CONSTRUCTION INDUSTRY COUNCIL
建造業議會

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零碳天地

Experience Gained from the First Zero Carbon Building in Hong Kong

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31 May 2013

Why Zero-carbon?

- Al Gore's talk in March 2008
  - New Thinking on the Climate Crisis

Source: http://www.ted.com/talks/al_gore_s_new_thinking_on_the_climate_crisis.html

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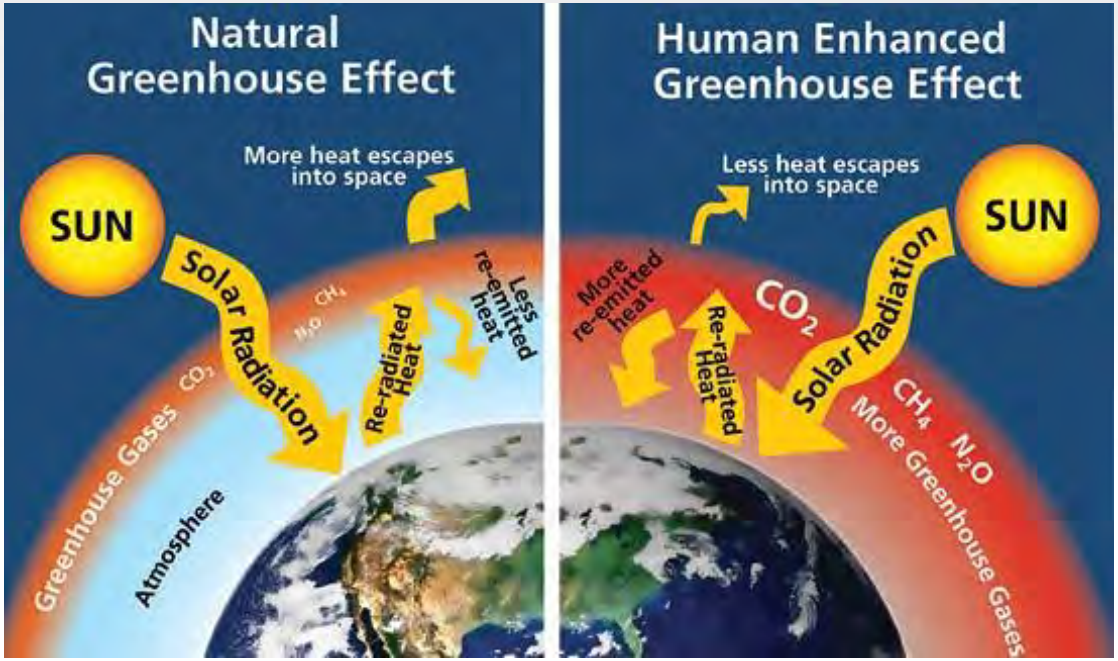
Why Zero-carbon?

Greenhouse Effect



Source: www.climatetheory.net

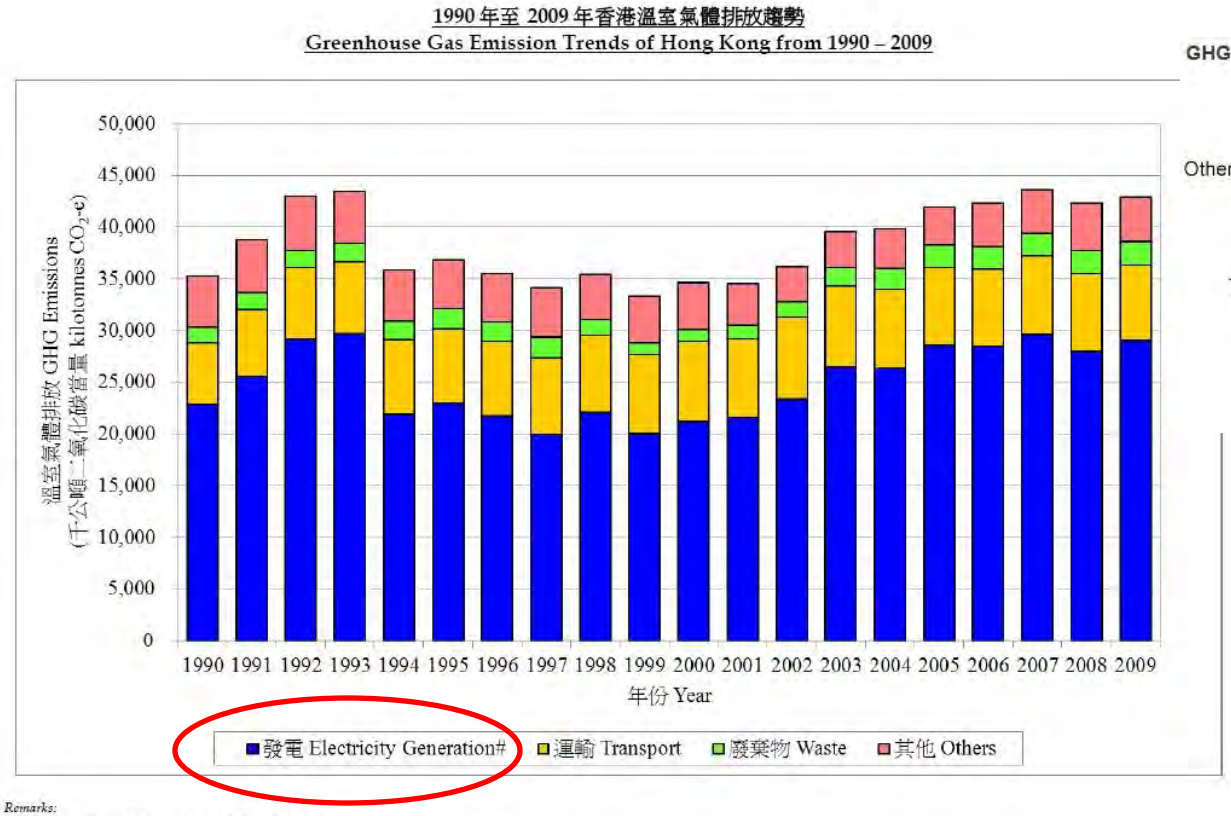
Impacts of GHG Emissions

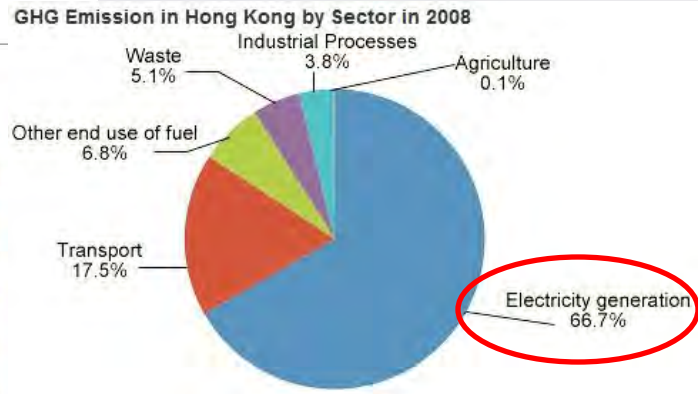
Environmental

Human health

Economic

GHG Emission Trends of Hong Kong





備註 Remarks:
\# 包括煤氣生產，佔能源生產的溫室氣體排放量約1%
Including Towngas production which accounts for only about 1% of GHG emissions caused by energy production
更新日期 Updated: 2012/1

Source: Environmental Protection Department

The construction industry has a significant role to play in GHG emissions reduction.

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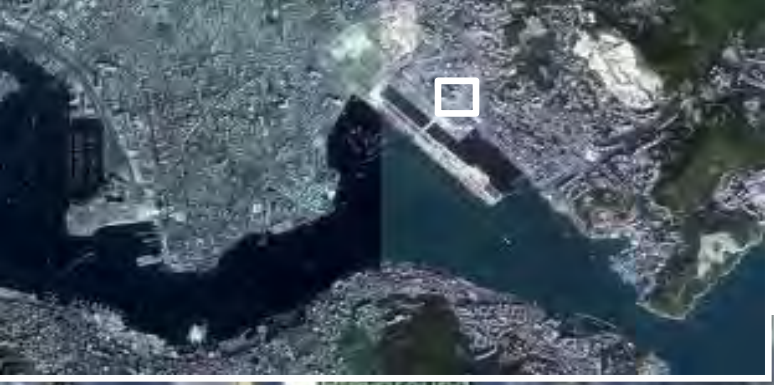
27 November 2011
ZCB Ground-breaking Ceremony

26 June 2012
ZCB Opening Ceremony



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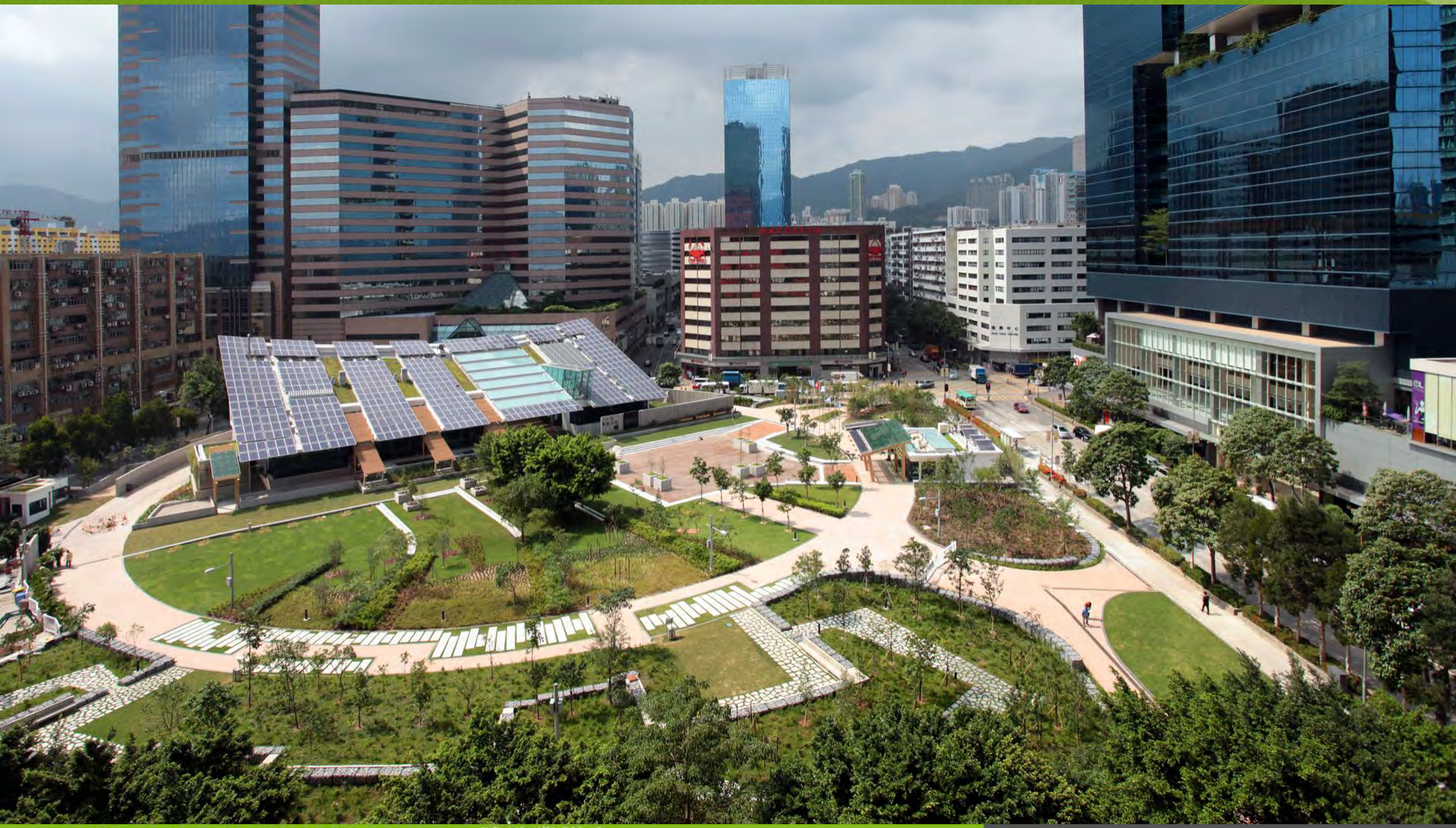
8 Sheung Yuet Road
Kowloon Bay, Hong Kong

As at May 2013



http://projects.mirrorsolution.com/panorama/ZCB/LOBBY/

Missions and Visions of ZCB

An Exhibition Centre	• to showcase the state-of-the-art eco-building design and technologies to the construction industry internationally and locally
An Education Centre	• to raise community awareness of low carbon living in Hong Kong • to promote human behavioural changes
An Information Centre	• to disseminate the latest green building technologies and practices as well as the performance evaluation results of ZCB to industry stakeholders

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Something Worth Noting

- 1st zero-carbon building in Hong Kong
- 1st building with grid feed-in in Hong Kong
- 1st native urban woodland in Hong Kong
- 1st large scale use of biodiesel made from waste cooking oil for electricity generation
- Account for carbon emissions during the operation stage
- Account for the embodied carbon of the construction process and the major structural materials

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Awards

- Green Building Award 2012 – Grand Award in the New Building – Hong Kong Category
- BEAM Plus Platinum (preliminary assessment)
- Royal Institute of Chartered Surveyors (RICS) Hong Kong Award 2013 – Innovation Award of the Year
- Hong Kong Institution of Engineers (HKIE) – Champion of the Innovation Award for Engineering Industry 2012/2013

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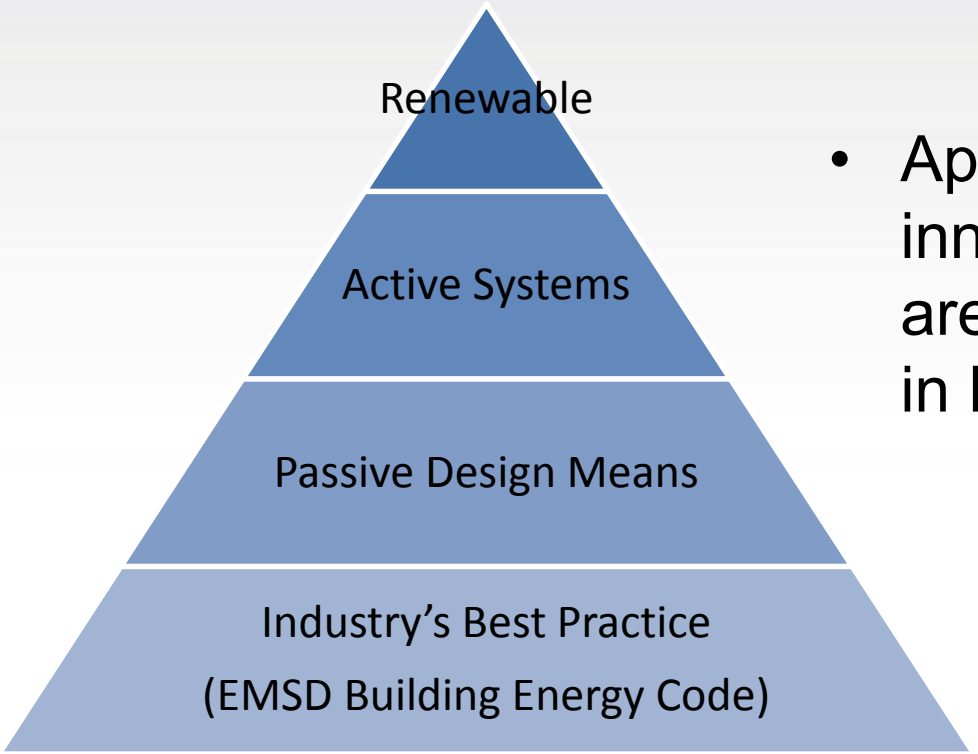
Energy Strategy of ZCB

Energy Hierarchy



- Applied more than 80 kinds of innovative technologies that are applicable to the context in Hong Kong

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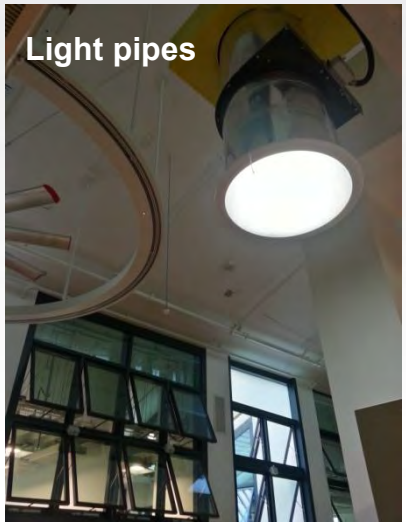
Energy Strategy of ZCB

1) Reduction of Energy Demand

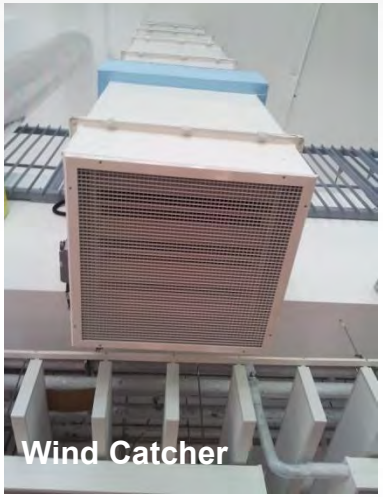


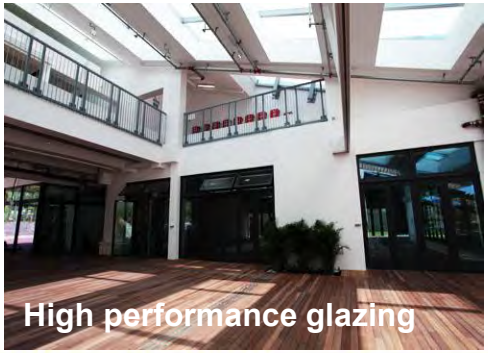
Passive Design

20%

Green Active Systems

25%





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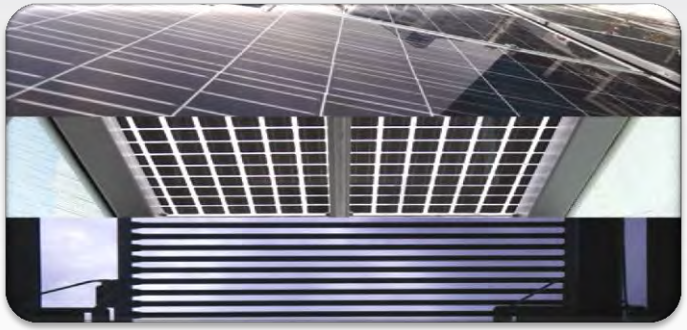
Energy Strategy of ZCB

2) Generation of Renewable Energy

Bio-fuel Tri-generation System

- fed by waste cooking oil (HK$9/L) collected from local restaurants and reprocessed
- energy utilisation rate of 75%



PV Panels

- multi-crystalline, BIPV, CIGS
- supply 70% of the energy required for ZCB

Surplus energy (estimated at 99 MWh/yr) pumps back to Hong Kong's public power grid.

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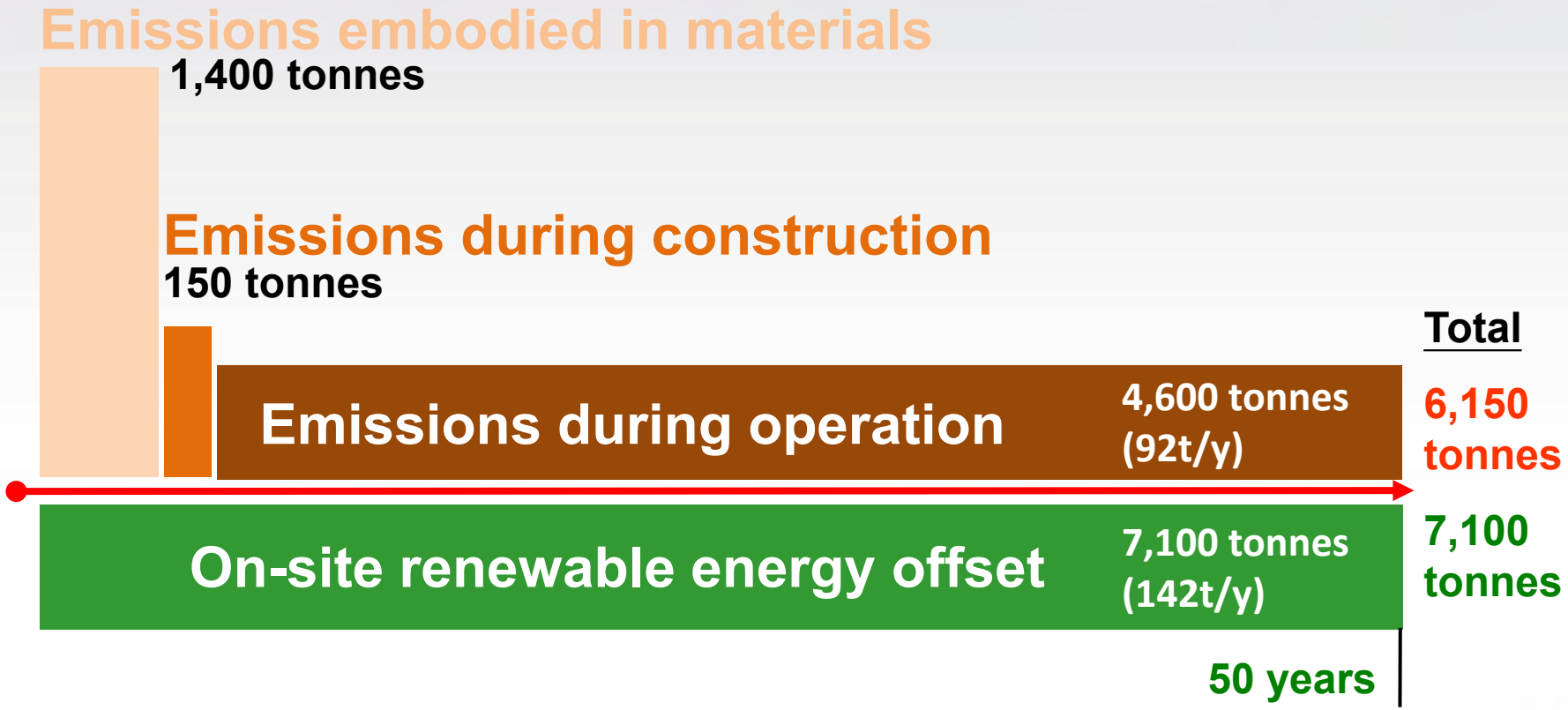
Carbon Strategy of ZCB



Net energy output over operating energy consumption to offset **embodied carbon of major structural materials & construction**

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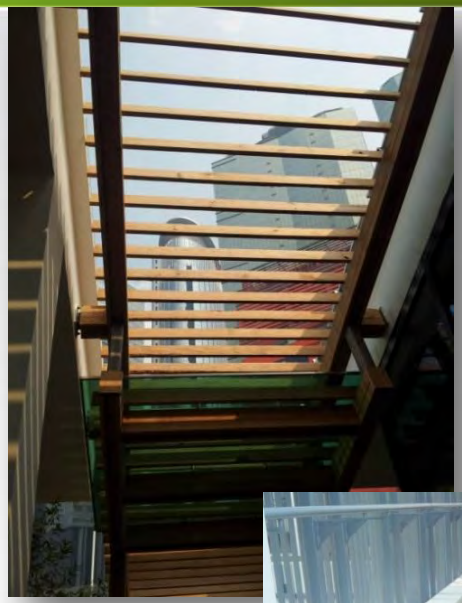
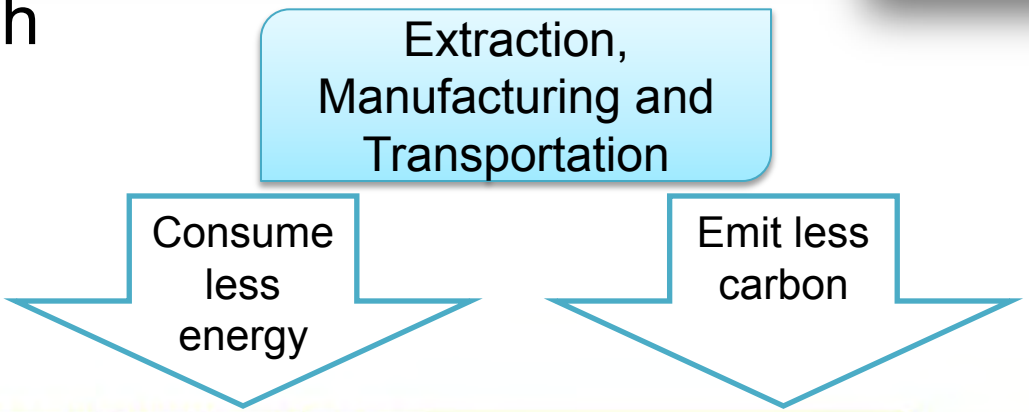
Carbon Strategy of ZCB

Low embodied carbon materials

- Regionally manufactured materials
- Sustainable timber
- Reinforced concrete with steel rebar with recycled content and high percentage of Pulverized Fly Ash





Carbon Strategy of ZCB

- Balanced cut and fill for the site formation works
- Gabion wall construction making use of construction debris salvaged from demolition

Performance

1) Construction Stage – CO_2 Reduction

	Reference CO_2 Emission	Target CO_2 Emission of ZCB	Reduction
Construction Process	2200 tones	150 tones	**30%**
Material Use		1400 tones	

Design Performance

2) Operation Stage – CO_2 Reduction and Energy Savings in Building

Typical Design	Building CO_2 Emission 140 t/yr		Building Energy Consumption 200 MWh/yr	
Measures Taken in Design to Reduce CO_2	Building CO_2 Reduction (ton CO_2/yr)	CO_2 Reduction (% of total building)	Building Energy Saving (MWh/yr)	Energy Saving (% of total building)
Envelope design	6	4	9	4
Ventilation design	10	6	14	6
Lighting design	33	20	47	20
Cooling design	27	15	38	15
Total Reduction	**76**	**45**	**108**	**45**
CCHP Generation	81	48	143 (generated)	N/A
PV Generation	61	36	87 (generated)	N/A

Energy Consumption: <100 kWh/sqm/yr
45% less than the baseline of
Hong Kong's Building Energy Code (BEC)

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Significance of ZCB

Concept of Carbon Footprint

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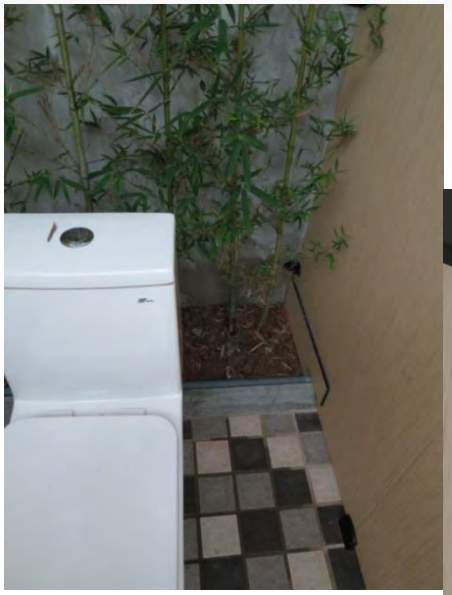
Significance of ZCB

Culture Shift

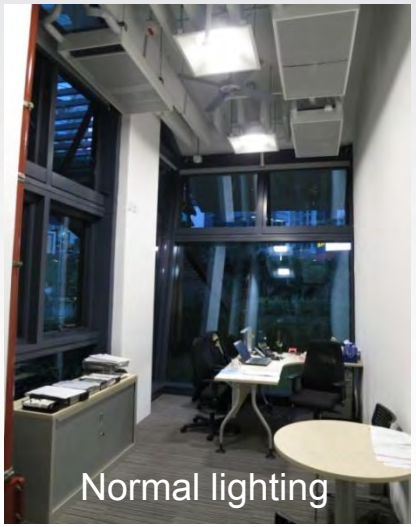
- Co-ed washrooms
- Natural ventilation
- Washroom plants

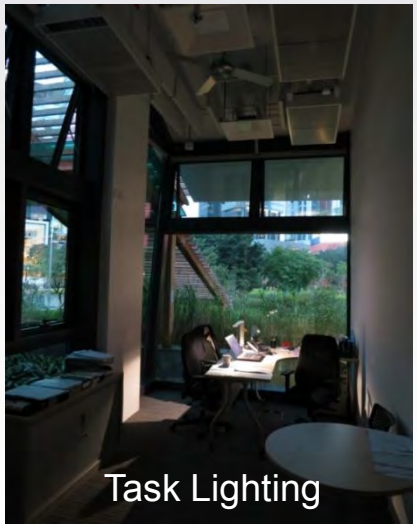


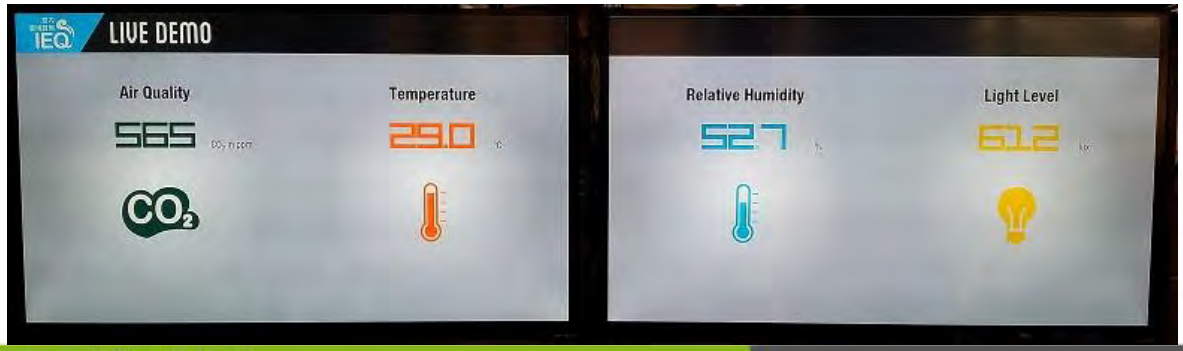
Significance of ZCB

Behavioural Changes

Thermal insulation of clothing







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Significance of ZCB

Close to the heart of general public

ZCB Eco-Home

Traditional Apartment

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Significance of ZCB

Public is interested in new ideas

Summary of Experience Gained

Our Intention

- to have the technologies displayed at the ZCB replicated wherever possible and realistically

Feasibility

- at present, technically difficult to achieve zero carbon emissions with a high-rise building

Most difficult challenge

- how to turn our existing stock of buildings into lower carbon buildings

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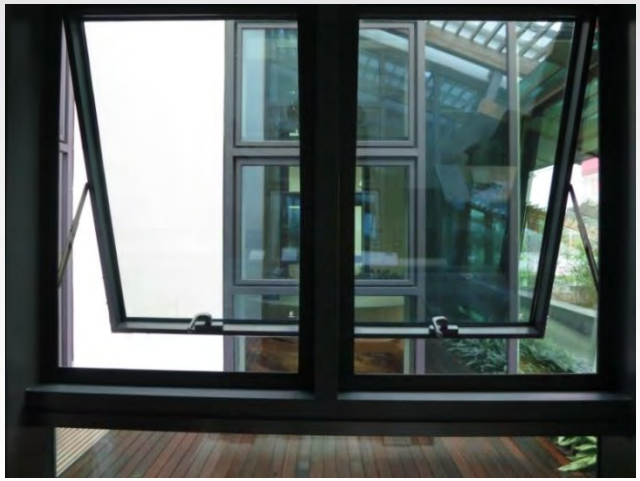
Summary of Experience Gained



Natural Ventilation vs IAQ

- Natural ventilation
  - 40% of the year
- Limitation
  - indoor air quality (IAQ) can only be as good as the ambient air quality

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Summary of Experience Gained

Comparison of Electricity Costs

- Cost of electricity generation from biofuel

  HK$3.5/Kwh

- Cost of electricity from grid:
  HK$1/Kwh

The **environmental cost** of electricity from grid must be included to promote renewable energy.

Summary of Experience Gained

Green buildings can help lower cost of electricity

Yeung Man-yau and William Chung [illegible] the future of our power market can be shaped

This year is proving critical in the shaping of a future electricity market for Hong Kong. While the government will soon review the scheme of control agreements with the city's two power companies, an inter-departmental steering committee has been established to map out strategies for green building development.

Buildings consume 90 per cent of our overall electricity, and green buildings are seen as a silver bullet to reform the Hong Kong electricity market; they help save energy and ease the tension that exists between environmental protection and electricity prices. Research shows green buildings could help cut electricity tariffs.

This finding emerged from a study by Greenpeace and City University of the impact of green buildings on the electricity market. The study found that, if all of Hong Kong's buildings were green buildings by 2020, the city would cut electricity consumption by 9.4 billion kWh and save HK$10.4 billion on natural gas expenses. On average, each citizen would save HK$1,500 on his or her electricity bill each year.

Some would say "greening" all buildings by 2020 is impossible. However, even with more modest targets, the outcome would still be impressive. The study found that with 38 per cent of the buildings green, we could cut 33 million tonnes of carbon dioxide emissions. And with just 28 per cent green buildings, Hong Kong would maintain its supply of electricity without needing to expand power station capacity.

This would affect the power companies' HK$5.7 billion investment into the construction of natural gas power plants, which would lead to lower electricity tariffs. It should be clear that a campaign to develop green buildings holds the key to market reform.

Looking abroad, Singapore has been even more aggressive in developing green buildings. In 2008, its government passed a law stipulating that all new buildings must achieve a Green Mark rating. It now aims to make 80 per cent of all buildings meet these green ratings by 2030 and is providing incentives for building owners in an effort to do so.

It's time for the Hong Kong government to act. It should set a goal of making 40 percent of the city's buildings green by 2020 and set energy saving targets for the power companies in its agreements with them.

This year will be a turning point for Hong Kong. If we miss this chance to review our electricity market and include a green building strategy in the future, Hong Kong people will continue to face electricity tariff hikes.

For a greener future, we have the solution; all that's needed is action from our government.

Yeung Man-yau is a Greenpeace campaigner. Dr William Chung Siu-wai is associate professor in the Department of Management Sciences, City University

"If all of Hong Kong's buildings were green buildings by 2020, the city would cut electricity consumption by 9.4 billion kWh and save HK$10.4 billion on natural gas expenses. On average, each citizen would save HK$1,500 on his or her electricity bill each year."

South China Morning Post, 30 April 2013

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Summary of Experience Gained

Management Contract

- Benefits
  - involving contractors from early stage of the project
  - no need to wait for the completion of all the design before construction tender
  - helping fast track the project
- Issues
  - easy to create abortive works
  - management contractor is not responsible for cost control whilst QS consultant may not have the best knowledge of the construction site
  - management contractor does not undertake any construction works although he is often better placed to do so

Summary

- Ensuring all **technologies perform collectively** as well as individually
- Many technologies are new and some are used for the first time in Hong Kong – performance is **yet to be fully tested**
- The building operates on the **natural ventilation mode** for over 40% of the year
- The **IAQ** can only be as good as the ambient environment outside the building
- Public is interested in **new ideas**
- The **promotion** is best done when the content is close to the daily life of the public
- **Education** towards low carbon living and working is as important
- **More information to come** out in near future

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The Future is in Our Hands

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http://zcb.hkcic.org