Feasibility of High-rise Zero Carbon Building: Progress and Plan

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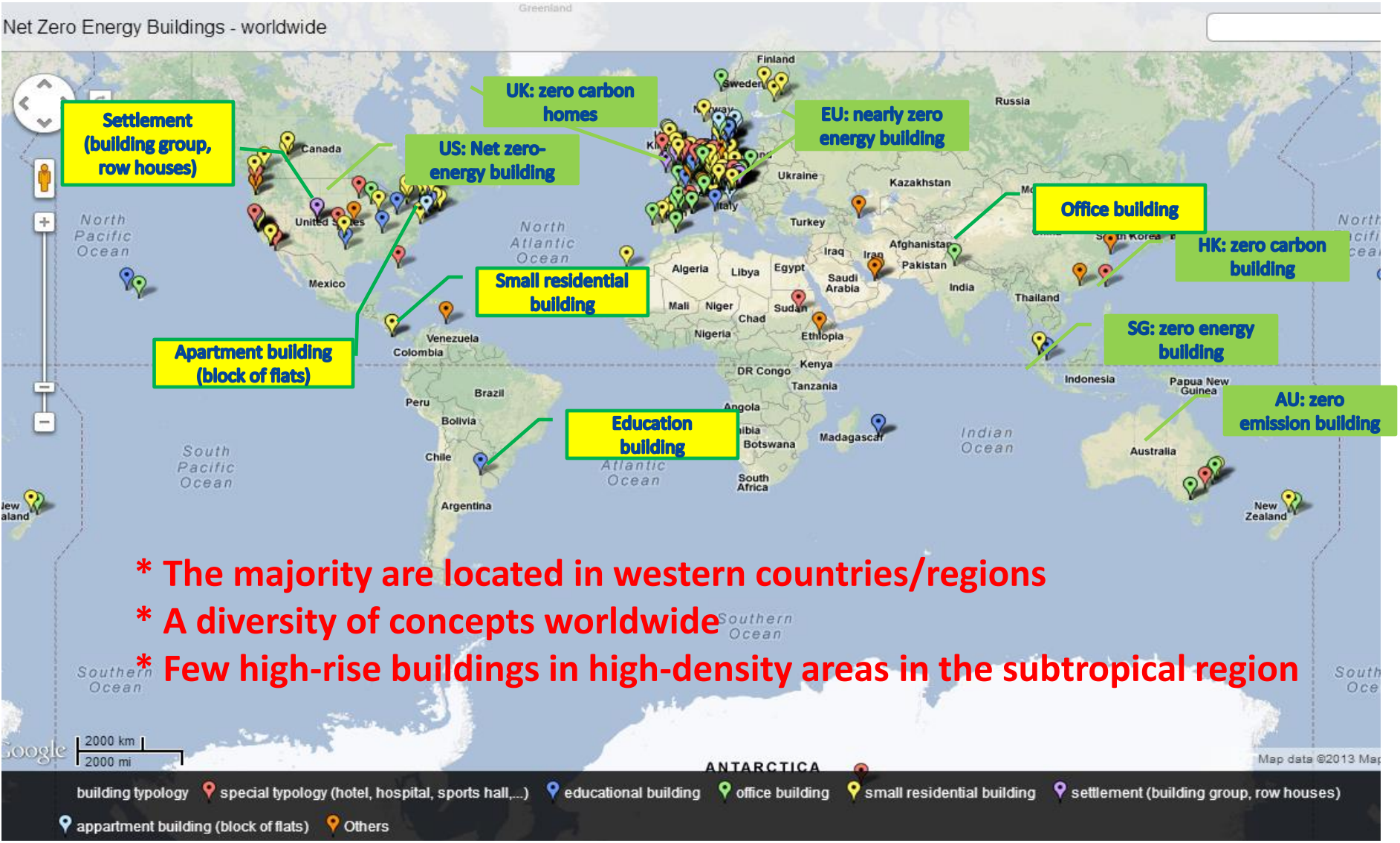
Centre for Innovation in Construction and Infrastructure Development (CICID)
The University of Hong Kong

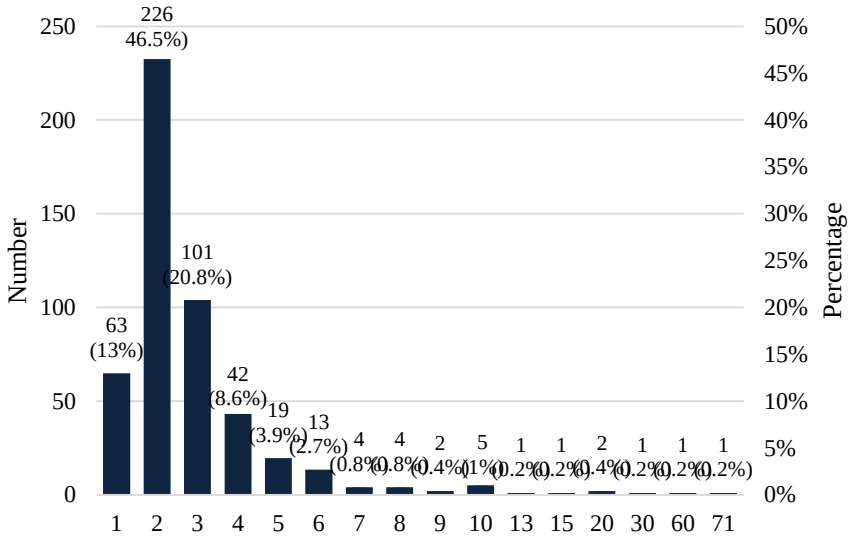
@ZCB, Hong Kong, 29 September 2014

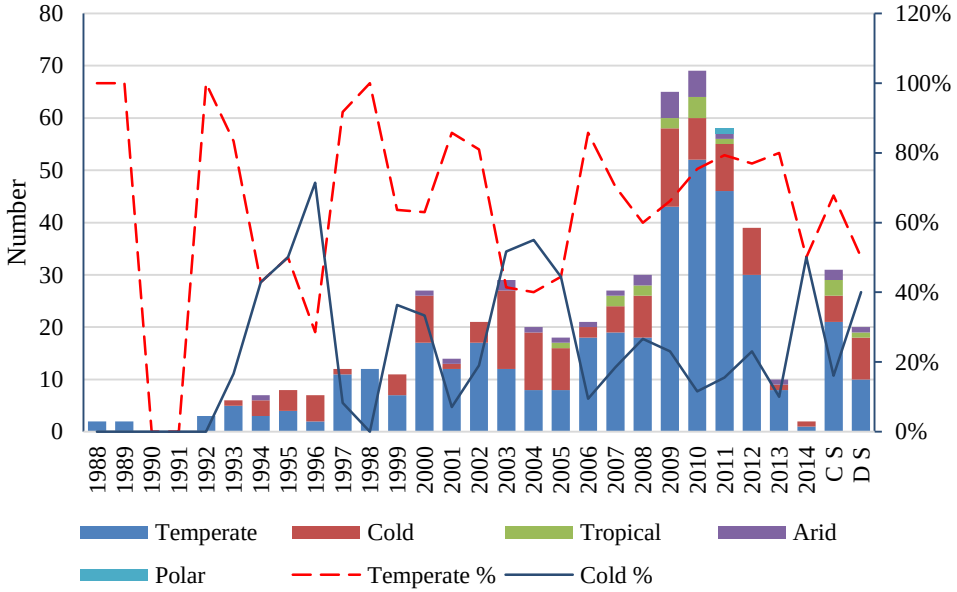
‘Net Zero Energy’ Buildings (IEA)

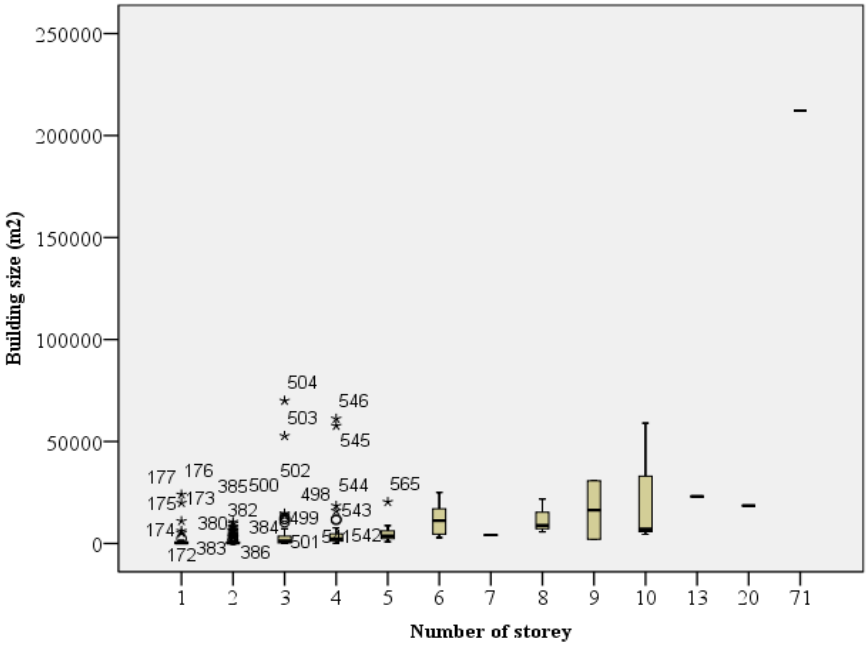


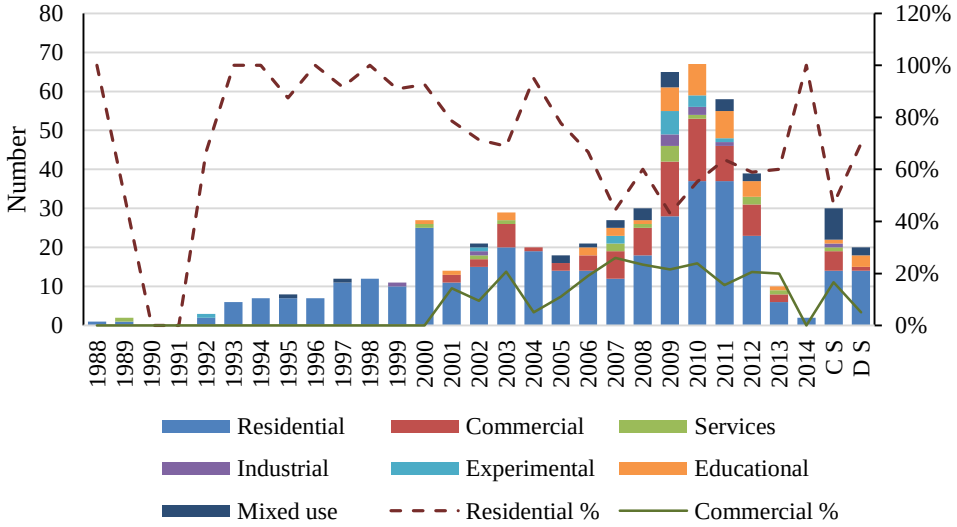
Source: http://batchgeo.com/map/net-zero-energy-buildings . Accessed 04 April 2013

‘Zero-carbon’ Buildings Worldwide: Patterns & Gaps

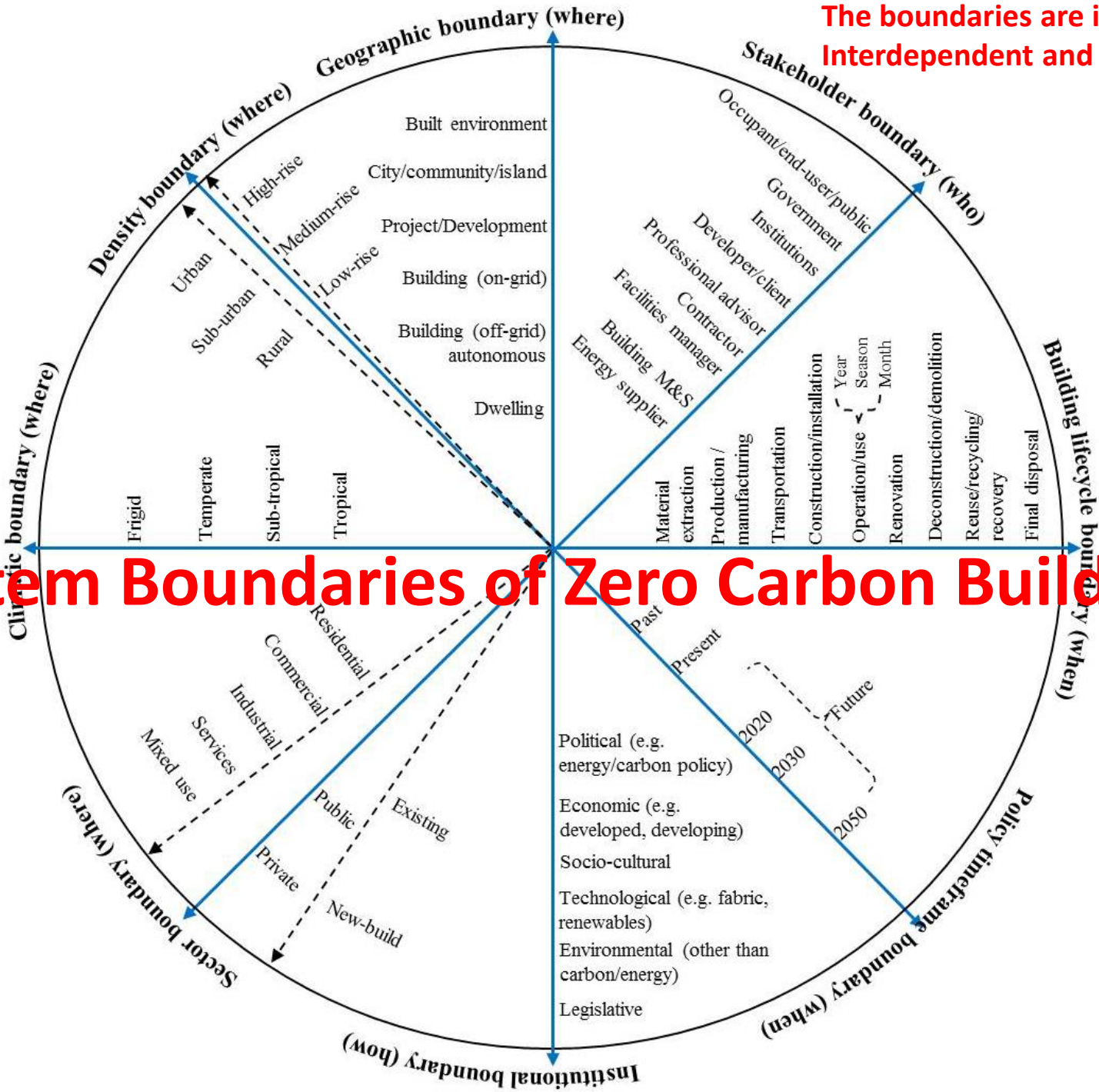






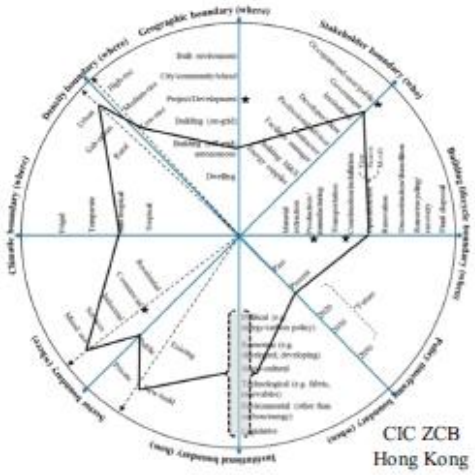


The boundaries are interactive, Interdependent and dynamic.

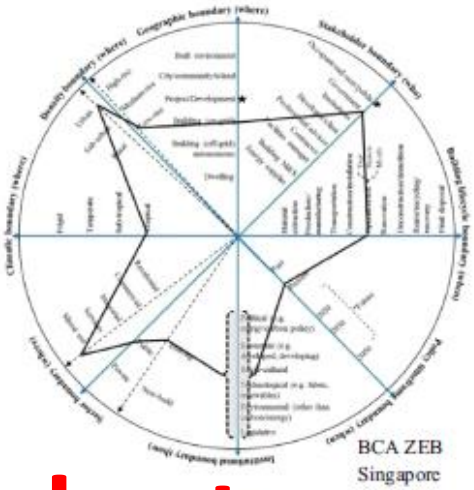


System Boundaries of Zero Carbon Building

Pan (2014)

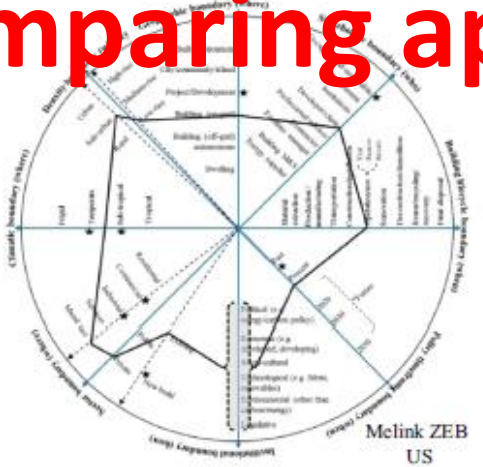


CIC ZCB
Hong Kong

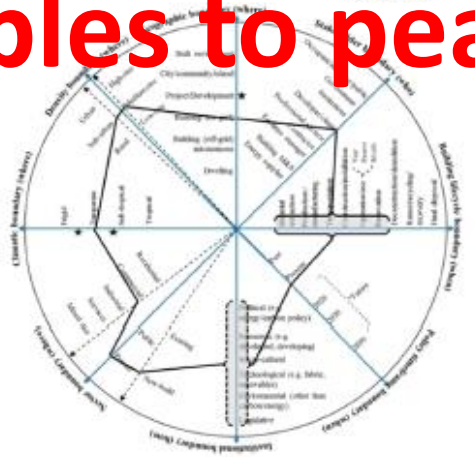


BCA ZEB
Singapore

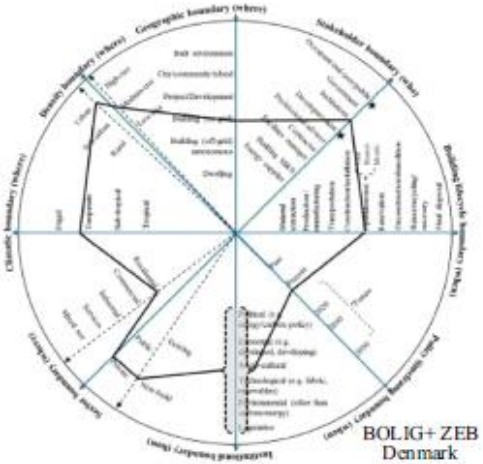
Comparing apples to pears !



Melink ZEB
US



Pixel Carbon Neutral Building
Melbourne



BOLIG+ ZEB
Denmark

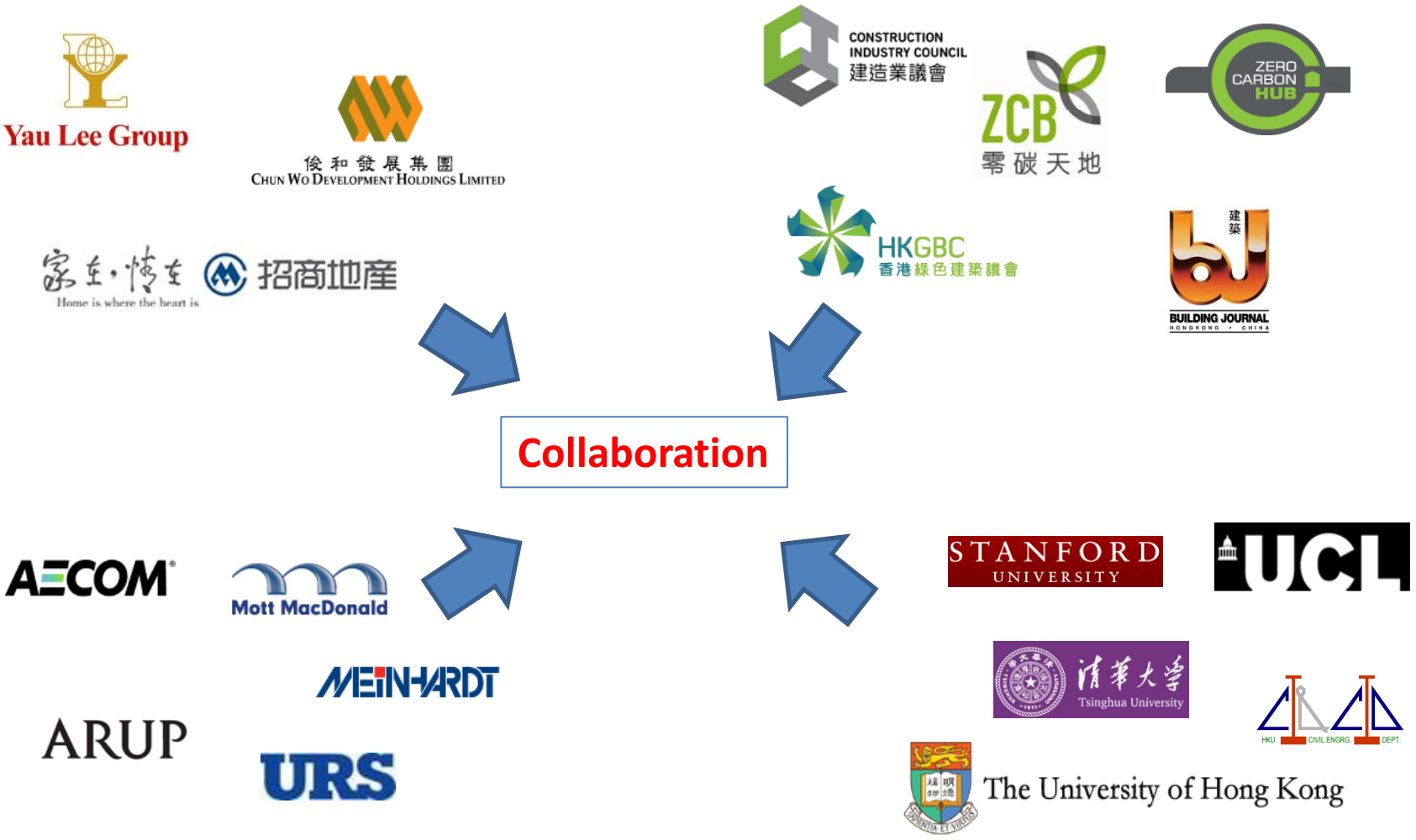
★ Relevant but secondary boundary options

Lifecycle boundary option (compared to the focus on operation only

Denote the complexity of the PESTEL aspects of the institutional boundary

Pan (2014)

CIC Fund: Project Team & Collaborators



Vision

- Contribute to the transformation of the Hong Kong built environment towards low carbon and sustainable development.
- Position the Hong Kong industry in a leading role in urban sustainability in the Asia Pacific Region and beyond.

Feasible?
&
Transformation

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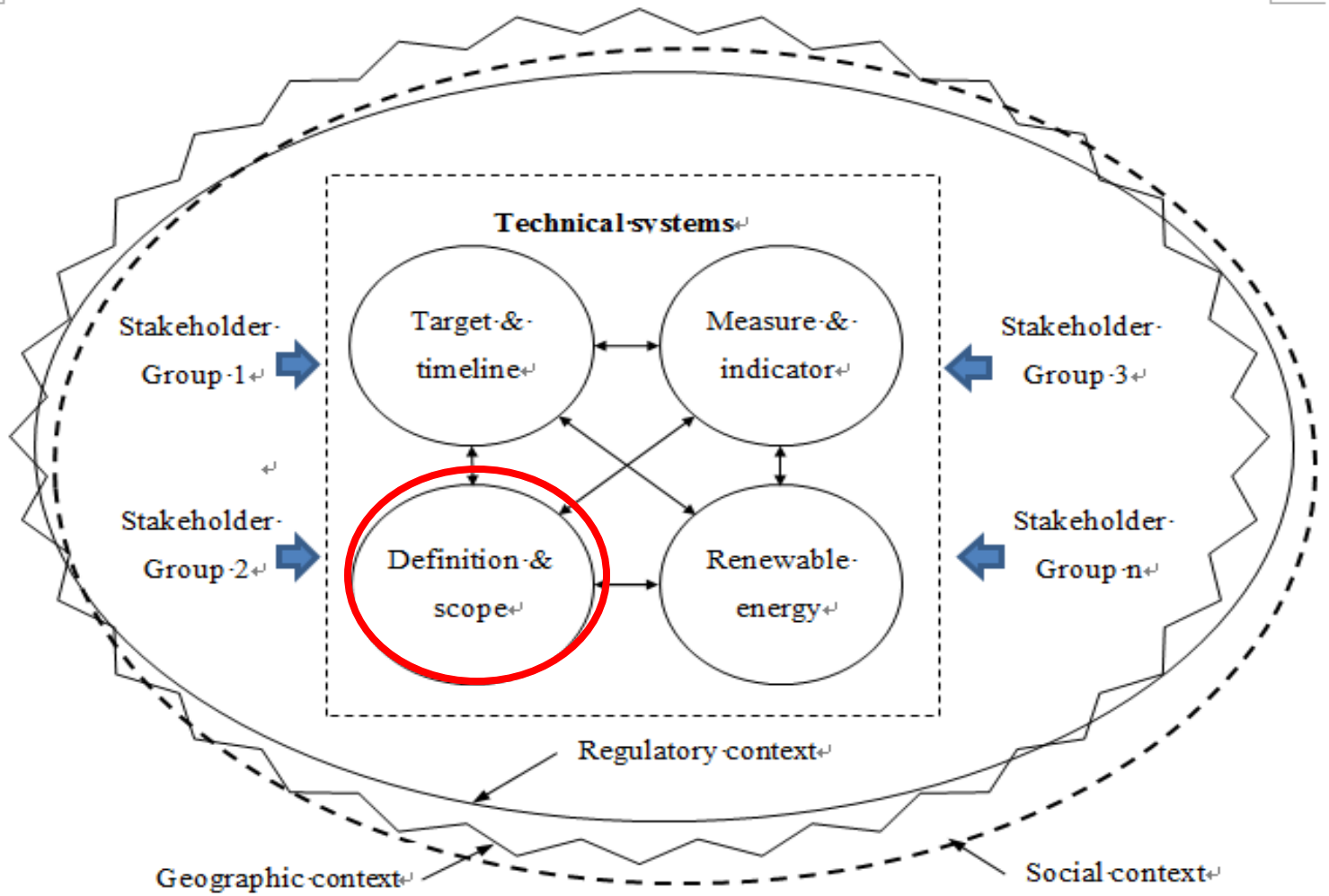
Expected Outcomes & Deliverables

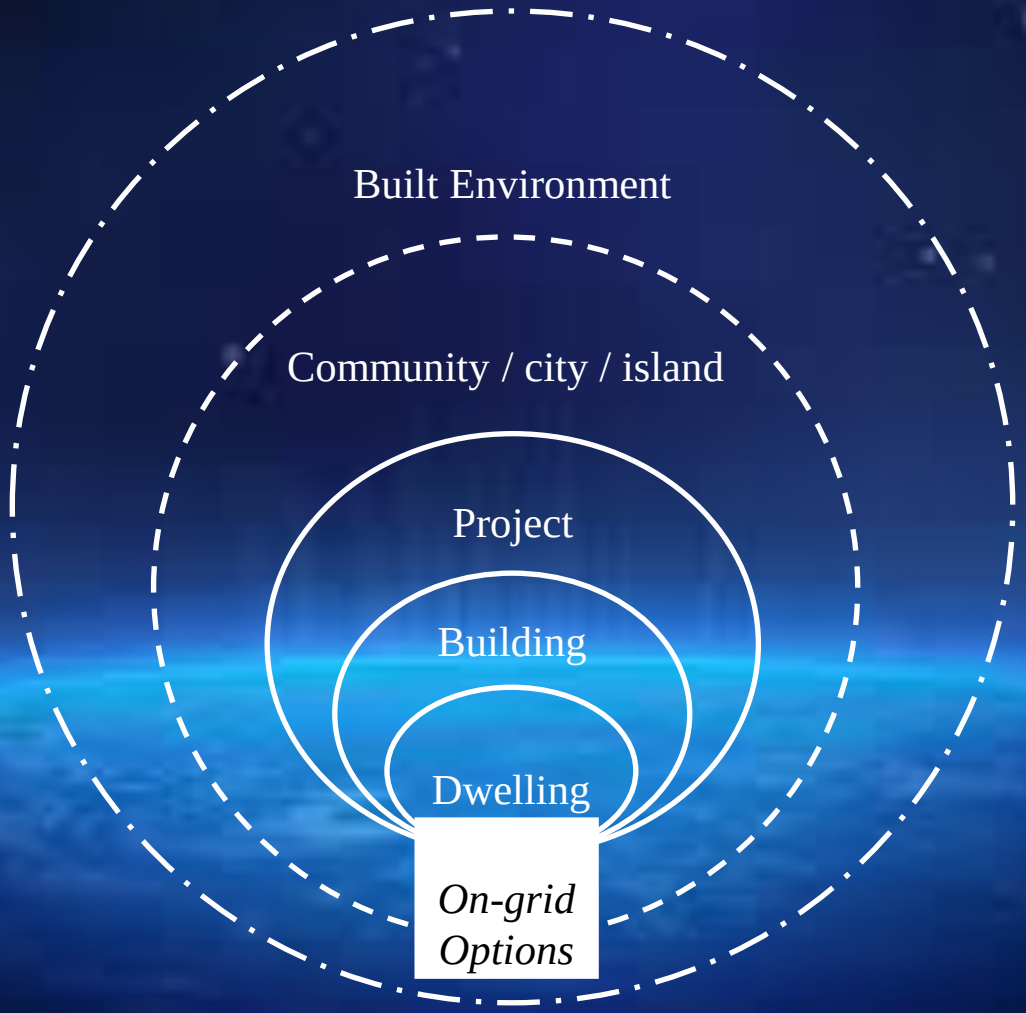
1	A Hong Kong's zero carbon building definition and design strategies	A publication
2	Zero carbon building scenarios and normative design solutions	Guidance and standards
3	Feasibility indices of delivering buildings in Hong Kong towards zero carbon	Report and technology roadmap and database
4	A systems feasibility model for zero carbon building in Hong Kong	A computer software program

Zero Carbon Building as a Socio-technical System



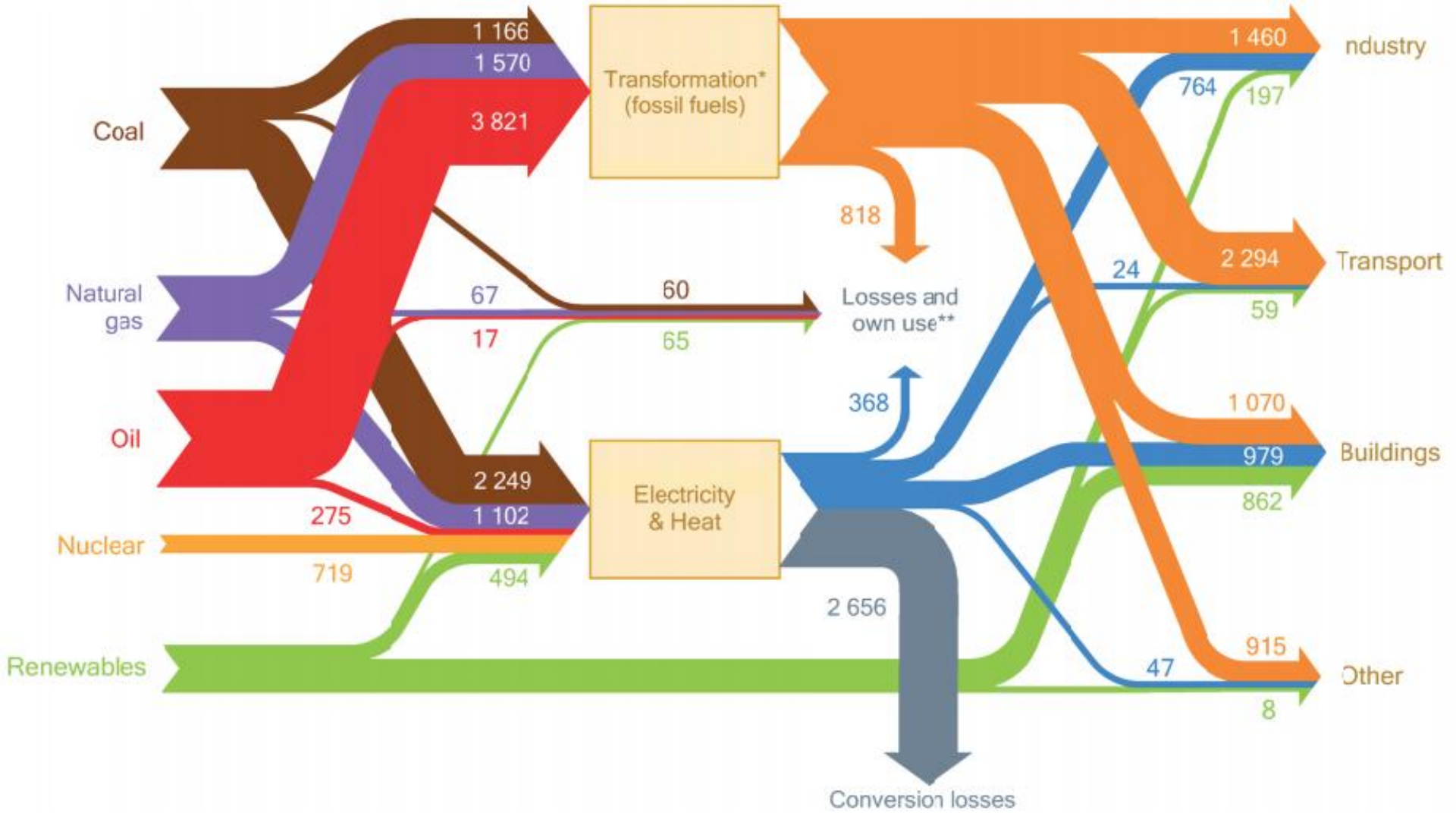
Pan and Ning (2014)

Geographic Boundary



Pan (2014)

Global Energy Flows (2010) (Mtoe)

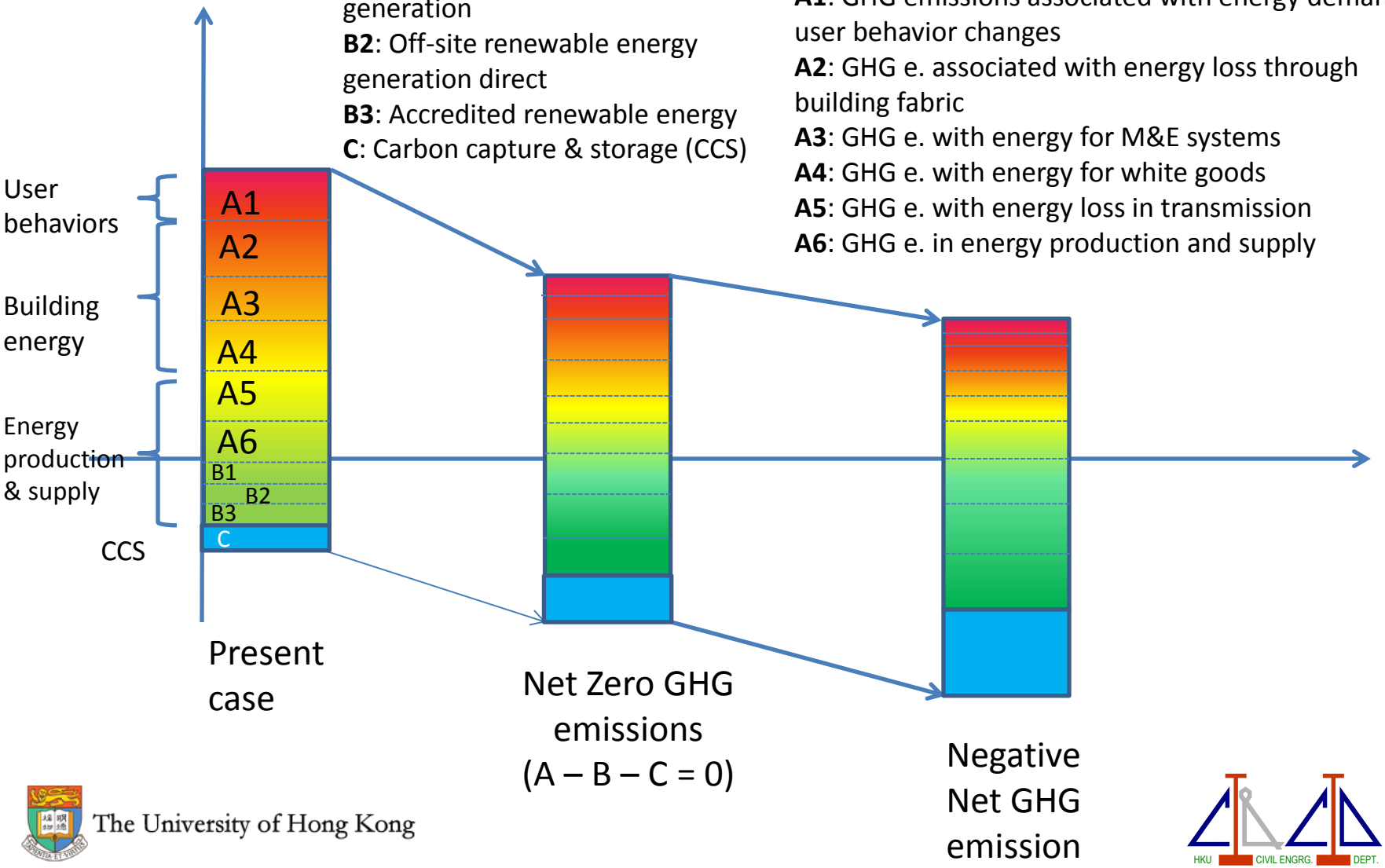


'World Energy Outlook 2012' by OECD/IEA

Ten Elements of Zero Carbon Model

To increase B & C:
B1: On-site renewable energy generation
B2: Off-site renewable energy generation direct
B3: Accredited renewable energy
C: Carbon capture & storage (CCS)

To reduce A:
A1: GHG emissions associated with energy demand by user behavior changes
A2: GHG e. associated with energy loss through building fabric
A3: GHG e. with energy for M&E systems
A4: GHG e. with energy for white goods
A5: GHG e. with energy loss in transmission
A6: GHG e. in energy production and supply



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Definition and Design Strategies

Energy scope:
- 10 elements --->

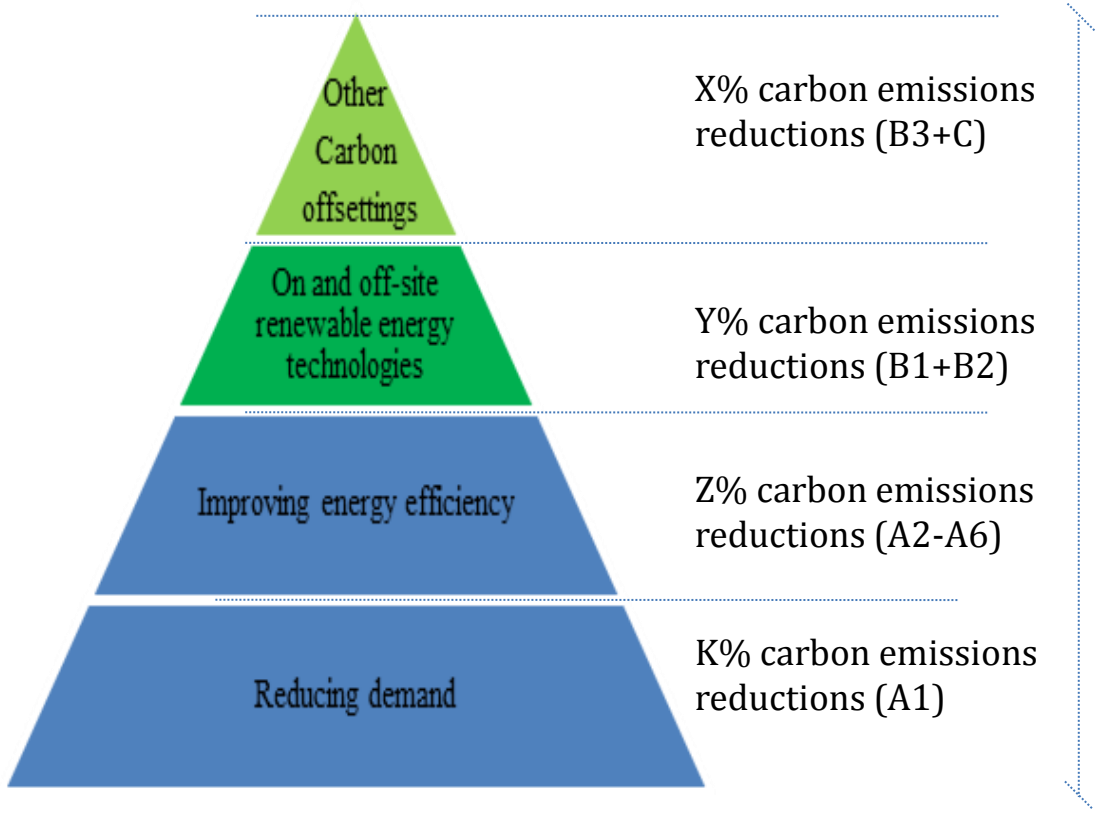
Unit of balance:
- End-use / delivered / primary energy

Indicators:
- kWh/m2/yr,
- carbon emissions: kgCO2/m2/yr

Period of balance:
- Annually

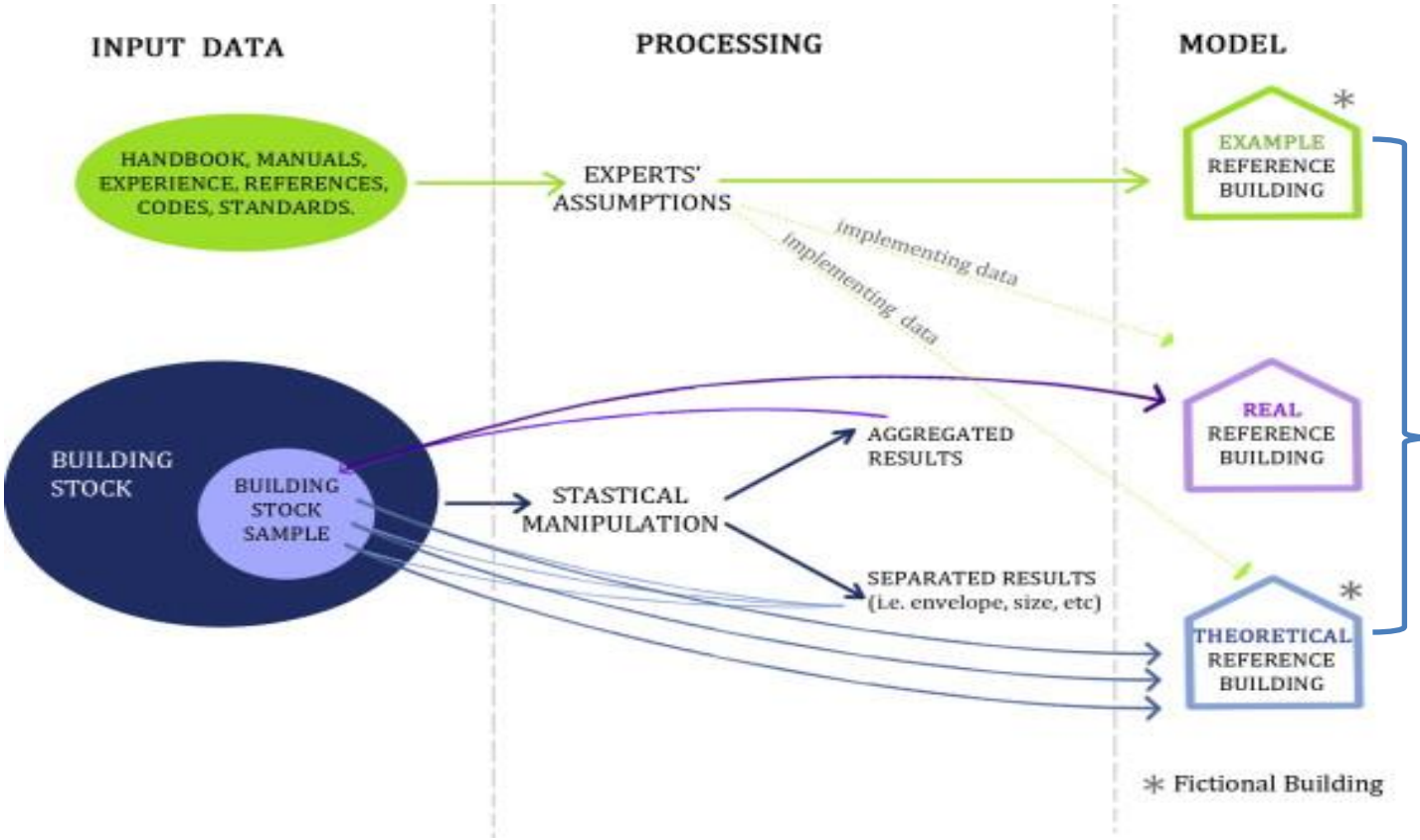
Renewable energy:
- Contribution of renewable energy

Connection with grid:
- Yes/no?



Towards net-zero carbon emissions during a typical operational year of the building within its regulatory, social and geographic contexts through the integrative use of appropriate socio-technical solutions?

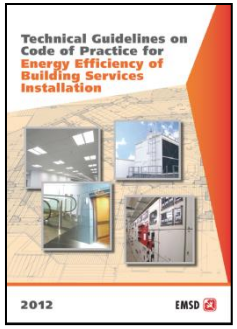
Methodology for Establishing Reference Building Models



Hong Kong Housing Authority

Yau Lee Group

HKGBC 香港綠色建築議會



Corgnati et al. (2013)

Scenarios and Normative Design Solutions






Revit Standard BIM Model

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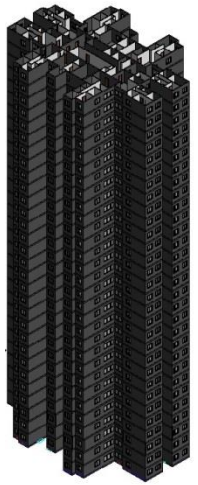
Revit Analytical Model

↓

gbXML Data

↓

DesignBuilder/
OpenStudio Model



Publish Housing

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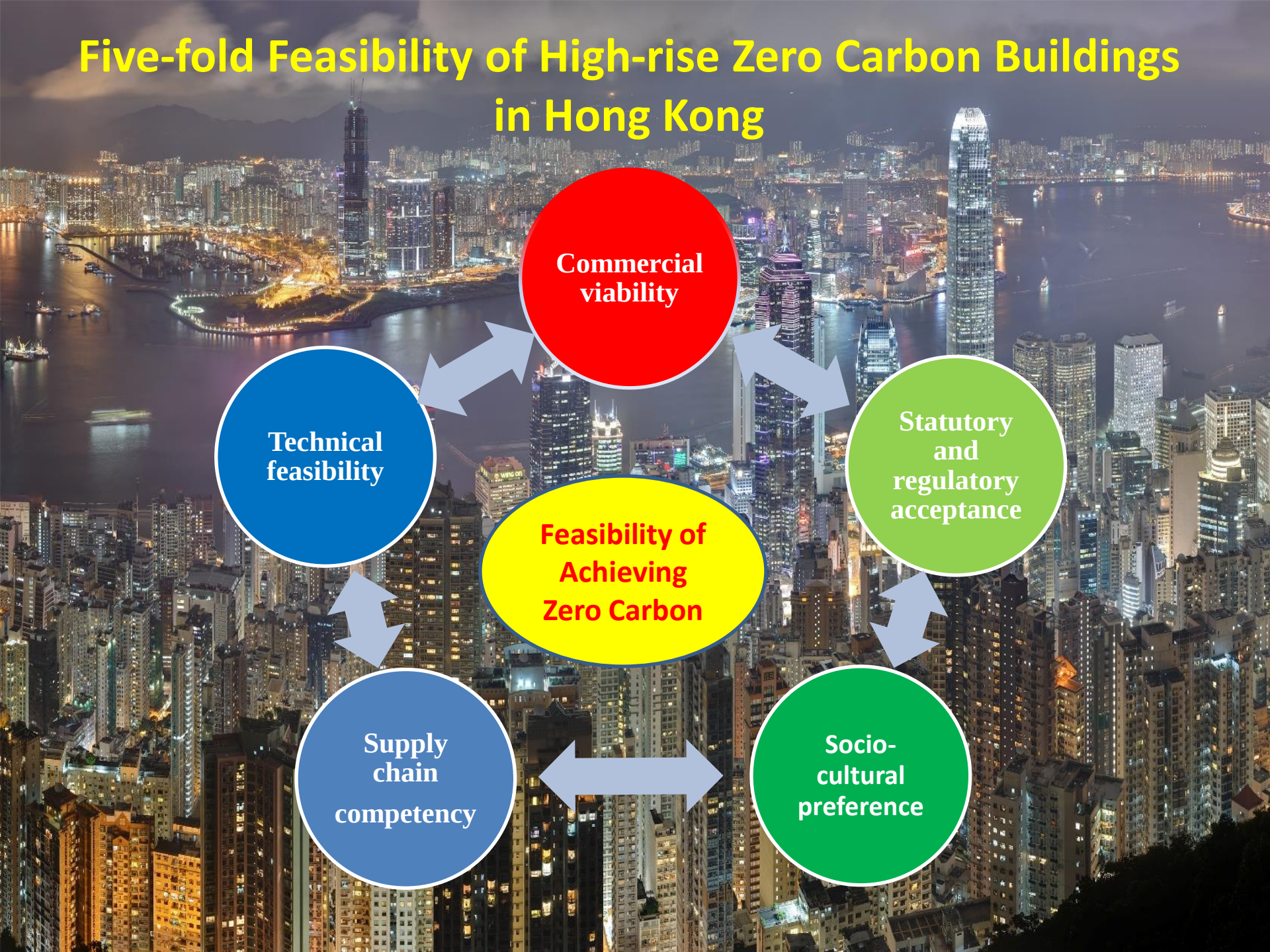
Private Office

Five-fold Feasibility of High-rise Zero Carbon Buildings in Hong Kong



Hong Kong Zero Carbon Building Partnership

for Enhancing Public and Stakeholder Engagement

Launch Event

@ZCB, 6 January 2015

Co-organised by:
Construction Industry Council (CIC)
&
Centre for Innovation in Construction and Infrastructure Development (CICID)
The University of Hong Kong

Supporting Organisations:

Hong Kong ZCB Partnership

- CIC-funded (24 months)
- Formal launch @ZCB on Tuesday 6 Jan. 2015
- Project team and collaborators
- Participation is invited
  - Organisations & individuals
  - Contact: Dr Wei Pan wpan@hku.hk, 2859 2671

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Hong Kong Housing Authority

BUILDING JOURNAL HONG KONG • CHINA

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Hong Kong ZCB Partnership

- **Expected project outcomes:**
  - Hong Kong Zero Carbon Building Partnership
  - Hong Kong Zero Carbon Building Portal
  - Database of real-time measurement and monitoring of HK public and stakeholders understanding, attitude and behaviour regarding ZCB
  - Project reports, workshop & seminar proceedings, and booklets

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