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THE UNIVERSITY OF HONG KONG



Hong Kong Zero Carbon Partnership for Enhancing Public and Stakeholder Engagement

Seminar Series of Hong Kong Zero Carbon Partnership

Zero Carbon Buildings: International Practice and Stakeholder Engagement

Seminar Proceedings

Co-organised by:

Construction Industry Council (CIC)
Zero Carbon Building Limited (ZCBL)
Centre for Innovation in Construction and Infrastructure Development (CICID)
The University of Hong Kong

Tuesday, 6th January 2015
The ZCB Multi-Purpose Hall, 8 Sheung Yuet Road, Kowloon Bay, Hong Kong

The University of Hong Kong
January 2015

The Hong Kong Zero Carbon Partnership

c/o

Department of Civil Engineering
The University of Hong Kong

Hong Kong, January 2015

Edited by Wei Pan, Pingying Lin, Thomas Ng, Guiyi Li and Julian Lee

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Mr. Felix Leung	China Trend Building
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Join The Hong Kong Zero Carbon Partnership

Should you be interested to join the Hong Kong Zero Carbon Partnership, please visit www.hkzcp.org or contact Dr. Wei Pan of the Department of Civil Engineering, The University of Hong Kong at wpan@hku.hk, +852 2859 2671.

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About The Hong Kong Zero Carbon Partnership

The zero carbon building approach has been adopted in many countries and regions as an important government strategy for addressing climate change, achieving a low carbon economy and uplifting quality of people's life. Zero carbon buildings are far more than a technological solution, but complex socio-technical systems. It is therefore important to enhance public and stakeholder engagement in the planning and delivery of zero carbon buildings. However, how stakeholders can work in partnership for delivering zero carbon buildings effectively remains a socio-technical challenge.

The Hong Kong Zero Carbon Partnership is a research initiative funded by the Construction Industry Council (CIC) and led by The University of Hong Kong (HKU) with support from a number of organizations including Zero Carbon Building Ltd., Hong Kong Housing Authority, Hong Kong Green Building Council, China Trend Building Press, Pennsylvania State University, and Zero Carbon Hub. The Partnership aims to function as a mechanism to bridge the links between the public and many stakeholder groups in Hong Kong and beyond, and provide a platform to support the transition of the buildings and the built environment in Hong Kong towards zero carbon and sustainability. Supporting the Partnership will be the Hong Kong Zero Carbon Portal with real-time measurement and monitoring of Hong Kong's public and stakeholders' understanding, attitude and behaviour regarding zero carbon building. The Partnership and its supporting Portal are expected to be sustained through a CIC-HKU joint force after the project is completed for the benefits of the industry and society.

Founding Organizations of the Hong Kong Zero Carbon Partnership



About The Seminar Series

The seminar series are an important part of the research initiative on which the Hong Kong Zero Carbon Partnership is based. The seminars aim to share and disseminate the knowledge of zero carbon building in relation to the principles, practices, policies and priorities in Hong Kong and internationally. The principles include the elements, parameters, boundaries of zero carbon buildings in a systems manner, and the associated public and stakeholders' perceptions. The practices refer to the challenges, opportunities, good practice and lesson learnt with regard to the planning and delivery of zero carbon buildings. The policies denote the relevant policies, codes and regulations to low or zero carbon building. The priorities mean the strategies for management and benchmarking. The seminars together will help Hong Kong public and stakeholders understand zero carbon buildings as complex socio-technical systems which embrace product, process and people, and therefore inform and support their attitudes and behaviours for building towards zero carbon.

Supporting Organizations of this Event:



Seminar Rundown

2:00 - 2:30pm	Registration
2:30 - 2:35pm	Welcome Remarks <i>Dr Guiyi Li, Director of ZCBL, Construction Industry Council</i>
2:35 - 2:45pm	Opening Speech <i>Mr. Albert Lam, Deputy Secretary (Works), Development Bureau, HKSAR</i>
2:45 - 2:55pm	Photo Session
2:55 - 3:05pm	Introduction to the Partnership <i>Dr Wei Pan, Associate Director, CICID, The University of Hong Kong</i>
3:05 - 3:35pm	Net-Zero Carbon Buildings: A US Perspective <i>Prof Chimay Anumba, Head of Department of Architectural Engineering, Penn State University, US</i>
3:35 - 3:55pm	Carbon Reduction for High Rise Residential Development: Myth or Reality <i>Ms Ada Fung, Deputy Director, Hong Kong Housing Authority</i>
3:55 - 4:20pm	Refreshments
4:20 - 4:40pm	Stakeholder Engagement for Building Towards Zero Carbon <i>Dr Raymond Yau, Director, Hong Kong Green Building Council</i>
4:40 - 4:55pm	Energy Efficient Air Movement <i>Dr Andy Chou, Managing Director, Big Ass Fans East Asia</i>
4:55 - 5:20pm	Plenary Session <i>All invited speakers</i>
5:20 - 5:25pm	Closing Remarks <i>Prof Thomas Ng, The University of Hong Kong</i>
5:25 - 5:45pm	Tour of ZCB by Participants

Executive Summary



(From left to right are Dr Guiyi Li, Dr Andy Chou, Prof Chimay Anumba, Ms Ada Fung, Mr Albert Lam, Dr Raymond Yau, and Dr Wei Pan)

On 06 January 2015 nearly 200 professionals from the HKSAR Government, the building industry, institutions and academia witnessed the launch of the Hong Kong Zero Carbon Partnership at the Zero Carbon Building, Kowloon Bay, Hong Kong. The undertakings took place over the first of the Partnership's seminar series, which is entitled 'Zero Carbon Buildings: International Practice and Stakeholder Engagement' and was co-organised by Construction Industry Council (CIC), Zero Carbon Building Limited (ZCBL), and Centre for Innovation in Construction and Infrastructure Development (CICID) of The University of Hong Kong, with support from Hong Kong Housing Authority (HKHA), Hong Kong Green Building Council (HKGBC), China Trend Building Press, Pennsylvania State University, Zero Carbon Hub, Kadoorie Institute and Asia Energy Studies Centre. At the seminar a blend of local and overseas speakers shared the state-of-the-art knowledge and practices of zero carbon building.



The zero carbon building approach has been adopted in many countries and regions as a government strategy for addressing climate change. However, how stakeholders can work in partnership for delivering zero carbon buildings effectively remains a socio-technical challenge. The Hong Kong Zero Carbon Partnership addresses this challenge by drawing on a research project led by The University of Hong Kong with CIC's funding support. The Partnership aims to help position Hong Kong as a world-class knowledge based, innovation driven and multi-stakeholder engaged hub for low zero carbon building in urban environments.

Welcome Remarks

Dr Guiyi Li

Director of ZCBL, Construction Industry Council



Bio

Dr Li is an environmental specialist with some 30 years' local and international experience in research, consultancy and management. He coordinated the development of ZCB, the first Zero Carbon Building in Hong Kong, from the inception, design to construction. He is currently responsible for the daily management and operation of ZCB and undertakes to promote ZCB and low carbon construction technologies / practices to industry stakeholders as well as green living concepts to the general public. Dr Li is a Chartered Engineer, a Fellow of Chartered Institution of Water and Environmental Management (CIWEM) and a past chairman of CIWEM Hong Kong Branch.

Dr Guiyi Li, Director of ZCBL of CIC, kicked off the seminar by welcoming all to the launch event of the Partnership. Dr Li shared the vision of ZCBL, “to serve as an exhibition centre, an education centre and an information centre for zero/low carbon building design and technologies and for promoting low carbon living in Hong Kong”. The ZCB, jointly developed by the CIC and Development Bureau, completed in 2012, is a milestone in Hong Kong's green building movement. Dr Li emphasised the importance of establishing the Partnership to engaging Hong Kong public and stakeholders in the transition of buildings towards zero carbon.

Opening Speech

Mr. Albert Lam

Deputy Secretary (Works), Development Bureau, HKSAR



Mr. Albert Lam, Deputy Secretary (Works), Development Bureau of the HKSAR Government delivered the opening speech. Mr Lam first outlined the policy context, “To build a low carbon city, we have to reduce the energy consumption by buildings which currently accounts for 90% of electricity consumption and 60% of greenhouse gas emissions. Zero Carbon Building Policy has been adopted by many developed jurisdictions as a government strategy for addressing climate change. However it is shown that to achieve the objectives of zero carbon buildings, behavioural changes of multiple stakeholders are as important as the green technologies. It remains a significant challenge to effectively

address the behavioural aspects.” Mr Lam also regarded “the Partnership programme is a much needed initiative to bring the key stakeholders of the building industry together, to discuss, recommend and hopefully take forward a workable strategy to address the various aspects of developing low/zero carbon buildings in Hong Kong and for reducing building energy consumption.” A low carbon strategy can only be workable and effective if it is accepted and adopted by the key stakeholders. Mr Lam lastly encouraged all the key stakeholders to participate in the Partnership to share wisdom and to help shape the low carbon future of Hong Kong.

Introduction to the Partnership

Dr Wei Pan

Associate Director, CICID, The University of Hong Kong

Bio

Dr Wei Pan is Associate Director of Centre for Innovation in Construction and Infrastructure Development (CICID) of The University of Hong Kong where he also co-chairs the Low Carbon Construction (LCC) Taskforce. Dr Pan is specialised in sustainable construction and management. His research interest focuses on zero carbon building, off-site prefabrication, lean construction, and decision making of technological innovation. Before joining HKU, he had a career in both academia and industry in the UK where he received his MSc in Construction Project Management with Distinction and PhD in Construction Management from Loughborough University. Dr Pan's career is supported by 20 years of experience internationally in building design and engineering, construction project management and innovation management. He is Chartered Builder, Chartered

Environmentalist, and Fellow of the Higher Education Academy.



Dr Wei Pan, Associate Director of CICID of The University of Hong Kong and also the Principal Investigator for the Partnership project, provided an introduction to the Partnership. Dr Pan recommended that zero carbon buildings be interpreted as complex socio-technical systems that embrace zero carbon products, innovative processes and multiple stakeholders. Public and stakeholder engagement is a must for effective delivery of buildings towards zero carbon. Dr Pan also reported on their research on similar initiatives of net or nearly zero carbon/energy buildings in the world, and outlined the drivers for and potential benefits from establishing the Hong Kong Zero Carbon Partnership. A key deliverable of the Partnership will be the Hong Kong Zero Carbon Portal which will provide real-time measurements and monitoring of Hong Kong public and stakeholders' understanding, attitude and behaviour regarding zero carbon building.

PPT

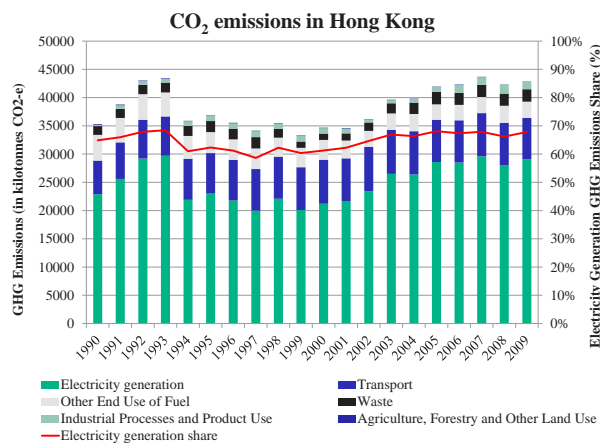
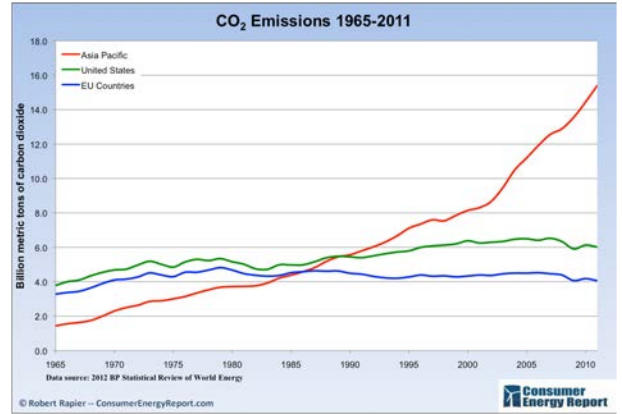


Introduction to the Partnership

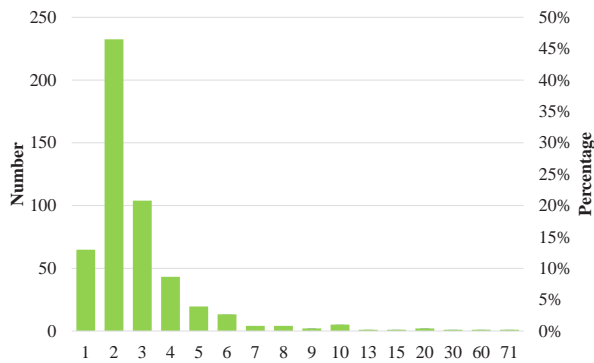
Dr Wei Pan

Centre for Innovation in Construction and Infrastructure Development (CICID)
The University of Hong Kong

Zero Carbon Buildings: International Practice and Stakeholder Engagement
Seminar Series of Hong Kong Zero Carbon Partnership
@ZCB, Hong Kong, 6 January 2015

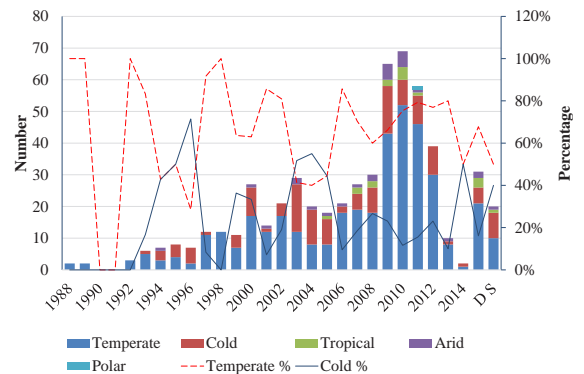


"Zero carbon buildings" by number of floors



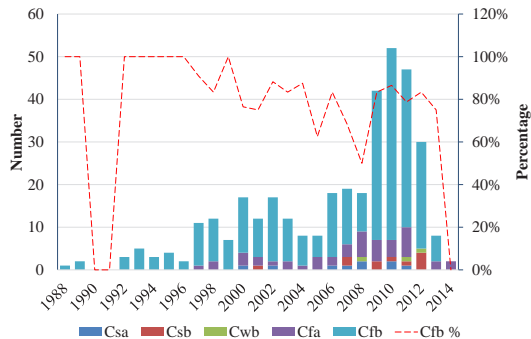
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"Zero carbon buildings" by climatic zone



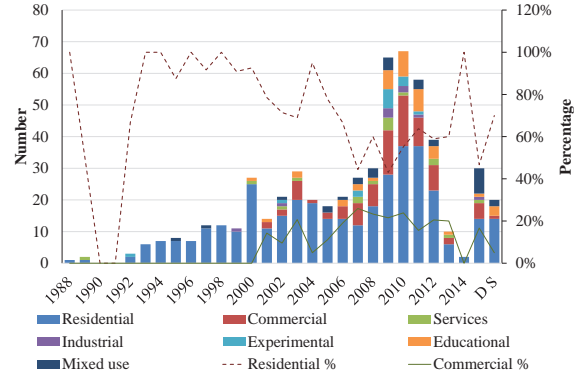
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'Zero carbon buildings' by climatic zone



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'Zero carbon buildings' by building type



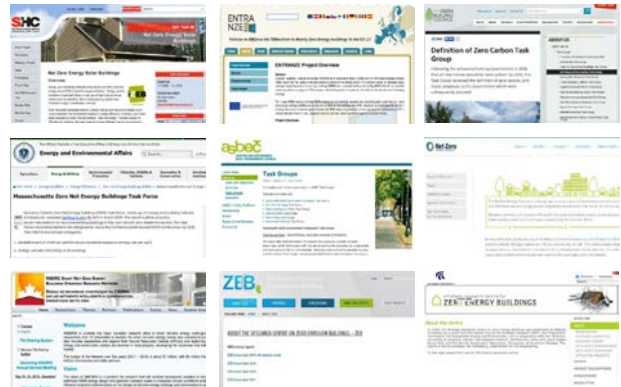
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"Zero carbon building" Policies

Region	Year	Subjects	Targets	References
	2018	new public buildings	nearly zero-energy	European Directive 2010/31/EU
	2020	all new buildings	nearly zero-energy	
	2025	all new commercial buildings	zero net energy	Energy Independence and Security Act, 2007
	2050	all commercial	zero net energy	
	2020	all new Federal buildings	design specifications for zero net-energy use	Presidential Executive Order 13514
	2015	at least 15% of any Federal agency's existing buildings and building leases	above zero net energy	
	2016	new homes	zero carbon	Communities and Local Government, 2006
	2019	New non-domestic buildings		

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Worldwide Efforts to Explore Zero



Worldwide Efforts to Explore Zero

Task Group / Organisation	Region	Main Drivers			
		Institution	University	Industry	Government
IEA SHCP Task 40 Net Zero Energy Solar Buildings	IEA countries	★	★★		
ENTRANZE	EU-27	★	★★		★
Zero Carbon Hub	UK	★		★★	
Definition of Zero Carbon Task Group	UK	★★		★	
Massachusetts Zero Net Energy Buildings Task Force	US	★	★		★★
Australian Sustainable Built Environment Council Sustainable Housing Task Group	Australia			★	
Net Zero Emission Homes					
Net-Zero Energy (Home) Coalition	Canada	★		★★	
Smart Net-Zero Energy Buildings Strategic Research Network (SNEBRN)	Canada		★★	★	
The Research Centre on Zero Emission Buildings (ZEB)	Norway	★	★★	★	
Strategic Research Centre for Zero Energy Buildings	Denmark	★	★★	★	

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Hong Kong Zero Carbon Partnership

- What is it?
- Who are involved?
- What does it do, and how?
- What will be the outcomes?
- How can I join?

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What is it?

- A research project
 - Entitled “*Hong Kong ‘Zero Carbon Building Partnership’ for Enhancing Public and Stakeholder Engagement*”
 - Funded by Construction Industry Council (CIC)
- A joint force for delivering buildings in Hong Kong towards zero carbon
- An initiative to help position Hong Kong as a world-class knowledge-based, innovation-driven and multi-stakeholder-engaged hub for zero carbon building in urban environments



Objectives

- 1) To establish and maintain a Hong Kong Zero Carbon Partnership
- 2) To develop and maintain a Hong Kong Zero Carbon Portal
- 3) To enhance Hong Kong public and stakeholders’ *awareness and understanding* of zero carbon building
- 4) To measure, examine and shape Hong Kong public and stakeholders’ *attitudes to and values* for zero carbon building
- 5) To encourage and guide Hong Kong public and stakeholders’ *behaviours and practices* of delivering buildings towards zero carbon



Who are involved?

- Founding members
- Potential members (with interest to join)
- Target members
 - 100 organisational & individual members
 - Demand, Supply, Regulation & Institution Groups of stakeholders
 - 5000 participants from the wider context of public and stakeholders of both buildings and building processes in Hong Kong



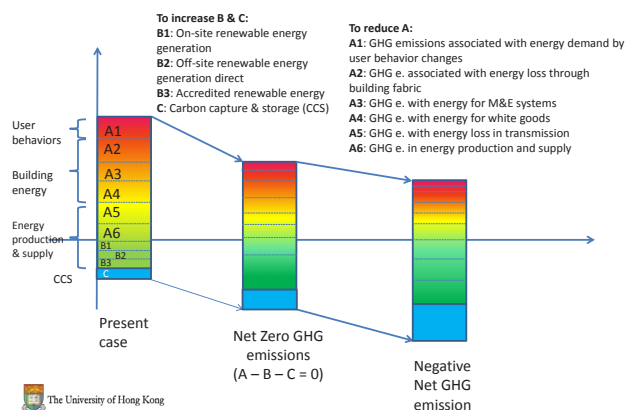
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Hong Kong Housing Authority

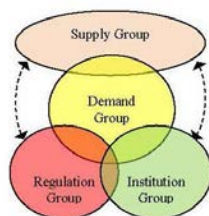


Zero Carbon Buildings are complex socio-technical systems, far more than a technological solution.



Partnership Membership

- ‘**Demand**’ group, e.g. the general public, building occupants and end-users, clients, investors and buyers, and also government;
- ‘**Supply**’ group, e.g. developers, professional advisors (e.g. architects, designers, engineers, planners, surveyors), contractors, facilities managers, building manufacturers suppliers, and energy producers and suppliers;
- ‘**Regulation**’ group, e.g. the government and its departments and agencies; and
- ‘**Institution**’ group, e.g. financiers, bankers, mortgage lenders, universities, and professional bodies



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Hong Kong Housing Authority



What does it do, and how?

- Mobilise project and **international benchmark** Hong Kong public and stakeholders’ *understanding, attitude and behaviour* regarding zero carbon building
- Launch and operate **Hong Kong Zero Carbon Partnership** to engage the wide-ranging stakeholders (*demand, supply, regulation & institution* groups)
- Develop and maintain **Hong Kong Zero Carbon Portal** to provide functions of a *real-time IT system to measure and monitor* stakeholders’ understanding, attitude and behaviour regarding zero carbon building, wikis & discussion boards, and smart phone interactions
- Organise public and stakeholder engagement **workshops and seminars** to help share knowledge of the *principles, practices, policies and priorities* of zero carbon building



Expected outcomes

- Hong Kong Zero Carbon Partnership
- Hong Kong Zero Carbon Portal www.hkzcp.org
- Database of real-time measurement and monitoring of public and stakeholders' *understanding, attitude* and *behaviour* regarding zero carbon building and relevant indices
- Project reports, workshop & seminar proceedings, and booklets focusing on the *principles, practices, policies* and *priorities* of zero carbon building



Benefits of joining the Partnership

- **Access to the state-of-the-art knowledge** of the principles, practices, policies and priorities of zero carbon building worldwide
- **Sharing** of understanding, attitude and practices of building towards zero carbon in Hong Kong
- **Premium registration** with the seminar and workshop series of the Hong Kong Zero Carbon Partnership
- **Enhanced business opportunities** for low or zero carbon building in Hong Kong
- **Networking** with wide-ranging stakeholders of low or zero carbon building in Hong Kong
- Opportunity to help **shape** the formulation and review of **government policies** on low or zero carbon building
- Joint force to help reduce buildings' energy use and carbon emissions in Hong Kong and to contribute to **turning Hong Kong into a low carbon metropolis**



The Hong Kong Zero Carbon Partnership

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Net-Zero Carbon Buildings: A US Perspective

Prof Chimay Anumba

Head of Department of Architectural Engineering, Penn State University, US

Bio

Prof. Chimay Anumba is a Fellow of the Royal Academy of Engineering. He holds a Ph.D. in Civil Engineering from the University of Leeds, UK; a higher doctorate – D.Sc. (Doctor of Science) - from Loughborough University, UK; and an Honorary Doctorate (Dr.h.c.) from Delft University of Technology in The Netherlands for outstanding scientific contributions to Building and Construction Engineering. His research interests are in the fields of advanced engineering informatics, concurrent engineering, knowledge management, distributed collaboration systems, and intelligent systems. He has over 450 scientific publications in these fields and his work has received support worth over \$150m from a variety of sources. He has also supervised more than 45 doctoral graduates and mentored over 20 postdoctoral scholars. He is a Chartered Engineer and Fellow of the ICE, IStructE and ASCE.



Prof Chimay Anumba shared with the audience a US perspective of net-zero carbon buildings. Prof Anumba critiqued, “While considerable resources are being devoted in Europe and Asia to the development of net-zero carbon buildings, the discourse in the US has been more in terms of net-zero energy buildings.” He then explored the similarities and differences between net zero carbon and net zero energy buildings, and the extent to which the disparate objectives could be aligned. Prof Anumba also provided examples of net zero energy buildings in the US, including both ‘new-build’ and ‘retrofit’ buildings, to outline the potential lessons for the Hong Kong building industry.

PPT

Net-Zero Carbon Buildings: a US Perspective

Prof. Chimay J. Anumba

Head, Dept. of Architectural Engineering
The Pennsylvania State University, USA

anumba@engr.psu.edu

Introduction

- Increasing concerns about climate change and its impact on the environment
- Increasing global focus on sustainability:
 - Ability of the present generation to meet their needs without compromising the ability of future generations to meet theirs.
 - Triple bottom line: economic, social, environmental
- Sustainable buildings/construction:
 - Reduced energy use
 - Reduced carbon content
 - Reduced greenhouse (GHG) emissions
 - Waste minimization
 - Increased recycling/'Design for Deconstruction'

Net-Zero Carbon Buildings

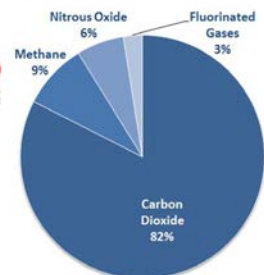
- Building that produces as much carbon-free energy as the total energy it consumes OR With annual net-zero carbon emissions
- Rely on renewable energy systems (on or off-site)
- Newton & Tucker, 2010:
 - **Carbon-Neutral Building:** generates sufficient surplus CO₂-e free energy over the course of a year that balances any purchase of grid energy;
 - **Net-Zero Carbon Building:** uses carbon free energy over the entire year, sufficient in quantity to supply all the household energy needs;
- Initial embodied energy/carbon – an important consideration; often amortized over building life.
- There are very few net-zero carbon buildings (Zuo et al, 2013)

Outline

- Introduction
- Net-Zero Carbon Buildings
- Net-Zero Energy Buildings
- Penn State Initiatives
- Commercial Retrofit Example
- Summary and Conclusions

Introduction

- USA and China responsible for 45% of GHG emissions (IEA, 2014)
- CO₂ constituted 82% of US GHG emissions in 2012
- Building sector accounts for about 36% of CO₂ emissions in developed countries:
 - ⇒ great potential for the reduction of GHG emissions



Carbon Dioxide Emissions in 2012
(Courtesy US EPA, 2014)

Approaches to Net-Zero Carbon Buildings

- Using renewable sources for the building materials and for their supply (Eikemeier and Wimmer, 2014)
- Renewable energy sources for the operational phase of the building to cut down CO₂ emissions
- Innovative construction methods
- Improved insulation
- Whole-life considerations at design stage
- Measurement and carbon calculations are critical
- The UK has directives to reduce carbon emissions by 2050
- EU Energy Performance Building Directive stipulates that all new buildings in the EU should aim to be net-zero energy from 2020.

NIST's NZERTF:

Net-Zero Energy Residential Test Facility



Key Features:

- Built in 2013
- 2-storey, 4bedroom, 3 bathroom house
- 'Virtual family of 4'
- Solar PV
- Airtightness
- Living Laboratory
- In 1st year, it generated more energy than it used (saving > \$4400)

Questions:

- Cost/ROI
- Scalability
- Replicability
- Etc.

Approaches to Net-Zero Energy Buildings

- Can be achieved in residential and commercial settings
- Start by constructing highly efficient buildings that incorporate energy efficiency measures:
 - Reduce load demand to the building
 - Control heat gain and heat loss/improved insulation
 - More efficient building enclosures
 - Glazing systems
- Use on-site renewable energy
- Use of off-site renewable energy
- The Federal government in the US has some laws in place for new federal buildings to achieve net-zero energy by 2020 (Executive Order #13514).
- DOE Building Technologies Program has a goal of making commercial net-zero energy buildings marketable by 2025.

Net-Zero Energy Buildings

- NREL outlines four aspects of net-zero energy (Torcellini et al, 2006):
 - **Net-Zero Site Energy** – building generates as much energy as it uses at the site;
 - **Net-Zero Source Energy** - energy generated onsite equals the energy used to deliver energy to a site;
 - **Net-Zero Energy Costs** – when cost of energy sold to utilities cancels out cost of energy paid to utilities;
 - **Net-Zero Energy Emissions** - when the amount of emissions-free renewable energy generated equals the energy used from emissions-producing energy sources.



Net-Zero Energy Buildings

- "Residential or commercial buildings with greatly reduced energy needs through efficiency gains such that the balance of energy needs can be supplied with renewable technologies." (Torcellini et al., 2006)
- Zero annual energy bill
- Carbon-neutral for operational energy
- Annual energy balance b/w energy used and energy produced
- Building can return excess energy to the Grid or to onsite storage (Torcellini et al., 2006; Kilbert, 2013)

US Perspective

- Very little focus on 'carbon'; no national targets...
- Much greater interest in 'energy'
- Several suggestions on the reasons for this:
 - Kyoto Protocol
 - Philosophical dichotomy
 - Ease of explanation
 - Relationship to 'bottom line'
- Energy Efficient Buildings => \$129m DOE Hub
- Net-Zero Energy Buildings...

Penn State Initiatives

MorningStar & Hybrid Renewable Energy Systems (HyRES) Lab

- Designed and **built by Penn State Students** for the 2007 Solar Decathlon
- Serves as a **teaching and research facility** dedicated to renewable energy systems, energy efficiency, and sustainability
- Leveraged to secure \$12.5M** in renewable energy and smart grid education and workforce funding
- Permanent location on 9 acre site** on campus is accessible to students, faculty, and community members



9 acre Sustainability Experience Center



Washington D.C. - 2007 Department of Energy Solar Decathlon Competition



University Park Campus - Permanent location on Penn State's 9 acre Sustainability Experience Center

MorningStar & Hybrid Renewable Energy Systems (HyRES) Lab

Key Design Features

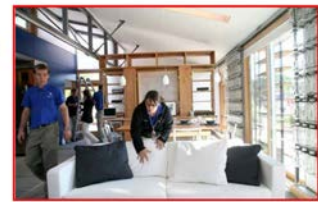
- Passive solar and daylighting
- Solar, wind, and geothermal energy
- EV charging with solar off-set
- Building Automation System supports research on advanced controls
- Sub-metering and monitoring supporting research and education

Research Programs

- Energy systems integration
- Advanced control strategies
- Indoor Environmental Quality (IEQ)
- Occupant feedback strategies

Teaching Programs

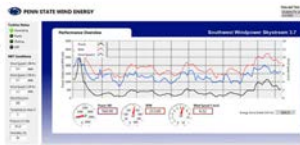
- Energy efficiency
- Sustainability leadership
- Solar energy design and construction
- Freshman experience seminars



MorningStar & Hybrid Renewable Energy Systems (HyRES) Lab



Student leadership and immersive learning experiences



Live data for energy and sustainability research and teaching



Linkages to sustainability efforts across colleges and campuses



Recruiting and Outreach for audiences of all ages

GridSTAR Center at Philadelphia Navy Yard - www.gridstarcenter.psu.edu

Grid-Smart Technology Application & Resource Center



GridSTAR Center's Mission

Mission: Serve as an **education and research resource** for Smart Grid technologies, policy and business practices

Features:

- Smart Grid Experience Center at The Navy Yard in Philadelphia
- Research infrastructure for smart grid systems
- Live data and hands-on immersive learning for smart grid systems
- Unique partnerships with manufacturers and technology providers



Private Navy Yard Electrical Grid

- Enables experimentation with new technologies
- Supports business models driving practical applications
- \$50M in planned grid modernization will inform research and education



Development Partners & Sponsors



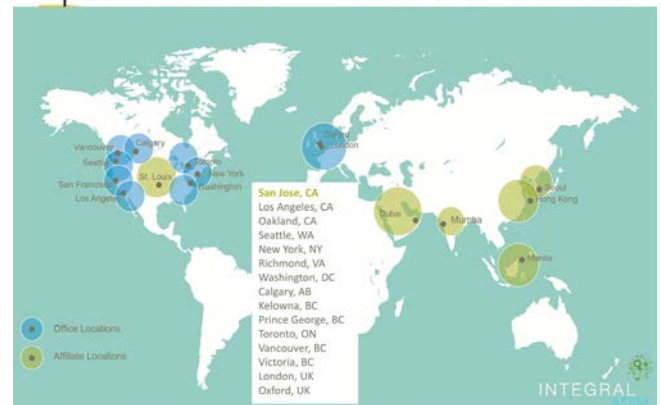
Summary of PSU Initiatives

- Neither initiative makes any claims to being net-zero energy or net-zero carbon
- The critical ingredients exist to move in that direction:
 - Diversity of renewable energy sources
 - High energy efficiency construction
 - Scope to interact with the Grid, EVs, other buildings, etc.
 - Energy storage capabilities
 - Scope for GHG emissions tracking (not currently done!)
- Potential exists for collaboration with HKU...

Commercial Retrofit Example

Integral Group

:: 300 Employees :: Energy
 :: 15 Offices :: Electrical
 :: Sustainability :: Mechanical



IDEAs Z Squared Office - Proof of concept: 2005 Remodel existing building to net zero energy



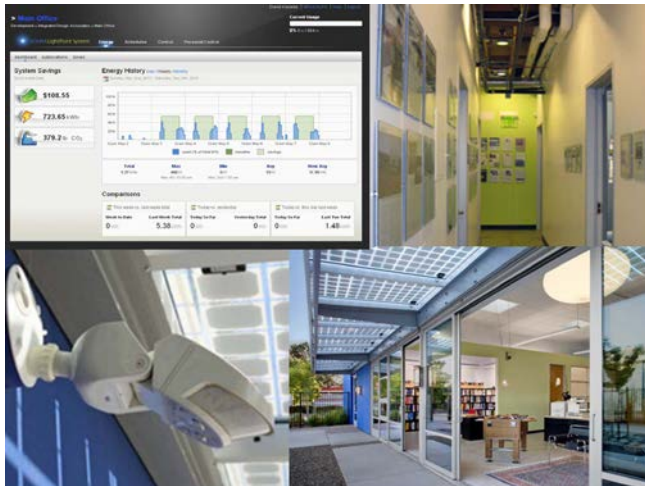
The IDEAs Z² Design Facility – Designed 2005

- Existing building remodel: 2007
- 1st US Net-Zero Energy commercial office
- ILFI Net Zero Energy Certified, Acterra, USGBC NCC, Flex Your Power Award winner
- Location: San Jose, California

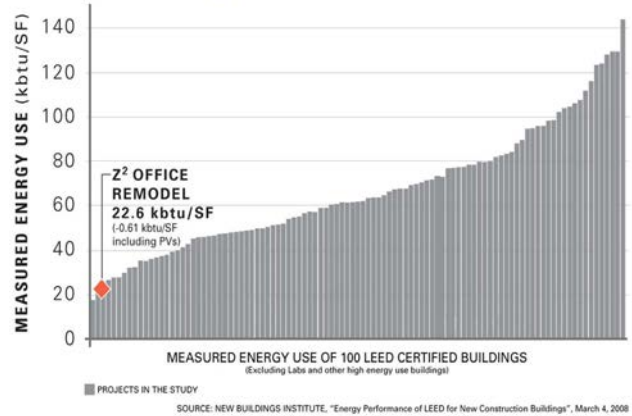
Key Green Features:

- tight thermal envelope
- control solar heat gain
- ground source heat pump
- radiant heating and cooling
- natural and displacement ventilation
- daylighting
- high efficiency lighting
- energy saving lighting controls
- high efficiency equipment
- plug load controls
- 28 kW BIPV photovoltaic system

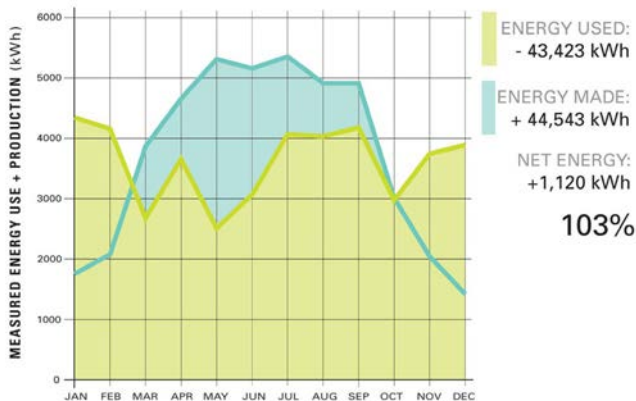




Result: Energy Use Below 50% of Title 24



IDEAs Office: Net Annual Energy Use (2009)



Summary & Conclusions

- Net-zero concept (energy or carbon) useful for discourse and action on energy demand reduction
- Definitions need to be standardized
- Net-zero energy/carbon buildings should be integral part of global/national energy policies
- More demonstration buildings needed to:
 - Experiment with a variety of approaches;
 - Demonstrate technical feasibility of non-carbon energy sources;
 - Show cost/ROI profiles;
 - Etc.
- Training and workforce development necessary

Carbon Reduction for High Rise Residential Development: Myth or Reality

Ms Ada Fung

Deputy Director, Hong Kong Housing Authority



Bio

In her career as Deputy Director of Housing, Ms Fung supervises the Development & Construction Division of the Housing Department, overseeing all facets of public housing development work in Hong Kong. She is the past Chairperson of the Architects Registration Board from 2010 to 2011, and immediate past President of the Hong Kong Institute of Architects from 2013 to 2014, and currently the Chairperson of the APEC Architect Monitoring Committee of Hong Kong, and a Director of the Hong Kong Green Building Council.

Ms Ada Fung delivered her invited speech entitled 'Carbon Reduction for High Rise Residential Development: Myth or Reality'. Ms Fung outlined the carbon reduction and energy saving initiatives of the HKHA, which include passive design, reducing consumption of lighting systems, lift installations and water pump installations, utilising solar energy, implementing carbon emission estimation (CEE), and implementing ISO 50001 Energy Management System (EnMS). Ms Fung also emphasised the importance of raising public awareness of saving energy. While shared with the audience the HKHA's achievements in sustainable development and reducing energy use and carbon emissions, Ms Fung alerted, "It is a long journey to arrive at "Zero Carbon Building" for high-rise buildings. Nevertheless, it will be a target for all of us." She also suggested "To achieve this target, we require: technology advancement in energy saving facilities and clean energy source, low embodied carbon building materials, green construction technology, public awareness on energy saving, and stakeholders' collaboration from building industry". Ms Fung finally urged all to "join hands to turn the myth to a reality".

PPT

CENTRE FOR INNOVATION IN CONSTRUCTION AND
INFRASTRUCTURE DEVELOPMENT (HKU CICID) SEMINAR:
ZERO CARBON BUILDINGS: INTERNATIONAL PRACTICE
AND STAKEHOLDER ENGAGEMENT



**CARBON REDUCTION
FOR HIGH RISE
RESIDENTIAL
DEVELOPMENT :
MYTH OR REALITY**

ADA Y. S. FUNG, JP
FHKIA, RIBA, REGISTERED ARCHITECT, APEC ARCHITECT
DEPUTY DIRECTOR OF HOUSING (DEVELOPMENT & CONSTRUCTION)
HONG KONG HOUSING AUTHORITY



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ZERO CARBON FOR HIGH-RISE RESIDENTIAL BUILDINGS?

MYTH?



REALITY?



2

CONTENT

1. INTRODUCTION
2. CARBON REDUCTION AND ENERGY SAVING INITIATIVES
3. RAISING PUBLIC AWARENESS OF SAVING ENERGY
4. ZERO CARBON BUILDINGS : A BIG CHALLENGE
5. WAY FORWARD



3

1. INTRODUCTION

- SUSTAINABLE DEVELOPMENT
- ELECTRICAL ENERGY CONSUMPTION IN HK & HA'S CHALLENGE



4

HOUSING AUTHORITY – MISSION

**“Provide affordable quality housing to
meet the needs of the public and
ensure effective use of public resources”**



**Core Values
基本信念**

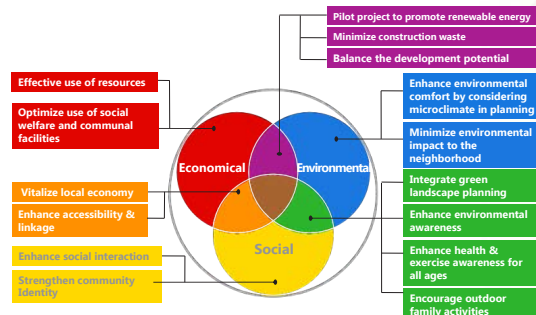
Research & Development



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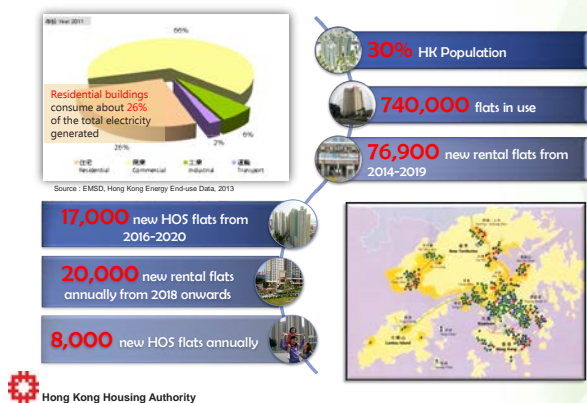
SUSTAINABLE DEVELOPMENT

To meet present social, economical and environmental needs
but NOT at the expense of future generations.



6

ELECTRICAL ENERGY CONSUMPTION IN HK & HA'S CHALLENGE



7

2. CARBON REDUCTION AND ENERGY SAVING INITIATIVES

2.1 PASSIVE DESIGN

2.2 REDUCING CONSUMPTION OF LIGHTING SYSTEMS

2.3 REDUCING CONSUMPTION OF LIFT INSTALLATIONS

2.4 REDUCING CONSUMPTION OF WATER PUMP INSTALLATIONS

2.5 UTILIZING SOLAR ENERGY

2.6 IMPLEMENTING CARBON EMISSION ESTIMATION (CEE)

2.7 IMPLEMENTING ISO 50001 ENMS



Hong Kong Housing Authority

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2.1 PASSIVE DESIGN

- optimize the use of **daylight** and **natural ventilation**
- provide adequate **air movement**
- Micro-climate studies** since 2004



Hong Kong Housing Authority

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2.2 REDUCING CONSUMPTION OF LIGHTING SYSTEMS

- Electronic ballasts** (save about **20 - 30%** energy as compared with electromagnetic ballast) and **T-5 fluorescent tubes** (save about **20%** energy as compared with T-8 tubes) since 2000
- Photo sensors** and **time switches** to fully utilize daylight
- Develop a **two-level lighting control system** for lift lobbies, corridors and staircases in domestic blocks, using **motion sensors** and **on-demand switches** with timer control (save about **30%** energy)
- Pilot **light emitting diode (LED) bulkheads** (save about **40%** energy as compared with compact fluorescent lamp bulkheads)

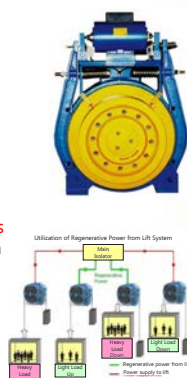


Hong Kong Housing Authority

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2.3 REDUCING CONSUMPTION OF LIFT INSTALLATIONS

- variable voltage variable frequency (VVVF) since 1996
- Light weight lift car decoration design
- Gearless lift drive** (save about **10%** energy as compared with geared lift drive)
- Permanent Magnet Synchronous (PMS)** lift motor (incorporated in gearless lift drive)
- Lift regenerative power** systems (regenerate about **20%** energy)



Hong Kong Housing Authority

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2.4 REDUCING CONSUMPTION OF WATER PUMP INSTALLATIONS

- Electronic variable speed drive control** systems for booster pumps (save about **30%** energy)
- Higher efficiency motors** (save about **5%** energy as compared with standard efficiency motors)



Hong Kong Housing Authority

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2.5 UTILIZING SOLAR ENERGY

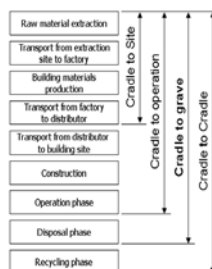


- Grid-connected PV system since May 2011 for at least **1.5%** of the communal electricity consumption for rental domestic blocks

2.6 IMPLEMENTING CARBON EMISSION ESTIMATION (CEE)

(SHEET 1 OF 4)

- In 2010, the HKSAR issued a Consultation Document proposing a reduction in carbon intensity of at least **50% - 60% by 2020** (2005 as baseline).



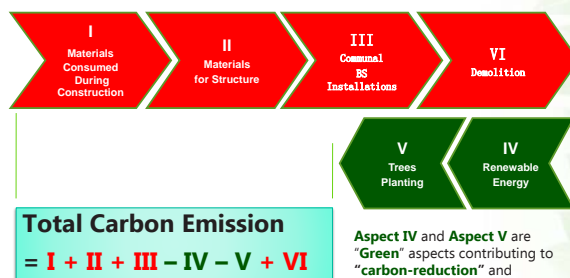
- A straight forward and pragmatic methodology to **control the embodied carbon emission** of building materials and **building operational carbon emission**.
- Life-cycle carbon emission for major construction materials and building operations from **cradle to grave**.

2.6 SIX ASPECTS IN CEE MODEL

(SHEET 2 OF 4)

Aspect	Embracing
I: Materials Consumed During Construction	<ul style="list-style-type: none"> Timber formwork for substructure & superstructure Steel formwork for superstructure
II: Materials for Building Structure	<ul style="list-style-type: none"> Concrete for substructure & superstructure Steel for substructure & superstructure
III: Communal Building Services Installations	<ul style="list-style-type: none"> Lighting, Lift, Water Supply, Security, CABD, A/C & Ventilation, Fire Services, Electrical Distribution System
IV: Renewable Energy	<ul style="list-style-type: none"> Solar and/or wind powered system
V: Trees Planting	<ul style="list-style-type: none"> Trees taller than 5m
VI: Demolition	<ul style="list-style-type: none"> Dismantling of building Transportation of building debris from site to landfill

2.6 TOTAL CARBON EMISSION (SHEET 3 OF 4)



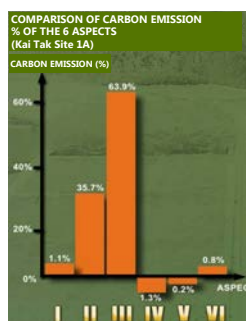
2.6 BENCHMARKING (SHEET 4 OF 4)

Aspects	Block Comparison		Estate Comparison	
	NH1 (Benchmark)	Sheung Shui Project	Kai Tak 1A (Benchmark)	Sheung Shui Project
CO ₂ Emission (kg) (Percentage of Total CO ₂ Emission)	I	372,418 (8.7%)	332,889 (0.9%)	740,079 (0.9%)
	II	17,324,483 (33.4%)	14,819,282 (38.0%)	32,042,637 (38.2%)
	III	33,737,071 (64.9%)	23,988,491 (61.5%)	209,364,438 (81.0%)
	IV	0 (0%)	-571,025 (-1.5%)	-4,111,380 (-1.3%)
	V	0 (0%)	-707,347 (-0.2%)	-388,700 (-0.5%)
	VI	527,120 (1.0%)	462,000 (1.2%)	2,738,736 (1.0%)
	Total	51,661,093 (100%)	39,041,606 (100%)	83,864,578 (100%)
Number of Flat	799	639	5,204	1,356
Gross Floor Area (GFA) (m ²)	33,078	27,722	212,886	58,774
Construction Floor Area (CFA) (m ²)	36,686	30,223	232,752	64,029
CO ₂ /Flat (kg/Flat)	65,033 (100%)	61,098 (93.9%)	62,956 (100%)	61,756 (98.2%)
CO ₂ /GFA (kg/m ²)	1,571 (100%)	1,466 (93.3%)	1,524 (100%)	1,427 (93.6%)
CO ₂ /CFA (kg/m ²)	1,416 (100%)	1,292 (91.2%)	1,408 (100%)	1,310 (93.0%)

Carbon emission below the Benchmark

2.7 IMPLEMENT ISO 50001 ENMS

(SHEET 1 OF 4)



- Based on the CEE Model, **communal building services installations** is the biggest portion of carbon emission
- An **Energy Management System (EnMS)** to ensure the energy efficiency of communal building services installations
- In 2014, further reduce **10%** energy consumption by lowering the Energy performance Indicator from the original **30 kWh/m² to 27 kWh/m²**

2.7 HA's ROADMAP OF ISO 50001 ENMS

(SHEET 2 OF 4)



- Rolled out HA's Energy Management System (EnMS) in December 2011 by modeling on the ISO 50001 best practice framework
- Awarded the first ISO 50001 certificate on residential building design in Hong Kong in June 2012
- Award the ISO 50001 certificate for 92 existing Estates (621 blocks) in August 2014.
- Plan to obtain the ISO 50001 certificate for the rest of 75 existing Estates (539 blocks) in April 2015

2.7 ISO50001 ENMS

(SHEET 3 OF 4)

- Provide a systematic framework to verify the energy performance of communal building services installation designs
- Verified by actual energy measurements taken after mass tenant intake



"What Gets Measured Gets Done"



2.7 ISO50001 ENMS

(SHEET 4 OF 4)

Energy Performance Indicators (EnPIs)

Year	2012	2013	2014
EnPI	30 kWh/m ²	30 kWh/m ²	27 kWh/m ²

Energy Objectives, Targets and Action Plans

Objective	Target	Action	Time Frame
To reduce energy use and consumption in communal area of domestic blocks	Achieve a reduction equivalent to 10% of the 2011 energy base line value by 2014	✓ Energy certificates	2012-2014 (on-going)
		✓ PV panel systems	
		✓ 2-level lighting control systems	2014 (on-going)
		✓ Optimized lighting designs	
		✓ Lift regenerative power for 18kW or above	2015
		✓ Gearless lift	
		LED bulkheads	

3. RAISING PUBLIC AWARENESS OF SAVING ENERGY

- PUBLIC ENVIRONMENTAL AWARENESS
- SOLAR-POWERED LAMP POLES
- SMART METER MONITORING AND ENERGY INFORMATION DISPLAY SYSTEM
- HOUSING CHANNEL
- GREEN STATION
- GREEN DELIGHT IN ESTATES

PUBLIC ENVIRONMENTAL AWARENESS



- Green initiatives to raise public environmental awareness
- For 30% of HK population living in public housing estates

- Put forth demonstrative installations
- Saving energy and resources not only for their own bills but also for the public account

SOLAR-POWERED LAMP POLES



- Installed one or more solar-powered lamp poles for each new public housing estates since 2008



SMART METER MONITORING & ENERGY INFORMATION DISPLAY SYSTEM

- Smart Meter Monitoring and Energy Information Display System
- make tenants aware of the energy/resource consumption figures and encourage them to reduce their consumption



HOUSING CHANNEL



GREEN STATION



GREEN DELIGHT IN ESTATES



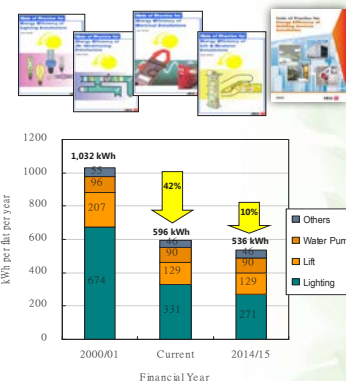
4. ZERO CARBON BUILDINGS : A BIG CHALLENGE

HA's ACHIEVEMENTS

- SAVING ENERGY
- OUTPERFORMING CEE BENCHMARK
- OUTPERFORMING ENERGY BASELINE
- GREEN PEACE'S FIGURES
- ZERO CARBON FOR HIGH-RISE RESIDENTIAL BUILDINGS?

SAVING ENERGY

- Non-statutory Building Energy Codes (BEC) since 2000, prior to mandatory BEC issued in September 2012
- ≥500 Building Energy Certificates have been awarded by EMSD
- Reduction of **42%** in annual electricity consumption in communal areas since 2000/01
- Target another **10%** in 2014/15

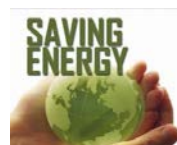


OUTPERFORMING CEE BENCHMARK

- Since the launch of CEE in February 2011, there have been 35 projects, comprising 105 domestic blocks, designed up to mid 2014.
- We have achieved a reduction in carbon emission of around **462,000 tonnes** for the whole life cycle of these domestic blocks, representing a **10%** reduction as compared with the benchmark figure.



OUTPERFORMING ENERGY BASELINE



- Optimized lift arrangement
- T5 Fluorescent Tube
- Electronic Ballast
- Day-light control for lighting system
- Electronic variable speed drive controls for water pump
- 2-Level Lighting System
- Grid-connected photovoltaic (PV) panel system
- Optimized lighting design
- Lift regenerative power for 18kW or above
- Gearless lift
- LED bulkhead

- All along, we have been implementing a number of energy saving initiatives.
- Since the launch of ISO 50001 EnMS in June 2012, there have been 95 domestic blocks designed up to mid 2014.
- As compared with the Energy Baseline, we have achieved a reduction in communal energy consumptions by **13%**, bringing about an annual electricity saving of around **4,984,000kWh**.

GREEN PEACE'S FIGURES

- According to Green Peace's press release in June 2010, the annual electricity consumption of communal areas per domestic flat of the some private domestic premises are as follows –

Private Estates	kWh per flat per year
Manhattan Hill	6,834
One Beacon Hill	6,725
The Pacifica	4,359
Aqua Marine	3,409
Central Park	3,294
Island Harbourview	3,127
Housing Authority PRH	807 (Green Peace's figure, 2010) 678 (HA's figure, existing building, 2013/14) 596 (HA's figure, new building design, 2013/14)

ZERO CARBON FOR HIGH-RISE RESIDENTIAL BUILDINGS?

- ❑ In the past decade, HA has successfully reduced energy consumption and carbon emission to a great extent (>40%).
- ❑ It is a **long journey** to "Zero Carbon Building" for high-rise buildings. Nevertheless, it will be a **target for all of us**.
- ❑ To achieve this target, **we require** :

Technology advancement in energy saving facilities & clean energy source

Low embodied carbon building materials

Green construction technology

Public awareness on energy saving

Stakeholders' collaboration from building industry



Let's join hands to turn the Myth to a Reality!

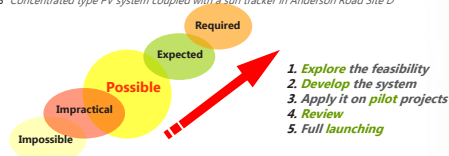
5. WAY FORWARD

WE CARE FOR OUR PEOPLE. WE CARE FOR OUR ENVIRONMENT.

- Achieve **low carbon development**, by innovative green design & construction, intelligent solutions & IT.
- Ensure **effective use of resources**, by R&D for green & innovative solutions -

Coming up researches-

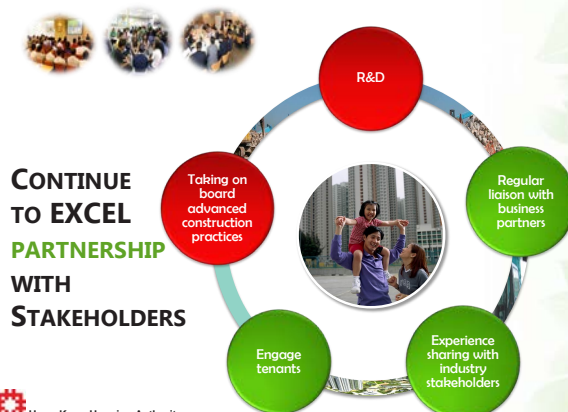
- Amorphous silicon and copper indium gallium diselenide (CIGS) thin film PV panels in Yau Lai Estate and Tak Long Estate
- Concentrated type PV system coupled with a sun tracker in Anderson Road Site D



- **Drive for green design, green construction and good management**, we assure quality and sustainability throughout the supply chain collaboration.

WE ENDEAVOR TO ADOPT LOW CARBON DESIGN TO DELIVER OUR HOUSING PROGRAMME ...

HARDWARE + SOFTWARE TECHNICAL + SOCIO





Thank You

Website "<http://www.housingauthority.gov.hk/en>"

Stakeholder Engagement for Building Towards Zero Carbon

Dr Raymond Yau

Director, Hong Kong Green Building Council

Bio

Dr Raymond Yau is a Director of HKGBC, he is Green Building Faculty Member. He is the 1st Vice Chairperson and Director of BEAM Society Limited and serves as Chairperson at Technical Review Committee.

Dr Yau is Arup Fellow and Director of Arup. Dr Yau is a building services engineer and building sustainability consultant who has over 27 years of experiences in the integrated design of sustainable and environmental responsive buildings and sustainable building physics. Dr Yau is the project director, responsible for the total engineering design of the CIC Zero Carbon Building. Many of his projects have won Green Building Awards or Sustainability Recognition such as Kansai International Airport Terminal, CIC Hong Kong's First Zero Carbon Building and Beijing Parkview Green.

He serves as the Members of Expanded Building Committee of Buildings Department and of Energy Efficiency and Conservation Sub-Committee of Environment Bureau, HKSAR Government. Dr Yau is Adjunct Associate Professor at Department of Architecture of CUHK and Guest Professor at

Chongqing University. Dr Yau is Fellow Members of HKIE and CIBSE.



Dr Raymond Yau delivered his invited speech entitled "Stakeholder Engagement for Building towards Zero Carbon". Dr Yau first provided an outline of the international context of addressing climate change and reducing carbon emissions. He then shared the HKGBC's new vision "To help save the planet and improve the wellbeing of the people of Hong Kong by transforming the city into a greener built environment". Dr Yau followed by elaborating the "HK3030" Campaign, a vision for a low carbon sustainable built environment in Hong Kong by 2030, which denotes the target to reduce the absolute electricity consumption of buildings by 30% by 2030 from 2005 level,

which provided a roadmap of achievable targets in support to the greenhouse gas reduction target set out by the Government. Dr Yau also briefed on the actions by HKGBC for the development of a low carbon sustainable built environment in Hong Kong, which include Building Energy Performance Recognition Scheme, series of rating tools for building sectors, guides for general public & buildings sectors, platforms for general public and building sectors to reduce waste, and a number of collaboration events worldwide.

PPT



Stakeholder Engagement for Building Towards Zero Carbon

Presented by
Ir Dr Raymond Yau
HKGBC Director

6 January 2014

Zero Carbon Buildings: International Practice and Stakeholder Engagement



Global Mission - Reduction of carbon emission

"The climate change deal, under which both sides (China & U.S.) committed to cutting greenhouse emissions, is very significant because it breaks new ground on an internationally divisive issue of the 21st century."
(14 November 2014 on SCMP)



WSB14 – WSBE17 Process

"We need and want to work together."

– Antonio Lucio, responsible for WSB14 Global Vision Area concluded the WSB14



Why?

In global terms, the building sector accounts for 1/3 of energy consumption, waste generation, and resource depletion

How?

By establishing mechanisms which can promote global dialogues that can draw immediate solutions to the global sustainability roadmap

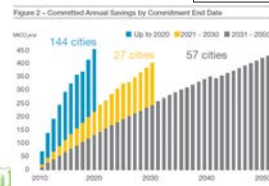
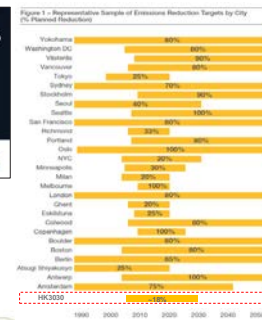
Expected results?

To reduce emission by 77% to avoid energy and climate collapse



The 'Global Aggregation of City Climate Commitments' report

- 228 global cities, representing 436 million people, have already set GHG reduction goals and targets
- By achieving the HK3030 campaign target, approximately 18 MtCO₂e/yr will be reduced



HKGBC New Vision

- To help save the planet and improve the wellbeing of the people of Hong Kong by transforming the city into a greener built environment.



HKGBC New Mission

- To lead market transformation by
 - advocating green policies to the Government;
 - introducing green building practices to all stakeholders;
 - setting design, construction and management standards for the building profession;
 - and promoting green living to the people of Hong Kong.





HK3030 Campaign

A Vision for A Low Carbon Sustainable Built Environment in Hong Kong by 2030

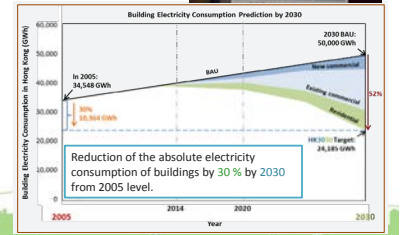


HK3030 Campaign

- Launched in Dec 2012
- Activation Ceremony in March 2013
- HK3030 – Market Drivers towards Sustainable Built Environment Policy Forum held on 17 Oct 2014

The Market Drivers

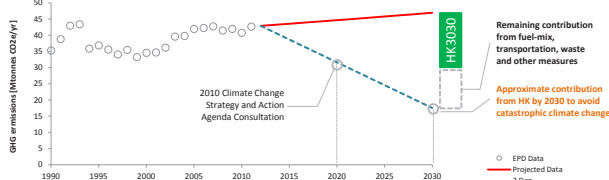
- Pursuing disclosure – the crucial role of benchmarking
- Tackling the significant impact of existing buildings head on
- Developing Hong Kong into an incubator of innovative design
- Leading with regulatory drivers
- Changing emphasis along the roadmap
- Financing the transformation



HK3030 Campaign

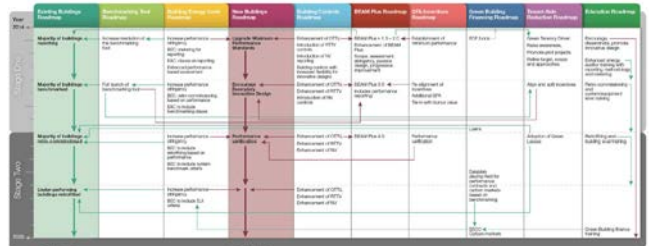
GHG Emission and Targets

- HK3030 will **reduce carbon emission by 18 MtCO₂e/yr**
- More than 40% reduction to other emissions related to electricity generation
- Contribute to more than 50% of the carbon reductions required if HK is to do its part in averting catastrophic climate change



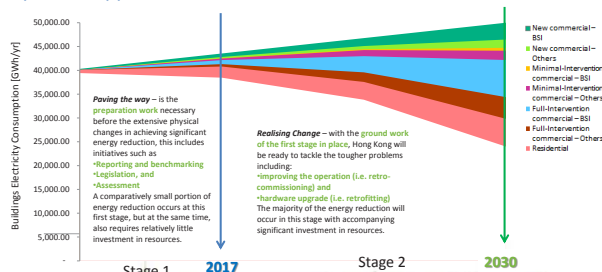
Long Term Plan for Sustainable Built Environment

Roadmap to Deep Energy Reductions



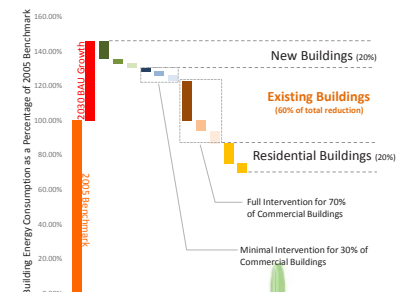
Market Drivers for Transformation of Green Buildings in Hong Kong

Sequential Approach



A Scenario to Illustrate HK3030

- In this particular scenario, the **bulk of reduction comes from existing buildings**, specifically, by targeting a select group of existing commercial buildings with full intervention strategies



Actions by HKGBC

For the Development of Low Carbon Sustainable Built Environment in Hong Kong

Hong Kong's Current Initiatives

The drivers for green building developments can be classified into 4 categories (from McGrawHill Construction on World Green Building Trends):

Regulatory drivers



- Building Energy Efficiency Ordinance (BEEO) and equivalent ordinances
- Mandatory Energy Efficiency Labelling Scheme (MEELS)

Economic drivers



- Environmental and Conservation Fund
- GFA Concession scheme
- Green loan and financing schemes
- Sustainable Development Fund

Environmental drivers



- BEAM Plus assessment system
- BESTOO and Building Energy Performance Benchmarking Tools for Commercial Buildings of Office and Retail Use in Hong Kong
- HKSAR Government leadership
- HKGBC Eco-product Directory
- HKGBC Green Building Product Labelling Scheme

Social drivers



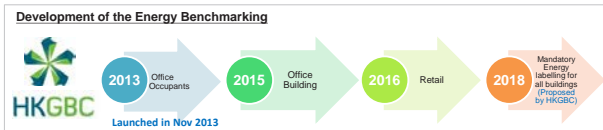
- BEAM Plus assessment system
- Environmental, Social and Governance (ESG) Reporting
- Hang Seng Corporate Sustainability Index Series
- Professional trainings and qualifications
- Public education

HKGBC Initiatives

Environmental drivers

Building Energy Performance Recognition Scheme

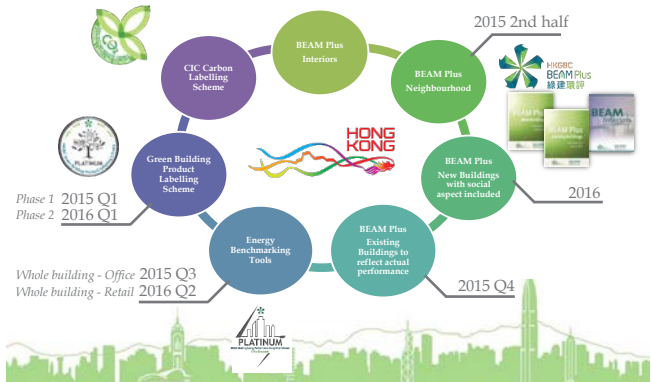
A series of HKGBC Building Energy Performance Recognition Scheme is currently under development



- Sub-metering is essential in providing more accurate data
- Shall be tied with BEAM Plus **Mandatory Energy Use Intensity (EUI)** requirements to improve overall electricity consumption of buildings
- Possible incentives for target achieved performers
- Mandatory benchmarking & reporting, and performance verification

Environmental & Social drivers

Series of Rating Tools for Building Sectors



Social drivers

Guides for General Public & Building Sectors

Green Architectural Design and Construction Management Guide for Minimisation of Construction and Demolition Waste (In Progress)

Hong Kong Green Office Guide (In Progress)



Social drivers

Platforms for General Public & Building Sectors to Reduce Waste





Social drivers

Activities to Inspire the Public to Go Green



Social drivers

General Public & Building Sector Participations



World-leading Role

Communication & Collaboration with Worldwide



Hosting of WorldGBC Congress 2015

Theme:
Urban Density: The Green Way for Urbanisation

•Co-organised by CIC and HKGBC

•October 2015



Welcoming **Over 100** global green building leaders and **Over 500** local and regional professionals



Hosting of World Sustainable Built Environment Conference 2017 (WSBE17)

Theme:
Multifaceted Urban Density: Delivering a Sustainable Built Environment

•Co-organised by CIC and HKGBC

•June 2017

•A return to Asia since the Conference last held in Japan in 2005

Welcoming

Over 2000

professionals, academia and government representatives worldwide



THANK YOU

Energy Efficient Air Movement

Dr Andy Chou

Managing Director, Big Ass Fans East Asia



Bio

Dr Andy Chou is the East Asia Managing Director for Big Ass Fans, the preeminent designer, manufacturer and global market leader for large diameter ceiling fans and high-tech residential fans. Dr Chou is currently located in Hong Kong, with the focus of building up the ceiling fan business locally and throughout East Asia by introducing Big Ass Fans' energy efficient fans and educating the public about their cooling benefits.

Prior to joining Big Ass Fans, Dr Chou was an attorney in the US and worked at Fortune 500 companies such as Adobe Systems Inc and Johnson & Johnson. Always intrigued by how technology can improve the lives of people, he joined the innovative and unconventional fan manufacturer, Big Ass Fans, earlier last year in 2014.

Dr Chou holds a B.A in political science, an M.B.A in Business Administration, and a Juris Doctor degree from Brigham Young University.

Dr Andy Chou gave a talk on energy efficiency and thermal comfort. Dr Chou explained how the High Volume Low Speed (HVLS) Fan can improve the thermal comfort by better mixing the upper and lower level indoor air and improve energy efficiency by consuming less energy. At the end of his speech, he also reflected on the theory of thermal comfort and explained the relationship between thermal comfort and heating and cooling of the buildings drawing on practical cases. Dr Chou proposed a future version of ceiling fans to monitor and respond to the specific behavioural patterns of users and provide a comfortable environment with less energy consumption.

PPT



Energy Efficiency and Thermal Comfort

By: Andy Chou – Big Ass Fans Managing Director of East Asia



Big Ass Fans

Largest HVLS Fan Manufacturer in the World

- Founded in 1999
- Over 100,000 fans sold by 2013 in over 80 countries
- Started in industrial spaces and expanded into residential and commercial applications
- Offices in Australia, Canada, Hong Kong, Malaysia and Singapore



Lexington, KY, USA Headquarters



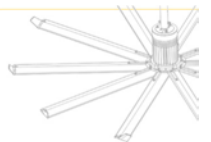
Big Ass Fans

Most Innovative HVLS Company

- Holds 93 patents and 144 patents pending
- World's only LEED Gold Certified R&D facility for ceiling fans
- World's only large diameter fan testing facility
- 9 % revenue reinvested into R&D



Big Ass Fans R&D Lab



Awards & Certificates



Thermal Comfort and Energy Consumption

What is Thermal Comfort?

Definition:

"That condition of mind which expresses satisfaction with the thermal environment and is assessed by subjective evaluation."

ANSI/ASHRAE Standard 55-2010, Section 3



It Is All A Matter Of Perspective

Thermal Comfort and Energy Efficiency

- \$18.6 billion on residential AC in the US in 2013
- If every home in the US raised its thermostat set point by 6 degrees F, we could eliminate 78 billion pounds of carbon



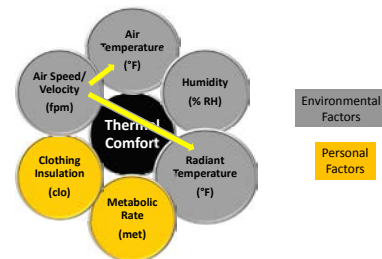
Park 7.4 million vehicles for a year



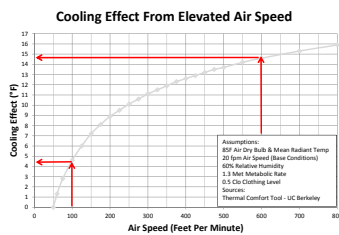
Carbon sequestered by 29 million acres of trees in 1 year

Shifting the Concept of Thermal Comfort

Shifting the Concept of Thermal Comfort

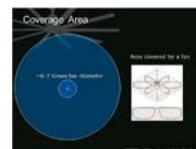


Shifting the Concept of Thermal Comfort: Cooling



According to the U.S. EPA and DOE, every degree C offset equals a 3-5% reduction in energy consumption for cooling

Shifting the Concept of Thermal Comfort: Cooling



1. Coverage area could be 6-7X diameter of fan

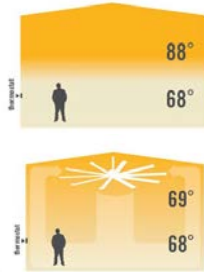
2. Low energy consumption
 - 1 Essence fan only uses 10W at lowest speed, about the same as a



- 600-1500W for AC



Shifting the Concept of Thermal Comfort: Heating



Destratification

- Up to 30% savings on winter heating bills

Shifting the Concept of Thermal Comfort: Heating

- Total Heating Hours reduced from 3429 to 2755, a 20% difference
- Cost savings = \$100,000 USD/Yr
- Night management hours decreased and heating start time delayed
- Payback > 8 months



Ceiling Fans: Into the Future

BIGASS

Ceiling Fans: Into the Future



Ceiling Fans: Into the Future



A good night's sleep with
optimal energy consumption

Thank You



Plenary Session



Ms Ada Fung, Prof Chimay Anumba, Dr Raymond Yau and Dr Andy Chou joined the plenary session facilitated by Dr Guiyi Li. A wide range of questions and comments were raised by the audience. Common themes of the plenary session included the need for a systems approach to reducing carbon emissions and public and stakeholder engagement in enabling behavioural changes.

Closing Remarks

Finally Dr Wei Pan delivered the closing remarks. Dr Pan pointed out that Hong Kong has its unique demographic and climatic conditions and the largest number of high-rises for a city in the world, which contributes to the unique challenge facing Hong Kong for carbon emission reductions. Because of this uniqueness, learning from elsewhere is useful, but exploration is more important, and the launch of the Hong Kong Zero Carbon Partnership is a milestone in such exploration. After thanking all contributions to the seminar the organisers wished that with a joined force from all including the demand, supply, regulation and institution groups of stakeholders of buildings and the process of building, substantial achievements will be made for building towards zero carbon in Hong Kong.

(Photos courtesy of Sanyuan Niu, Long Chen and Qiuchen Lu)



The Hong Kong Zero Carbon Partnership
www.hkzcp.org

Hong Kong, January 2015