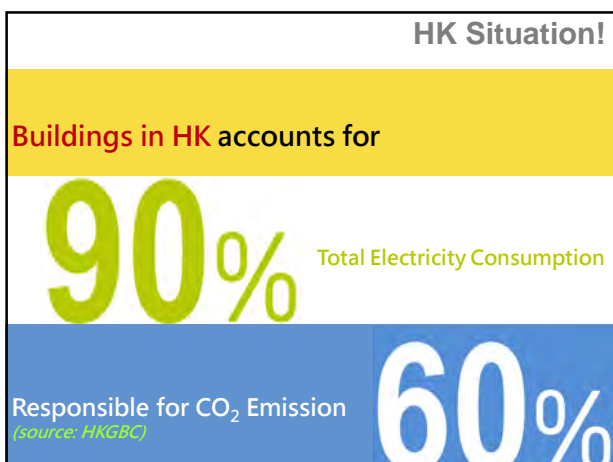
(Building and Construction Authority, Singapore)

- ❑ Buildings are responsible for
 - 40% of world's global greenhouse gases emissions
 - 40% of solid waste generation globally
- ❑ Buildings use 12% of the world's water
- ❑ Air quality in buildings typically contains up to 5x more pollutants than outdoor air
- ❑ Buildings utilize 1/3 of the world's resources

Green Building Designs/Technologies

(Building and Construction Authority, Singapore)

- Daylight illumination and sun-shades, ventilation and thermal capacity of materials
- Passive designs to benefit from: massing, orientation, façade and sun-shading fins/panels, daylighting transmitters, natural ventilation, ETTV and greenery
- Active designs: AI in AC system, sensors in lighting, escalators and mechanical ventilation, energy recovery, renewable energy



HKGBC

Inaugurated in **November 2009**
4 Founding Members: Construction Industry Council (CIC)
 Business Environment Council (BEC)
 BEAM Society Limited (BSL)
 Professional Green Building Council (PGBC)

Green Building Assessment
(source: Conrad Wong, Chairman, HKGBC)

Assessment methods to evaluate green buildings in the World

<p>Category of Assessment:</p> <ul style="list-style-type: none"> □ Site Aspect □ Material Aspect □ Water Use □ Energy Use □ Indoor Environmental Quality □ Innovation and Additions 	<p>Category of Assessment Area:</p> <ul style="list-style-type: none"> □ New Building □ Existing Building □ Fitting-out □ Community (Neighborhood) □ Enforcement Method <ul style="list-style-type: none"> □ Market Force, Branding □ Government Policy – BD Submission □ Tax or Loan Incentive
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Green building concepts

Energy Use

- **Energy efficient building design:** building orientation, site planning, access of daylight, external shading devices
- **Energy efficient systems & equipment:** renewable energy system- photovoltaic panels, wind turbines, ventilation & lighting system, electrical appliances with energy labels
- **Energy management:** energy metering, operation & maintenance

Site Aspects

- **Site location:** local transport, neighborhood amenities
- **Site planning & design:** landscaping & planters, ecological impact, cultural heritage
- **Emissions from site:** light pollution, noise from building equipment

Water Use

- **Water efficient appliances:** auto-stop fixtures
- **Water recycling:** rainwater harvesting & grey water recycling
- **Water efficient irrigation**
- **Monitoring & control:** water metering, leakage detection devices

Materials Aspect

- **Selection of materials:** sustainable forest product, recycled materials, rapidly renewable materials
- **Waste management and Recycling:** waste sorting, food composting facilities

Indoor Environmental Quality

- Indoor air quality
- Ventilation
- Thermal comfort
- Lighting
- Acoustic & noise
- Hygiene
- Security
- **Building amenities:** barrier free facilities

BEAM Professionals (BEAM Pro)

- HKGBC accredits BEAM Pro (綠建專才) and BEAM Assessors in collaboration with BSL
- BEAM Prof must attend regular CPD
- 2014 HKGBC rolled out a new qualification, BEAM Affiliate (綠建通才) who supports the BEAM Pro in Green Building Projects
- The route to BEAM Pro from BEAM Affiliate is through BEAM Pro training & Exam

Hong Kong Building Environmental Assessment Method (HK-BEAM)

- Introduced in 1996
- BEAM Society established in 2002
- BEAM Plus re-launched in 2010 for NB & EB (First Appeal by BSL, Final Appeal by HKGBC)
- 2012-BEAM Plus v1.2 (with Passive Design Criteria)
- 2013-BEAM Plus interiors
- **Both BEAM Plus NB & EB are under review**

- BEAM Plus Neighbourhood Development (ND) – 2015 Q4 – (Assessment Area = Site Area + Impact area) Watch Out!
- CIC Carbon Labelling Scheme for Construction Products 2012
- Eco Product Directory & Green Building Labelling Scheme Q4 2014 (15 mtls/products)
- Guide books 2014:
 - HK Green Office School Guide
 - HK Green Shop Guide
 - Green Tenancy Driver for Office Buildings

HK 3030 Campaign

A Roadmap for Building Energy Consumption for Hong Kong

Target: 30% Absolute Energy from 2005 level by 2030



Benchmarking & Energy Saving Tool (BESTOO) – Office Occupants 2013

Label Rating:

- Platinum (top 10 percentile)
- Gold (top 20%ile)
- Silver (top 30%ile)
- Bronze (top 40%ile)
- Green (top 50%ile)
- No rating (below 50%ile)

Check: <http://www.hkgbc.org.hk/bestoo>

Under revamp: Whole Building 2015 Q3

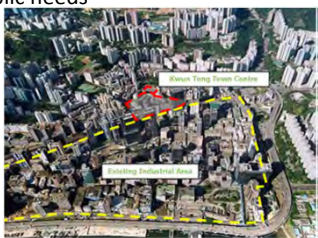
Whole Building Retail 2016 Q2

Identify the key policy tools in promoting a sustainable built environment

Sustainable Built Environment (Key policy tools)

Hong Kong Planning Standards & Guidelines (HKPSG)

- Ensures during planning process gov't reserves adeq land to facilitate social and econ devt and pub facilities to meet public needs



- Covers local, district & territorial guidelines on: residential densities (2), community (3) & recreational facilities, open space/greening (4), industrial land (5), retail facilities (6), utility services (7), internal transport facilities (8), env planning (9), conservation (10), urban design (11) & Misc (12)



Sustainable Built Environment (Key policy tools)

Sustainable Building Design Guidelines

1. Building Separation:

restricts the overall length of a bldg in relation to width of adjoining street (min permeability 20%, 25% or 33.3% stipulated depending on size of site & building height)



Alt: performance-based approach using air ventilation assessment (AVA) by wind tunnel modelling or computational fluid dynamics to compare the baseline case



Sustainable Built Environment

(Key policy tools)

2. Building Set Back: to improve air ventilation, env quality at pedestrian level & mitigate the deep “street canyon effect”



- Requires a bldg abutting a narrow street less than 15 m wide should be set back
- No part of the bldg, up to a level of 15 m above street level (pedestrian zone), should be within 7.5 m from centre of street

Sustainable Built Environment

(Key policy tools)

3. Site Coverage of Greenery:

to improve env quality of urban space (esp pedestrian level) & to mitigate the heat island effect

- New bldg devt with site areas = or >1000m² should be provided with greenery at pedestrian zone, communal podium roof/flat roof/main roof, slope and retaining structure



Green Roof



Fu Shan Estate Wet Market



Upper Ngau Tau Kok Estate

- Min reqt: 20% for sites 1000m² to 20000m²
- 30% for sites = or > 20000m²
- At least ½ of total greenery area be provided in pedestrian zone
- Water features, grass pavers and vertical greening accepted



Vertical Greening



Yau Lai Estate



Sustainable Built Environment

(Key policy tools)

4. Gross Floor Area Concessions:

Joint Practice Notes by BD, PlanD and LandsD since 2001

- Incentives on GFA and site coverage concessions for green features in private bldgs: balconies, utility platforms, wider common corridors & lift lobbies, communal sky gardens, acoustic fins, sunshades & reflectors, wing walls, wind catchers & funnels, non-structural prefab extl walls and noise barriers



- New policy in April 2011: overall cap of 10%

- Mandatory plant rooms, car parks, & communal sky gardens excepted



Sustainable Built Environment

(Key policy tools)

5. Energy Efficiency of Bldgs

- Building (Energy Efficiency) Regn for Commercial Bldgs/hotels: Overall thermal transfer value (OTTV) 2011 – podium: 56W/m² & bldg tower: 24 W/m²
- Energy Efficiency of Residential Buildings (PNAP APP-156)
- Control of Residential thermal transfer value (RTTV)
- Control of ventilation for thermal comfort



Planning for Sustainable Development

PDD Surveyors – Can you contribute ?



Planning and Design for Sustainable Development



Planning & Design for Sustainable Development

前期策划 (Preliminary planning)

- 项目选址 (choice of site)
- 可行性研究 (feasibility study)

市场因素 (market factors) : 市场可行性 (marketability) 、 可持续发展 (sustainability)

财务可行性 (financial viability) 、 政策 (policy) 、 环境 (environment) 、 经济 (economics) 、 民生、社会影响 (social effects) 等

法规 (statutory requirements) :

地契/土地合同

(Government land lease)

城市规划条例 (Town Planning Ordinance)

建筑物条例 (Buildings Ordinance/Regn)

• 项目定位 (project positioning)

• 总体发展概念 (Total development concept)



Thermal Comfort

Environment factors

- Air Temperature
- Air speed Velocity
- Humidity
- Radiant Temperature

Personal factors

- Clothing Insulation
- Metabolic Rate

Waste Reduction Management

Key elements of the 5R principle:

- **Rethink** the need to use the material/equipment
(重新思考是否有需要使用)
- **Reduce** - use less (減少使用)
- **Reuse** - use again (重用物料/物件)
- **Replace** by environmental friendly substitutes
(以環保物料代替)
- **Recycle** - create new life/usage (循環再造)

Identify the common features in green buildings of Hong Kong

Identify the common green features

- Light sensors
- BMS
- Vertical green wall/Green roofs
- LED lights
- T5 tubes
- Motion sensors
- Rainwater collection system
- ISO 9001

Identify the common green features

- Motion sensors
- ISO 14000
- Regular and timely maintenance to systems
- Tempered glass
- Solar panels
- hard landscaping
- Water saving devices
- Separate metering

Renewable Energy



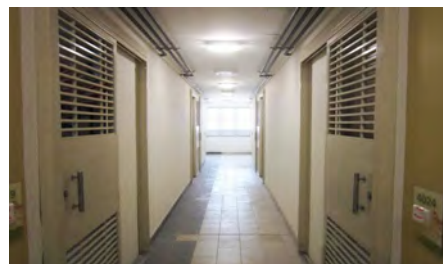
Mono-crystalline silicon PV panels installed at Lam Tin Estate Phases 7 & 8

Renewable Energy



Wind-solar hybrid energy generating system for lighting at Sau Mau Ping South Estate

Energy Saving



LED installations at Kai Ching Estate

Energy Saving



Manual push button of two-level lighting control

Vertical Greening



Yau Lai Estate

Green Construction Method



Volumetric precast components

Reusable modular site hoarding

Sustainable Materials



GGBS as a partial substitute of cement in precast concrete facades

Timber come from sustainable sources Forest Stewardship Council (FSC)

Common Green Building features

(source: Swire Properties, ARUP, Yau Lee, HA and others)

- **HVAC:** water-cooled chillers, VVVF inverter variable speed drive, CO2 sensor + heat recovery chiller
- **Lighting:** replace T8 tubes with T5 or LED + motion sensors
- **Lifts and elevators:** regenerator power + permanent magnet power
- **Sky gardens, soft landscape,** vertical + horizontal greens
- **Solar hot water, Low-E glass panels,** motorized roller blind, integrated solar water cladding, heat pump, pattern recognition energy saving solution, fresh air control, chilled headboard, energy optimization solution, lift counter weight optimization + power management
- **Sensor controls, performance maintenance, rebalancing of valves & dampers, BMS controls, façade upgrading etc...**

1st Commercial Building in HK to achieve BEAM Plus Provisional Platinum Rating (EB)

(BEC HQ- Jockey Club Environmental Building)

- **Chiller:** oil free variable speed air-cooled high efficiency compressor
- **Weather Station on roof**
- **Lighting:** LED panels to replace T8 tubes
- **Light and Motion Sensors**
- **Smart Metering**
- **Rainwater Collection System**
- **Washroom facilities:** low flow taps + dual-flush systems
- **Waste & Recycling Facilities** + waste audit and waste management
- **Building Management System**
- **IAQ Monitoring** + regular AC & filter replacements
- **ISO 14001 EMS** in place
- **Environmentally friendly purchasing planning**

Preview of coming attraction

Ist Zero Carbon Building (ZCB) in Hong Kong

ZCB – key features

- *Carbon Neutral*
- *Energy Plus*
- *Climate positive*
- *Waste-to-Energy*
- *Urban Native Woodland*
- *Certified BEAM Plus Platinum rating*
- *Educating*
- *Experimenting*
- *Evaluating*
- *Evolving*

Integrated Design based on energy hierarchy approach and eco-efficiency

- **Passive design (20% energy saving)**
[*cross-ventilated layout*<=>*wind catcher*<=>*Earth Cooling Tube*<=>*Ultra-Low Thermal Transfer Value (OTTV)*<=>*North Glazing*<=>*External Shading*<=>*High Performance Glazing*<=>*Optimized window to wall ratio*<=>*Light Pipes*<=>*Heat Reflecting Shade*<=>*Cool Paint*<=>*Clerestory for daylighting*<=>*Light Shelf*]

- **Green active systems (25% energy saving)**

[*High-Volume-Low-Speed Ceiling (HVLS) fans*<=>*High Temp Cooling System*<=>*Intelligent Lighting Management*<=>*Active Skylight*<=>*Task Lighting*<=>*Regenerative Lift*<=>*Bio-fuel Tri-generation system*<=>*Absorption Chiller*]

- **Renewable Energy**

[Photovoltaic Panels (poly-crystalline, Building-Integrated thin-film and cylindrical CIGS<>Bio-diesel Tri-generation fuel]

Design for Hybrid ventilation

- Natural ventilation for 30% of the year (January to April) [Auto wdw control by BMS(high) + Manual control(Low)]
- Aided natural ventilation (March to June, October to December) (HVLS fans)
- Under-floor displacement cooling (8 months) + radiant cooling (for the hottest 5 to 6 months) under BMS

Low Carbon Materials & construction

- High % use of PFA in rc structure
- Balanced cut & fill for excavation(basement) & filling (woodland)
- Lean construction approach (fair-faced concrete, unpainted metal works)
- Gabion wall (savaged concrete debris)
- Regionally manufactured materials (eco-paver, raised floor system)
- Low carbon materials (zinc panels for signage)

Urban Native Woodland

- 2000m², 13% of site area
- 220 native trees (over 40 species), shrubs, ground cover, lawns
- Providing food and shelter for native wildlife
- Ring Path for leisure walking & pedestrian crossing showcase for:
- One Planet Living concept {Zero carbon<>Zero waste<>Sustainable Transport<>Sustainable Materials<>Local & sustainable Food<>Sustainable Water<>Urban Woodland & Biodiversity<>Green Culture<>Green & Fair Trade<>Health & happiness}



Identify the **parties** in the design of green buildings

Green Building Designs & Technologies

Green Building is environmentally responsible and resource efficient throughout a building's life-cycle, from:

Requires close cooperation of the client, planning/design teams, architects, engineers, construction teams, and the operation, maintenance and management teams **throughout all stages in the life-cycle of a building.**

Maintenance (保养工作范围)

- A 检修 (Servicing)
 - 预防损耗 (prevent wearing)
 - 减少故障 (minimize breakdown)
- B 修理 (Repairs)
 - 制止损坏, 查找原因 (arrest breakdown, investigate causes)
 - 回复运作 (recovery)
 - 回馈 (feedback)
- C 更换 (Replacement)
 - 构建经济寿命完结更新 (renewal of parts at end of economic life)
 - 回馈 (feedback)
- D 改善 (Improvement)
 - 提升标准 (enhancement of standard)

Photovoltaics (PV) Technology

(source: EPIA)

- PV use cells to convert solar radiation into electricity both on sunny & cloudy days
- **Crystalline System** (mono-crystalline & poly-crystalline)
- **Thin Film**
- Others: concentrated photovoltaics & flexible cells)
- **Building Integrated Photovoltaics (BIPV)**

Renewable Energy

Mono-crystalline silicon PV panels installed at Lam Tin Estate Phases 7 & 8

Wind-solar hybrid energy generating system for lighting at Sau Mau Ping South Estate

Biophilic Design

(source: Terrapin Bright Green)

Design strategies for improving health and well-being in the built environment

- Nature in the space
- Natural Analogues
- Nature of the space
- 老莊思想，回歸自然，融入大自然之設計

Thematic Gardens

Thematic Garden at Choi Wan(I) Estate

Thematic Garden at Sha Kok Estate

Some Observations

- From urbanization back to rural/natural areas
- Monitor and Management
- Collaboration of professionals
- Innovation breakthroughs: solar, power walls etc.



Green building designs create a useful platform for early interdisciplinary design communication and coordination:

Great opportunity for changing the silo attitude of the professions!

It is a matter of balance and interdisciplinary collaboration



Pay particular attention to the long term performance of the green buildings, its systems, its maintenance and management



Its success depends on the joint efforts of the Government, professionals, NGOs (HKGBC etc.) and all stakeholders



Q & A