



# The first zero carbon building in Hong Kong



Photo: Gene Au Yeung

In order to combat the increasing pressure from climate change, the Hong Kong Government has proposed targets for greenhouse gas (GHG) emissions reduction. Buildings are the major contributor to GHG emissions in Hong Kong and are therefore both a challenge as well as an opportunity for GHG emissions reduction. As such, the construction industry has a significant role to play in GHG emissions reduction. Within the ambit of the Construction Industry Council Ordinance, one of the functions of Construction Industry Council (CIC) is to promote good practices in the construction industry in relation to environmental protection, sustainable construction and other areas conducive to improving construction quality. On this basis, CIC, in collaboration with the Hong Kong Government, is developing the first zero carbon building in Hong Kong.





**ZCB is a signature project to showcase state-of-the-art eco-building design and technologies to the construction industry internationally and locally and to raise community awareness of sustainable living in Hong Kong.**

#### FAST FACTS

location	Sheung Yuet Road, Kowloon Bay, Kowloon, Hong Kong
total site area	14,700 square meters (including the Zero Carbon Building with a footprint of approximately 1,400 square meters and a landscaped area for public use)
key components	exhibition and education area, eco-office, eco-home and multipurpose hall in the building eco-plaza, outdoor exhibition areas, Hong Kong's first urban native woodland, eco-cafe in the landscape area
building height	3 storeys including basement
completion date	June 2012

#### ENERGY INFORMATION

45% more efficient than the current standard design

- 20% of energy saving through passive design
- 25% of energy saving through green active systems

estimated energy use	116MWh/year
estimated energy use of the landscape area and others	15MWh/year
estimated output from biodiesel tri-generation system	143MWh/year
estimated output from PV panels	87MWh/year
estimated surplus energy export	99MWh/year
estimated net CO2 reduction by onsite renewable energy generation	7,100 tonnes (over 50 years)

## Key features

### Carbon Neutral

The first zero carbon building in Hong Kong which is designed and equipped to offset operating energy consumed from the grid by on-site renewable energy generation with grid-feed-in on an annual basis.

### Energy Plus

The building generates on-site renewable energy more than operation needs, from photovoltaic panels and a biodiesel tri-generation system. Beyond the common definition of a zero carbon building, ZCB exports surplus energy to offset embodied energy of its construction process and major structural materials.

### Climate Positive

ZCB improving local micro-climate by reducing heat island effect and greenery coverage is more than 50% of the site

### Waste-to-Energy

Large-scale use of biodiesel made from waste cooking oil and utilizing 70% of the source energy as compared to the normal level of 40%

### Urban Native Woodland

It is the first urban native woodland in Hong Kong.

### Beam Plus Green Building Certification

Achieving Beam Plus Platinum rating, the highest rating for excellent building environmental performance.

“ *Hong Kong's electricity generation accounted for 67% GHG emissions in 2008. Buildings account for 90% of total electricity consumption in Hong Kong* ”

### Educating

The complex is open for public visits/tours with a target of over 40,000 visitors per year.

### Experimenting

ZCB is a showcase project to inspire positive change of the public and the industry towards carbon reduction and sustainable living. The project adopts state-of-the-art design and technologies some of which are for the first time in Hong Kong.

### Evaluating

Real-time control and monitoring through a comprehensive Building Management System with smart control with over 2,800 sensing points

### Evolving

Flexible design to cater for the fast-evolving low carbon and eco-building technologies and changing needs





## Building Design

# Integrated design based on energy hierarchy approach and eco-efficiency.

ZCB's first priority on energy conservation is by passive design which achieves 20% of energy saving. The tapered and linear built form designs enhance air flow as well as daylight, and reduce solar heat gain. Cross-ventilated layout provides effective natural ventilation and reduces the demand of air-conditioning. High-performance envelope and glazing with external shading create an ultra-low Overall Thermal Transfer Value (OTTV) of the building envelope at 11 W/m<sup>2</sup> (more than 80% lower than maximum value required under current statutory control).

The second priority is on energy efficiency by green active systems, achieving 25% of energy saving. High-Volume-Low-Speed Ceiling (HVLS) fans are installed to enhance air movement and reduce the demand of air-conditioning. Desiccant dehumidification avoids overcooling of air for humidity control. Under-floor displacement cooling effectively cools the inhabitant's zone at a higher supply air temperature (5 degree Celsius higher than conventional air-conditioning systems). Radiant cooling by

chilled beam is used to cool the inhabitants.

Lastly, on the efficient production of renewable energy, increasing energy utilization by 75% as compared to conventional electricity supply from grid Bio-diesel Tri-generation generates over 143MWh per year. Photovoltaic panels (three different types: poly-crystalline, Building-Integrated thin-film and cylindrical CIGS) to generate about 87MWh per year; the main building roof is inclined to maximize solar irradiance on PV panels. Solar thermal is used to generate hot water for eco-cafe area

### Design for Hybrid Ventilation

Designs for natural ventilation for 30% of the year (January to April) include: automatic window control for high windows by the Building Management System with manual control option and manual control for low windows with window contacts linking to the Building Management System

Aided natural ventilation (March to June, October to December) by using HVLS fans to enhance air movement.

Under-floor displacement cooling operating for 8 months of the year and radiant and cooling operating for the hottest 5 to 6 months in the above period under automatic control by the Building Management System.

#### Low carbon materials and construction

The use of reinforced concrete structure with high percentage (25 to 35%) of pulverized fuel ash (PFA); balanced cut and fill construction for the excavation works for basement and the filling in the urban native woodland.

Application of lean construction approach with an emphasis on resource conservation for less material and less waste (e.g. fair-faced concrete, unpainted metal works). Gabion wall construction by using concrete debris salvaged from on-site demolition works, the use of regionally manufactured materials (e.g. eco-paver, raised floor system) and the use of low carbon materials (e.g. zinc panels for signage).



“ Hong Kong Government proposed 50-60% Carbon Intensity Reduction by 2020 (compared to 2005 baseline) ”





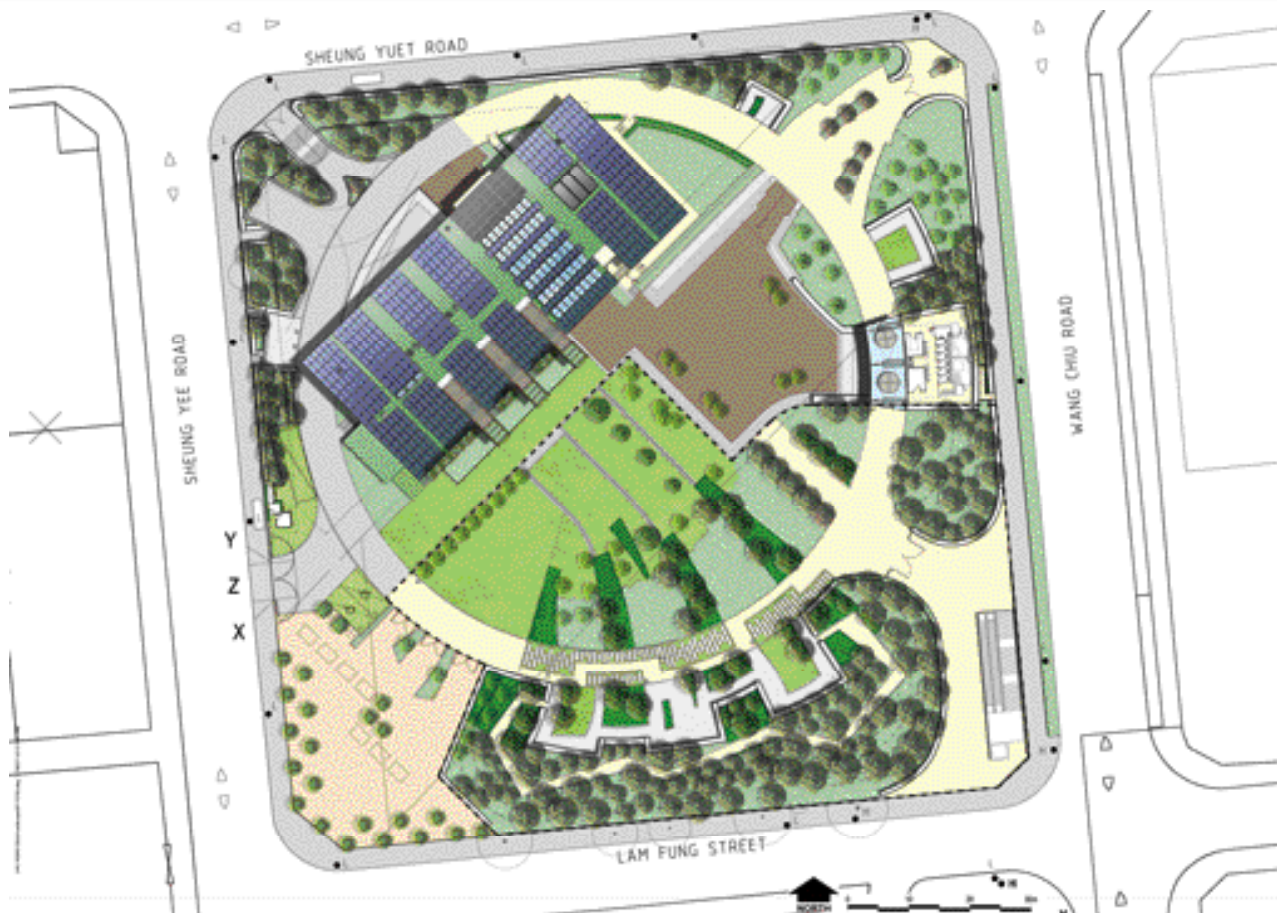
## Landscape design

The main objectives of ZCB's landscape design is to maximize the cooling effect in summer and improve comfort level; to enhance visual amenity and biodiversity, and finally, to achieve zero carbon emissions from the ZCB and the landscape area.

### Landscape design features

- Climate Positive - High greenery coverage enhances microclimate and mitigates urban heat island effect
- Greenery area covers over 50% of the total ZCB site
- There are some 370 trees within the site area, out of which over 300 trees are native species.
- The landscape design improves the cooling effect and is estimated to lower the air temperature by up to 1 degree C.
- Each mature tree absorbs around 23kg of carbon dioxide a year. The greenery serves as a 'sink' to absorb carbon dioxide on one hand and to cool the local air on the other.

“ 60% of total GHG emissions of Hong Kong are related to buildings ”



Master layout plan

## Hong Kong's first urban native woodland to enhance

### Biodiversity

The planted urban native woodland area is about 2,000 sq m, which consists more than 13% of the total ZCB site area. It includes 220 native trees of over 40 different species and a diversity of native shrubs, providing food and shelter to attract native wildlife into the city. The urban woodland creates a high quality ecosystem embedded in a built-up area of the city to benefit both wildlife and people.

The species in the urban native woodland are chosen based on four cardinal criteria: (1) diversity of species composition; (2) diversity of tree final size and form; (3) food and shelter for native wildlife; and (4) ornamental flowers or fruits.

The planting pattern is random to emulate the natural woodland, with small trees interspersed amongst the medium and large trees aiming at the formation of a dense tree canopy when mature. Some trees with ornamental traits have been selected to improve visual amenity.

It offers pleasant natural aroma and fresh oxygen and removes gaseous and particulate air pollutants to improve air quality.

### Use of recycled/sustainable materials

- Used recycled materials such as eco-pavers
- Used sustainable timber (FSC timber)
- Construction and demolition waste is used for gabion planter wall
- Balanced cut and fill
- Excavated soil during construction is used as fill in Urban Native Woodland
- Reduced export of excavated soil as waste

## Cultural shift – One Planet Living framework

The "Ring Path" in the landscape area is designed for leisure walking and pedestrian crossing showcases the 'One Planet Living' concept, a framework to live and work within a fair share of the earth's resources. 'One Planet Living' concept covers 10 aspects of sustainable living, including:

1. Zero Carbon
2. Zero Waste
3. Sustainable Transport
4. Sustainable Materials
5. Local and Sustainable Food
6. Sustainable Water
7. Urban Woodland and Biodiversity
8. Green Culture
9. Green and Fair Trade
10. Health and Happiness



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## Visitor experience

PT.	LOCATION	FEATURES
A	Hall	<ul style="list-style-type: none"> <li>• 3-D video on climate change</li> <li>• Multipurpose room for conferences, seminars and corporate functions</li> </ul>
B	Model Display	<ul style="list-style-type: none"> <li>• Reflective Insulating Radiant barrier</li> <li>• Green Education towards a Low Carbon City</li> </ul>
C	Building Environmental Performance Assessment Dashboard (BEPAD)	<ul style="list-style-type: none"> <li>• Intelligent Building Management System (BMS)</li> <li>• Building Environmental Performance Assessment Dashboard (BEPAD)</li> </ul>
D	Eco-office	<ul style="list-style-type: none"> <li>• High-Volume-Low-Speed Ceiling (HVLS) Fan</li> <li>• Chilled Beam</li> <li>• Underfloor Displacement Cooling</li> <li>• Desiccant Dehumidification</li> <li>• Intelligent Lighting Management</li> <li>• Task Lighting</li> <li>• Temperature Set-point Adjustment</li> <li>• Regenerative Lift System</li> <li>• Zero VOC Sealer and Paint</li> <li>• Green Carpet</li> <li>• Suspended Acoustic Baffle</li> <li>• Enhanced Security</li> <li>• Room Design For Daylighting</li> <li>• Eco-office Design &amp; Operation</li> </ul>
E	Gallery (G/F)	<ul style="list-style-type: none"> <li>• Climate-responsive Built Form and Orientation</li> <li>• Cross-ventilated Layout</li> <li>• Active Skylight</li> <li>• Spatial Adaptability</li> <li>• Flexible Engineering Services</li> <li>• Eco-gypsum Block Wall</li> <li>• Green Raised Floor System</li> <li>• Sustainable Timber/Recycled Materials/Reduction of Demolition and Construction Waste/Rapidly Renewable Materials</li> </ul>
F	Gallery (M/F)	<ul style="list-style-type: none"> <li>• Wind Catcher</li> <li>• Ultra-Low Overall Thermal Transfer Value</li> <li>• Optimized Window to Wall Ratio (WWR)</li> <li>• High Performance Glass Wall System</li> <li>• External Solar Shading</li> <li>• Clerestory for Day-lighting</li> <li>• Light Shelf</li> <li>• Light Pipe</li> <li>• Earth Cooling Tube</li> <li>• Electrical Operable Window System</li> <li>• Low Embodied Carbon Materials</li> <li>• Low Embodied Carbon Construction</li> </ul>

PT.	LOCATION	FEATURES
G	Eco-home	<ul style="list-style-type: none"> <li>• Naturally Ventilated Home</li> <li>• Low Residential Thermal Transfer Value</li> <li>• Green Balcony</li> <li>• Green Materials</li> <li>• Waste Reduction/Sorting/Recycling</li> <li>• Smart Display and Control of Appliances</li> <li>• Energy Efficient Appliances</li> <li>• Water Efficient Sanitary ware</li> </ul>
H	Viewing Platform	<ul style="list-style-type: none"> <li>• Pre-grown Green Roof</li> <li>• Polycrystalline / Building Integrated / Cylindrical CIGS Photovoltaic (PV)</li> <li>• Flexible Mounting for PV</li> <li>• Green Insulation</li> <li>• High Greenery Coverage</li> <li>• Micro-climate Monitoring Stations</li> </ul>
I	Green Active Systems Plant Rooms	<ul style="list-style-type: none"> <li>• Adsorption Chiller</li> <li>• Desiccant Dehumidification</li> <li>• Bio-diesel Tri-generation</li> <li>• Grey and Black Water Recycling, Stormwater Harvesting</li> </ul>
J	One Planet Living Loop	<ul style="list-style-type: none"> <li>• Water Efficient Irrigation</li> <li>• Fair-faced Concrete</li> </ul>
K	Eco-toilet	<ul style="list-style-type: none"> <li>• Waterless Urinal</li> <li>• Low-Flow Sanitary ware</li> </ul>
L	Constructed Wetland	<ul style="list-style-type: none"> <li>• Constructed Wetland</li> <li>• Grasscrete</li> <li>• Bicycle Parking and Shower Facility</li> </ul>
M	Eco-plaza	<ul style="list-style-type: none"> <li>• Outdoor living, eco-education / exhibition</li> </ul>
N	Landscape Area	<ul style="list-style-type: none"> <li>• Air Tree</li> <li>• Anti - light Pollution Outdoor Lighting</li> <li>• Solar Thermal System</li> <li>• Gabion wall with Recycled debris from Demolition</li> </ul>
O	Native Urban Woodland	<ul style="list-style-type: none"> <li>• A collection of over 40 native plant species to promote biodiversity</li> </ul>



Officiating Guests Switch on the ZCB Carbon Footprint Indicator



John Tsang, Financial Secretary (Right) and Lee Shing-see, Chairman of Construction Industry Council (Left) unveil the opening plaque of ZCB



# Air Handling Unit



## CIC Zero Carbon Building



*Hong Kong's 1<sup>st</sup> zero carbon building*



SAIVER AHU with **desiccant wheel** for industrial dehumidification application in CIC Zero Carbon Building.



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Wetland



Greenwall  
Cabling system



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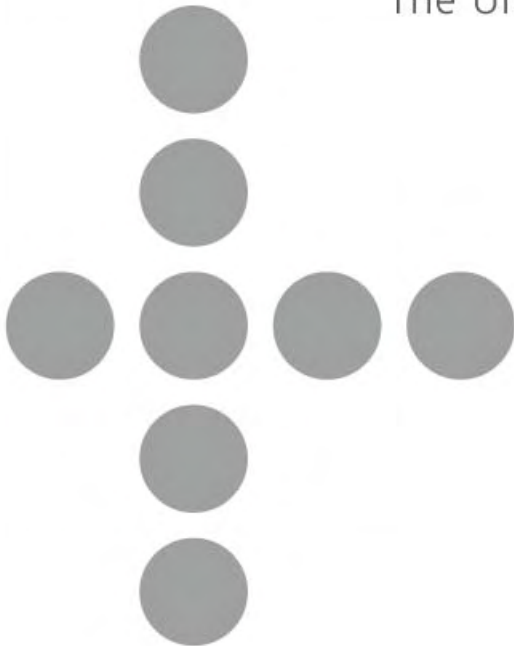
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