Energy Benchmarking Tool for Low-Carbon Transformation in Hong Kong: A Scientific Approach and Its Practical Applications

Dr Benny CHOW

Director cum

Chairman of the Industry Standards and Practices Committee cum

Chairman of the HK BEST Steering Committee

Hong Kong Green Building Council

WORLD Sustainable Built Environment Conference 2017 HONG KONG

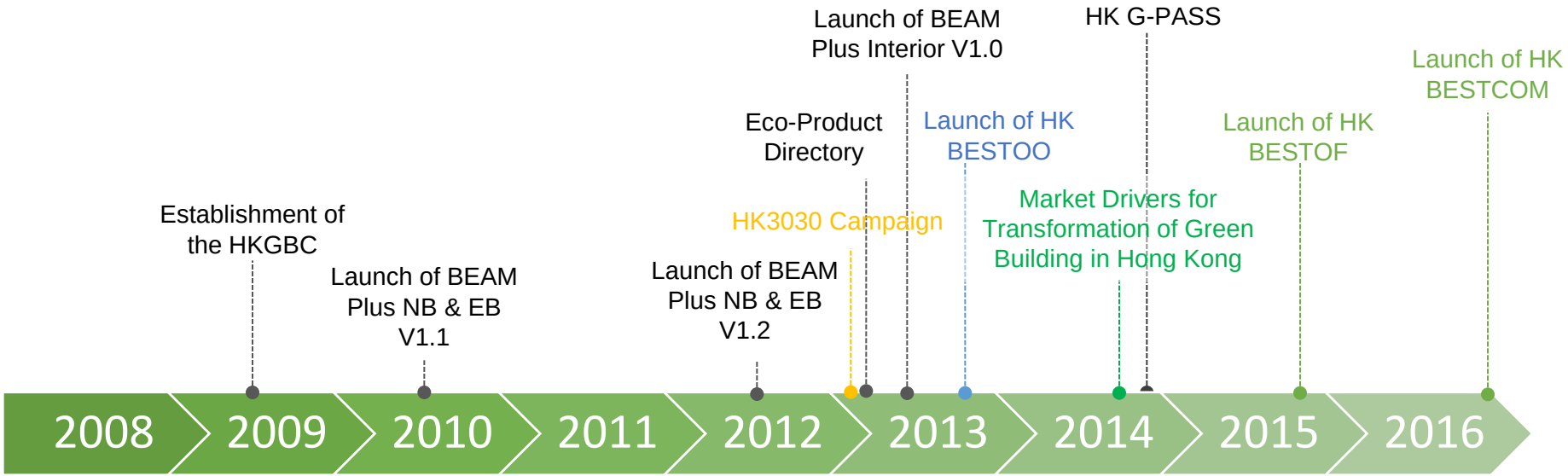
Organisers: CONSTRUCTION INDUSTRY COUNCIL 建造業議會 HKGBC 香港綠色建築議會

International Co-owners: SBE SERIES iiSBE UNEP Sustainable Buildings and Climate Initiative FIDIC Global Alliance for Buildings and Construction

Hong Kong's Green and Energy Saving Initiatives

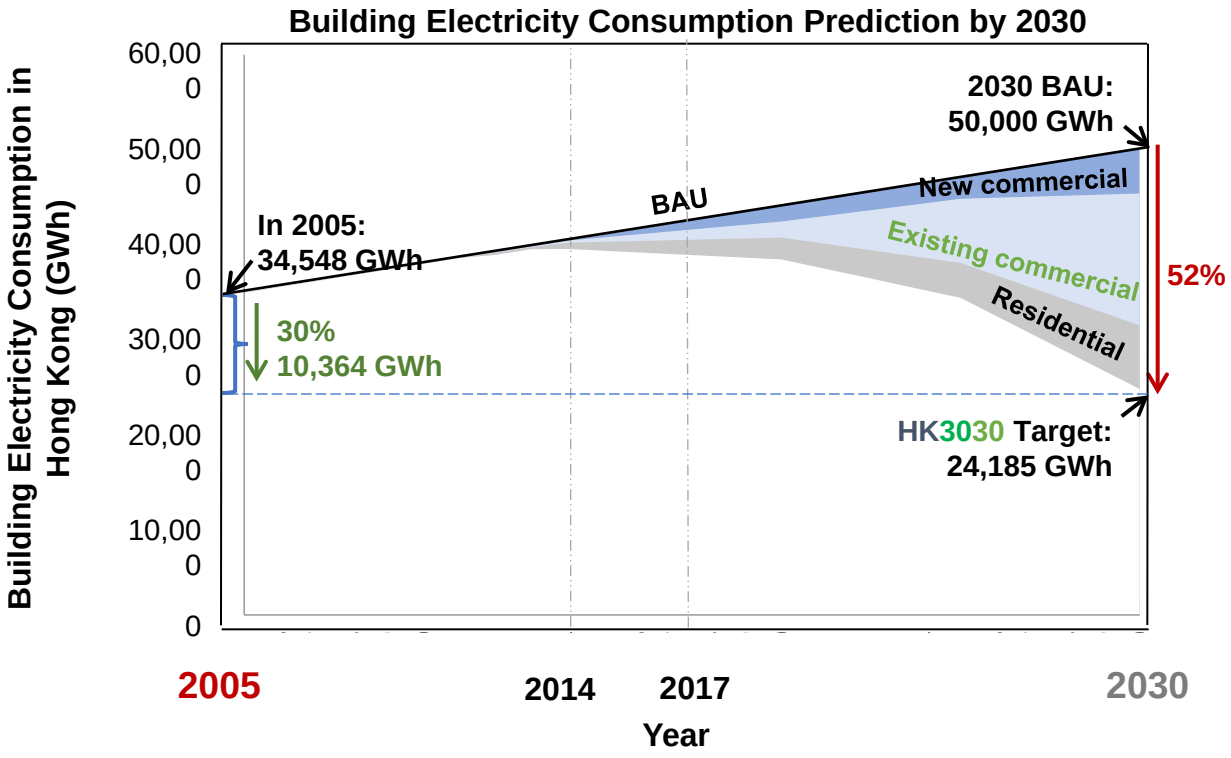
Environmental drivers

- BEAM Plus assessment systems (NB/EB/Interiors/Neighbourhood)
- HKGBC Benchmarking and Energy Saving Tool – Office Occupants (HK BESTOO)
- HKGBC Benchmarking and Energy Saving Tool – Office Buildings (HK BESTOF)
- HKGBC Benchmarking and Energy Saving Tool – Commercial Buildings (Office/Retail) (HK BESTCOM)
- Eco-Product Directory
- HKGBC Green Product Accreditation and Standards (HK G-PASS)
- HK3030 Campaign
- Market Drivers for Transformation of Green Buildings in Hong Kong



HKGBC HK3030 Campaign

- HK3030 Campaign aims to enable a **reduction of 30%** to the absolute building electricity consumption by 2030, as **compared to the level of 2005**.



Key Facts:

Buildings take up over **90% of electricity** consumption in Hong Kong

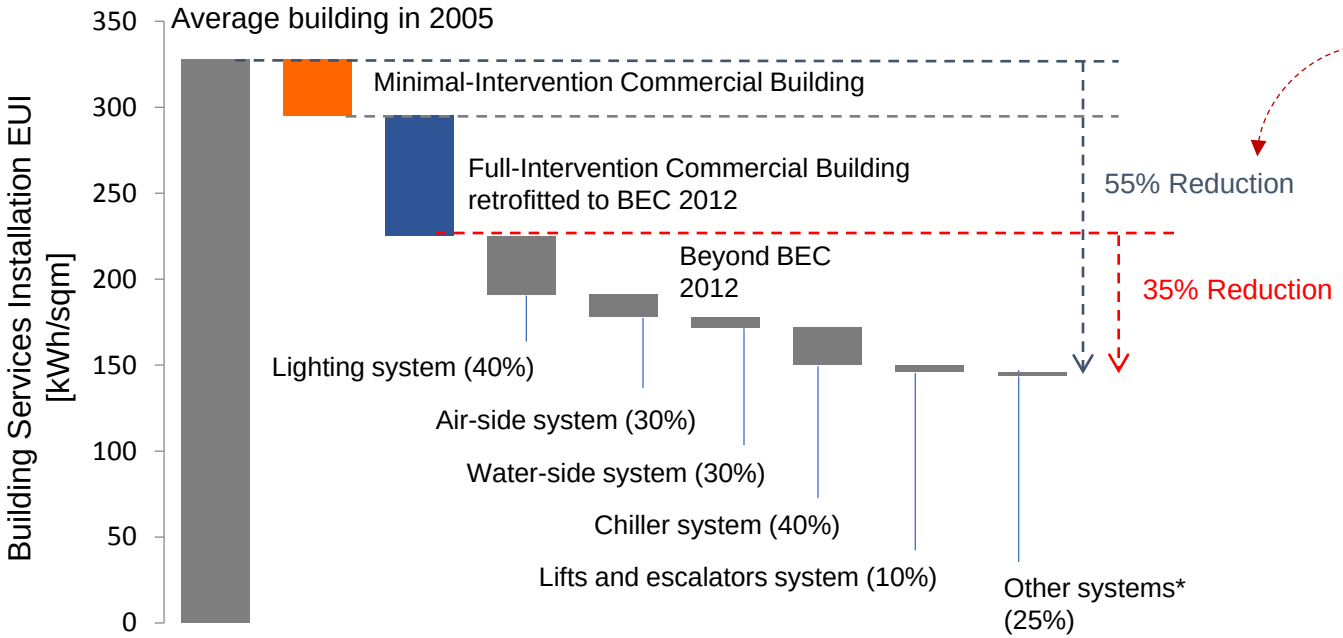
Account for more than **60% of greenhouse gases emission**

The HKGBC was **established in 2009** to lead the market transformation to a sustainable building environment

Opportunities for Existing Buildings (EB)

- About **58% of building electricity demand** in the year 2030 will come from existing commercial buildings
- On average, these buildings will need to **reduce energy use intensity by 55%**, as compared to the intensity level of an average commercial building in 2005.

Reporting → **Benchmarking** → **Retro-commissioning** → **Retrofitting**



Remark: Bracketed percentage refers to increase in efficiency to that specific system through equipment specifications and enhanced controls/operation

*Other systems include: Centralised hot water, Pumping, Mechanical ventilation, etc.

Energy Utilisation Index(EUI) doesn't tell the whole story…

A building's energy efficiency can be related to many building characteristics / constraints:

Service provision
- 24-hour A/C
- F&B
- Convention Centre
- Common Area

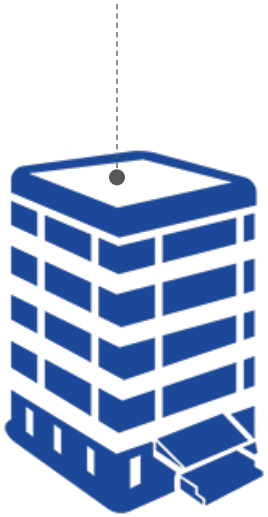
Building Services Installations

Operation Hours

Occupancy Rate

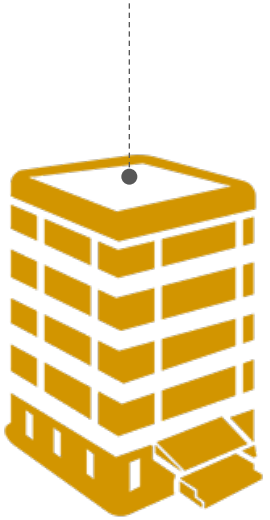
Building A: EUI: 500 MJ/m^2/annum

Facilities: Grade A Office, F&B, 24-hour A/C
Occupancy Rate: 70%



Building B: EUI: 400 MJ/m^2/annum

Facilities: Typical Grade B Office
Occupancy Rate: 60%



Which building is more energy efficient?

Benefit of Energy Benchmarking

Benchmarking brings the answers to following high-level questions:

i) Where is each building positioned in the market in terms of its energy use?

ii) What is the potential of energy saving for the whole building sector of similar buildings?

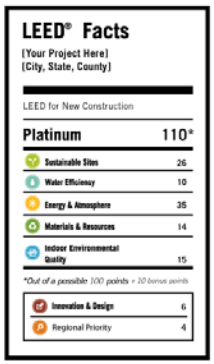
iii) How is performance of the local market compared to the rest of the world?

Note: numbers for illustration purpose, not actual EUI value

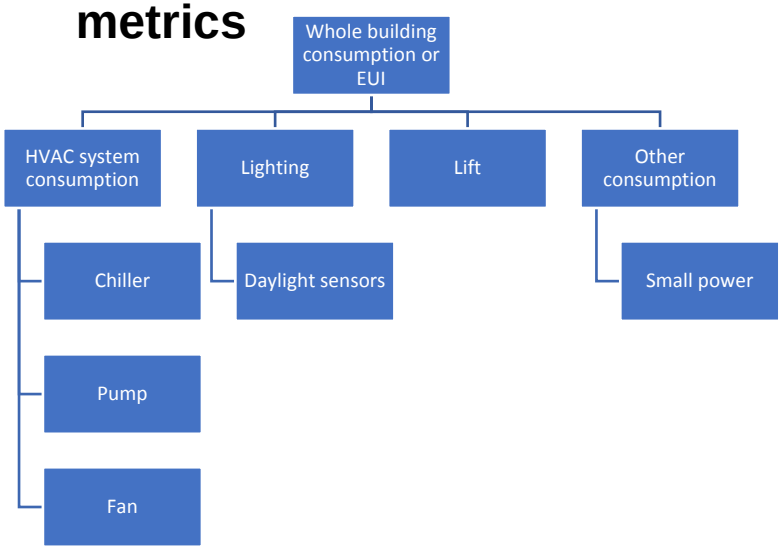
State-of-the-art Methods and Existing Rating Programs Worldwide

Point-based Rating System (e.g. BEAM Plus, LEED)

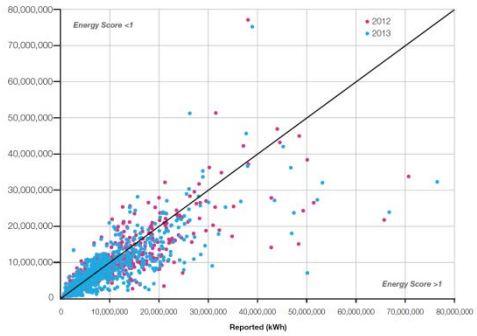
HKGBC BEAM Plus 綠建環評



Hierarchal and End-use metrics

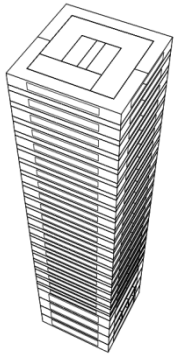


Statistical Approach (Regression)



More suitable for Hong Kong's unique building context!

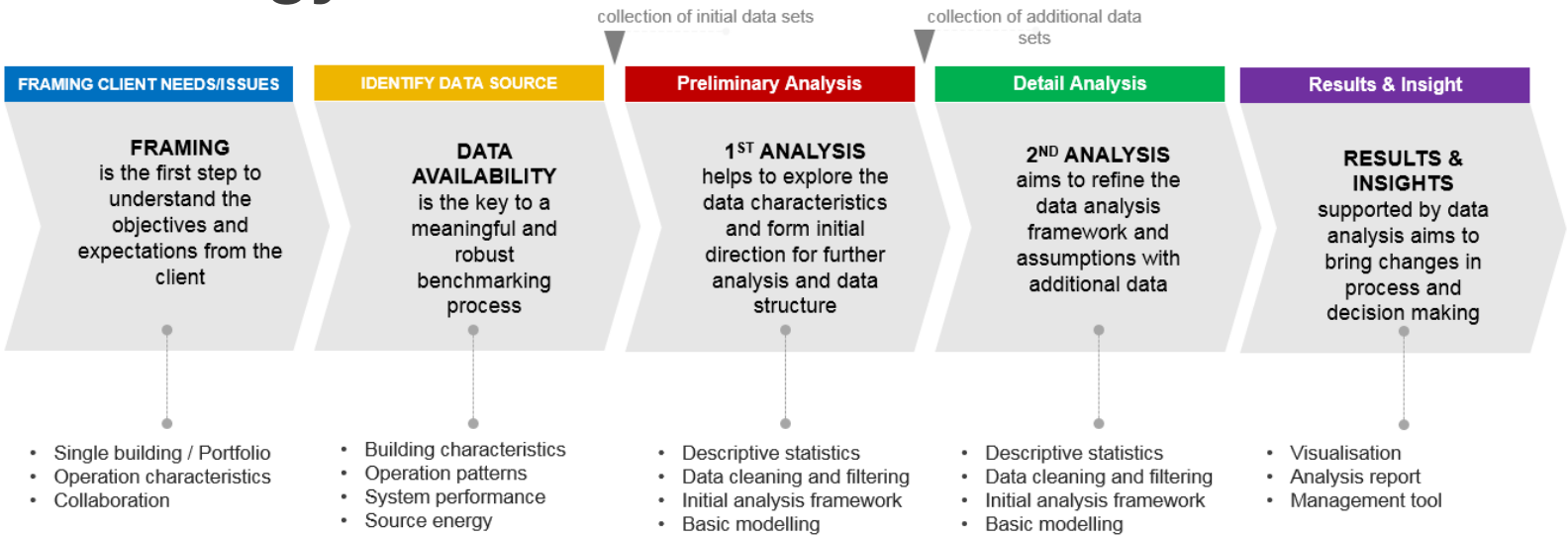
Simulation Model-based Approach



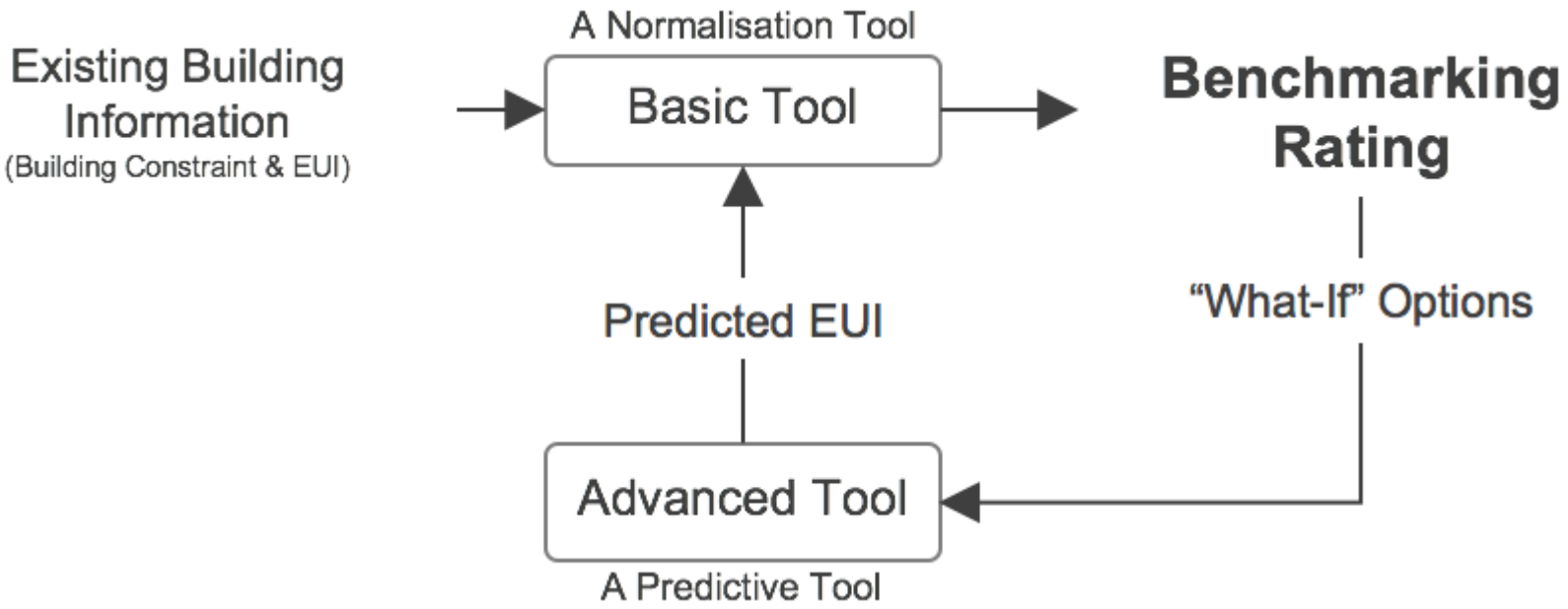
Challenges

- Large no. of mixed-used buildings (e.g. Commercial & Retail, Headquarters)
- Variation in operations patterns (e.g. building w/ 24-hour A/C)
- Data quality (e.g. lack of sub-metering for older buildings)

Methodology



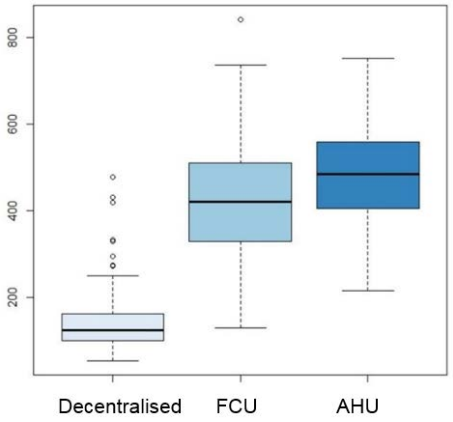
The Benchmarking Tool



Development Process

Data Collection and Filters

Outliers, wrong inputs, missing data



Categorisation

AHU, FCU and Decentralised

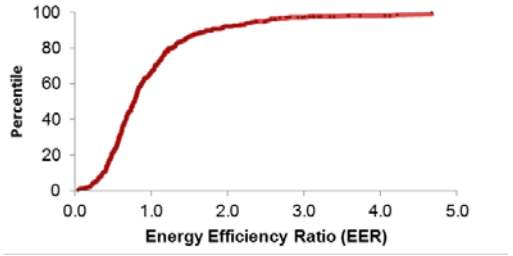
Regression Analysis

Parameter correlation, transformation (e.g. natural log), sensitivity test

Rating System Development

Rating based on normalised EUI

EER=Measured EUI/normalised EUI



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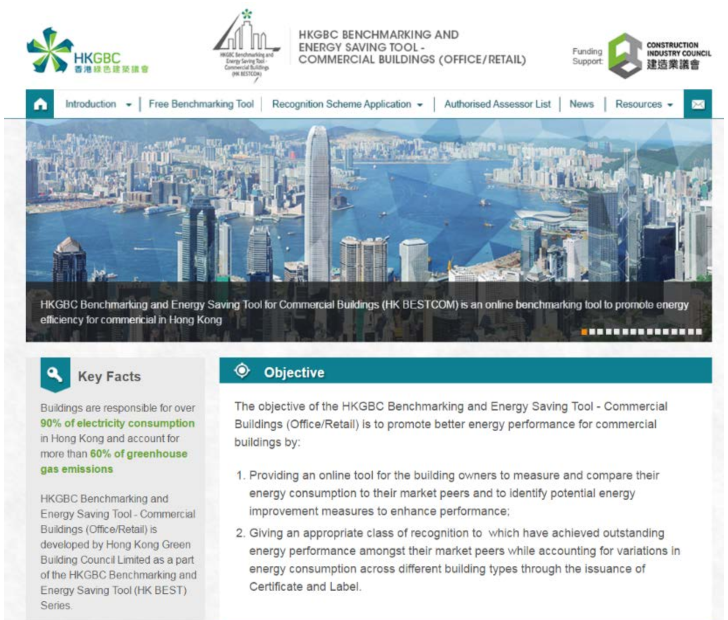
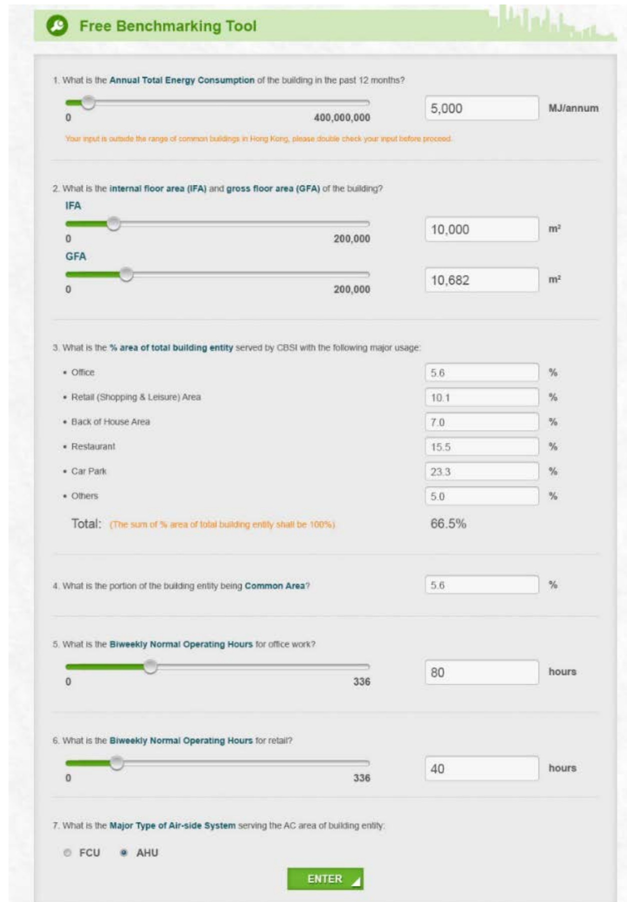
Simulations for "What-If" Function Development

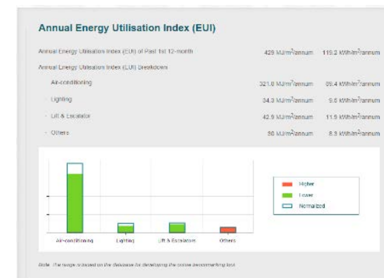
Matrix formed by simulations results for key performance parameters (Chiller COP, chilled water loop, LPD etc.)

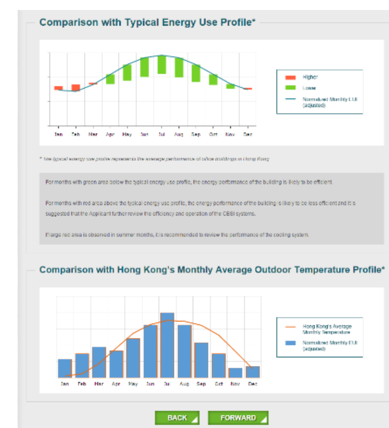
Online Platform





HKGBC Benchmarking and Energy Saving Tool (HK BEST)





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CIB

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UNEP Sustainable Buildings and Climate Initiative

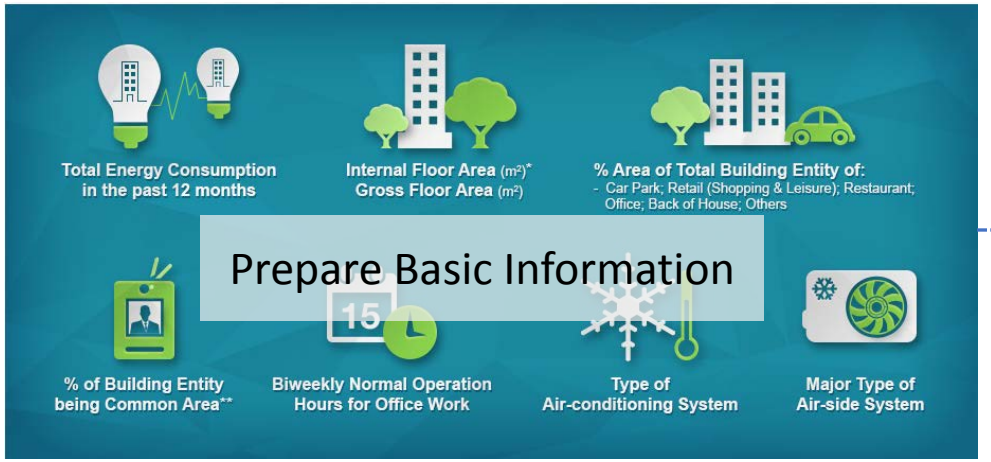
FIDIC

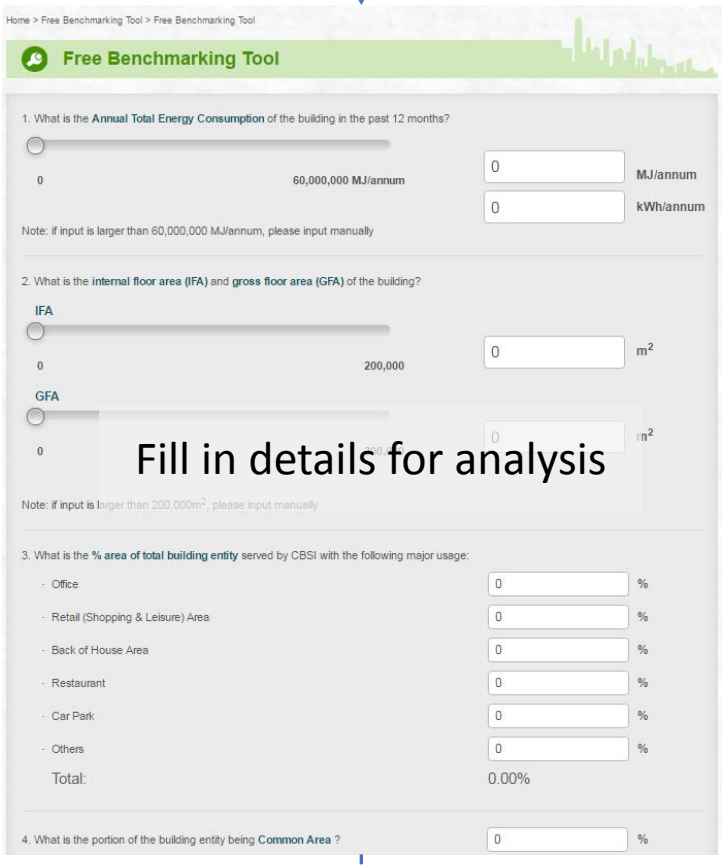
Global Alliance for Buildings and Construction

Becoming a HK BEST Authorised Assessor

BEAM Pro + Registered Energy Assessor + Training

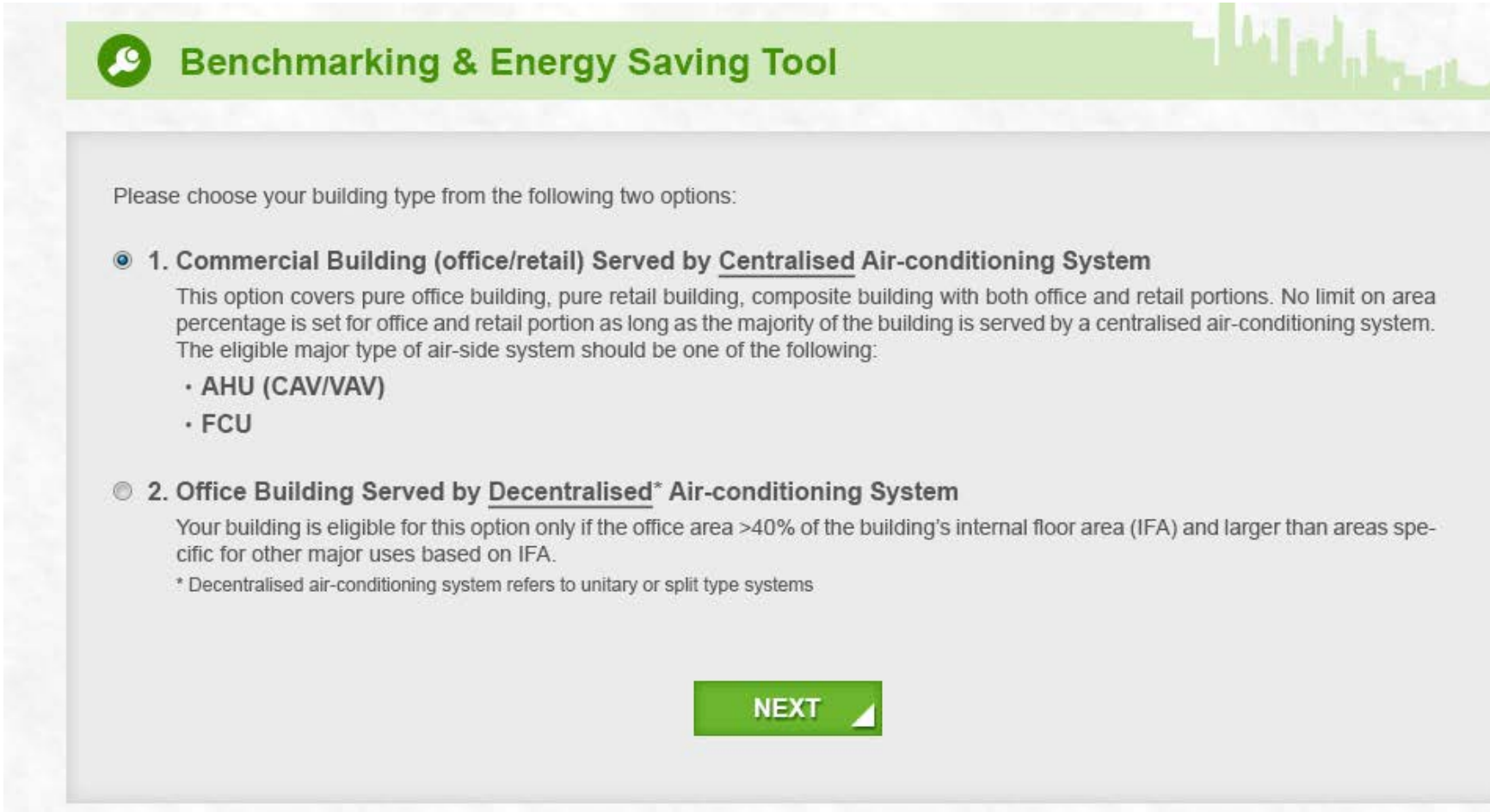
Free Benchmarking Tool





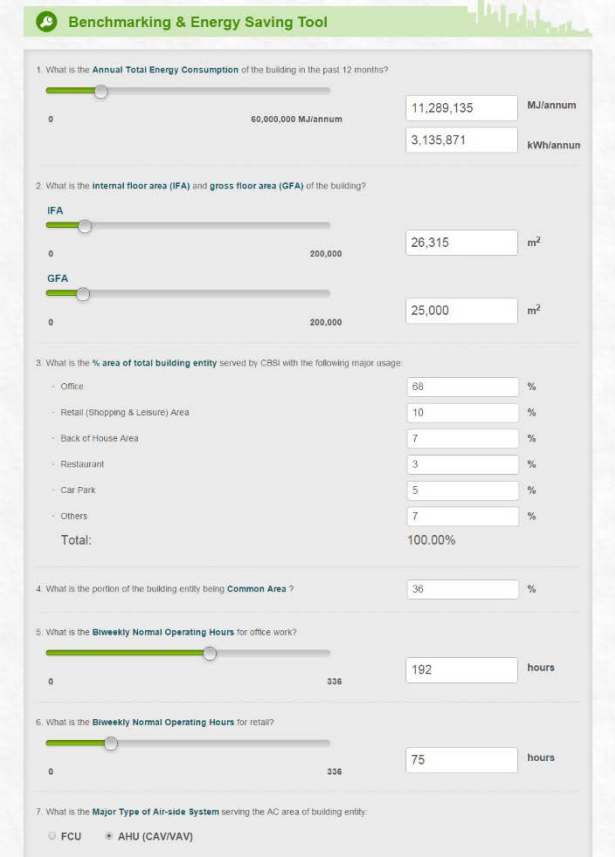
Recognition Scheme

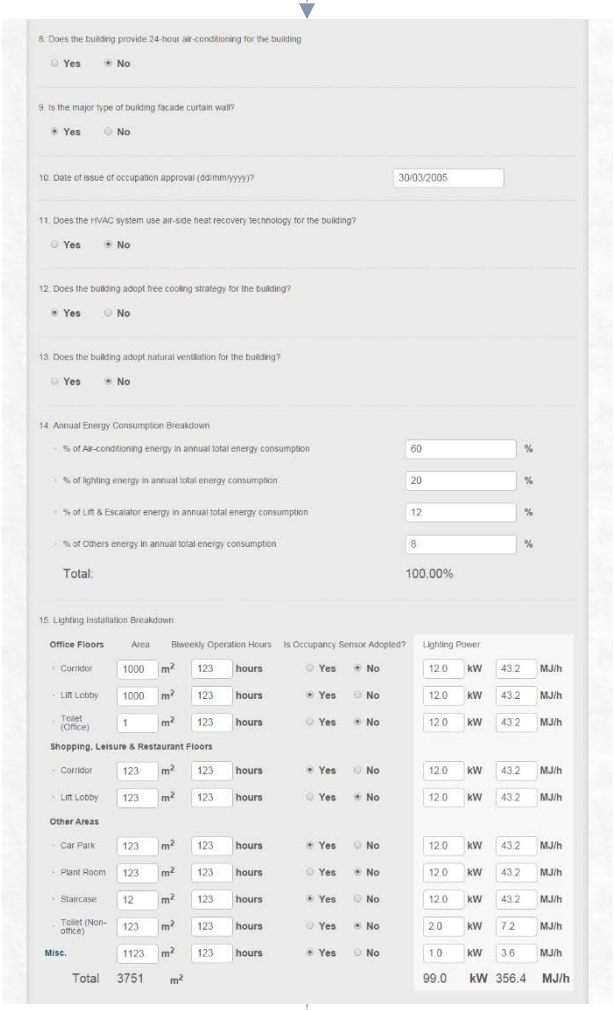
Select the Building Type

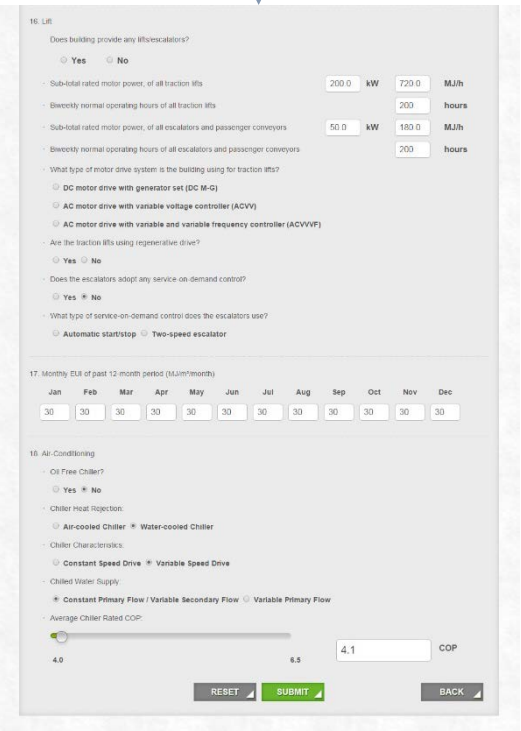


Recognition Scheme

Fill in the details

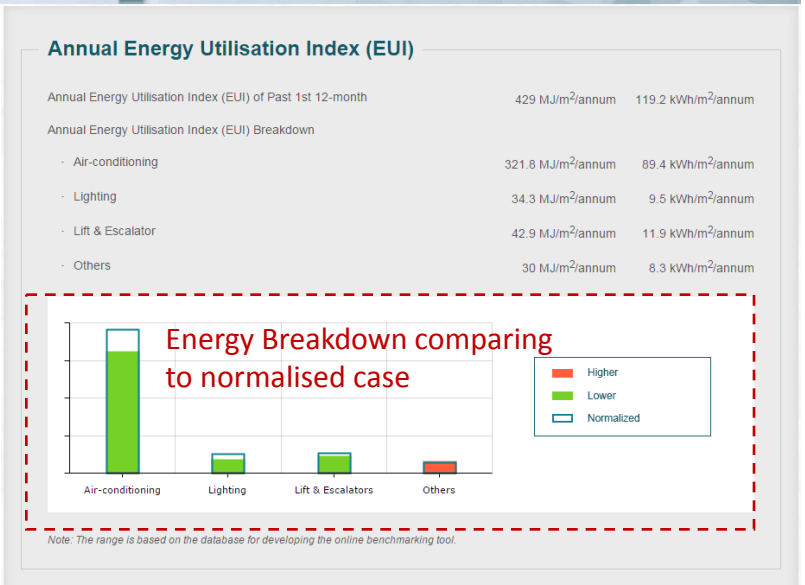


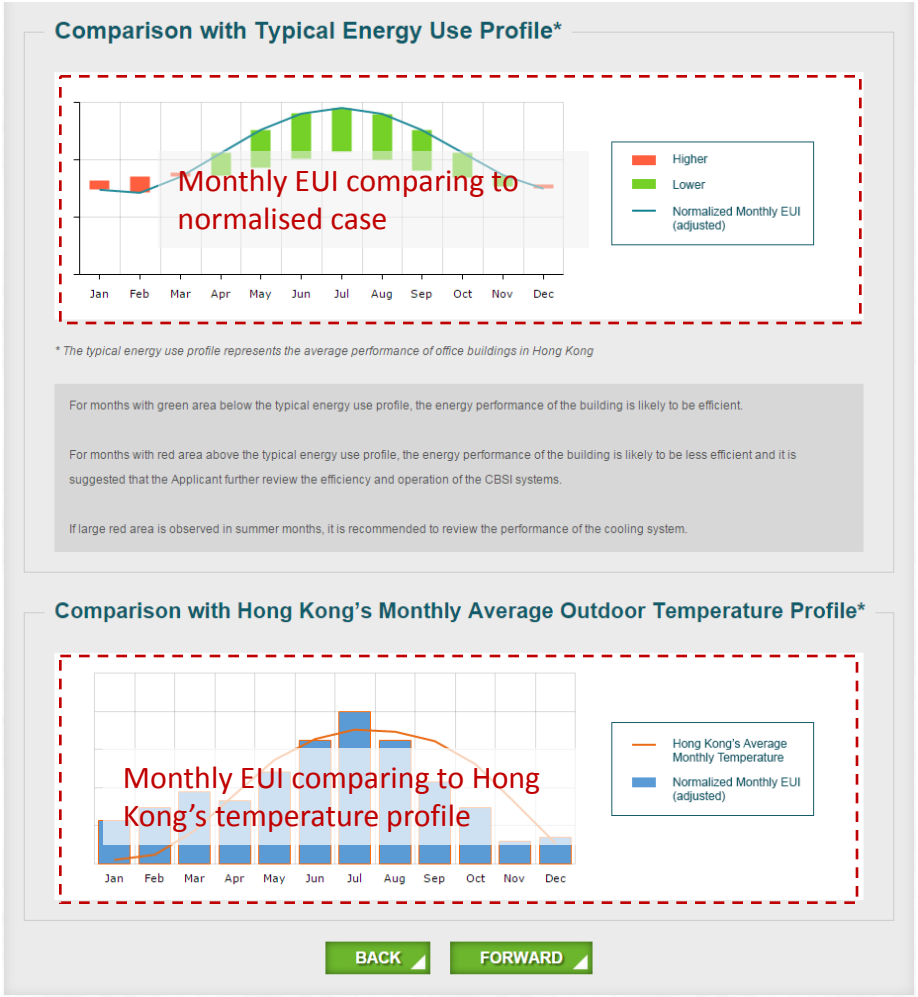




Recognition Scheme

Result page based on the current condition of the building





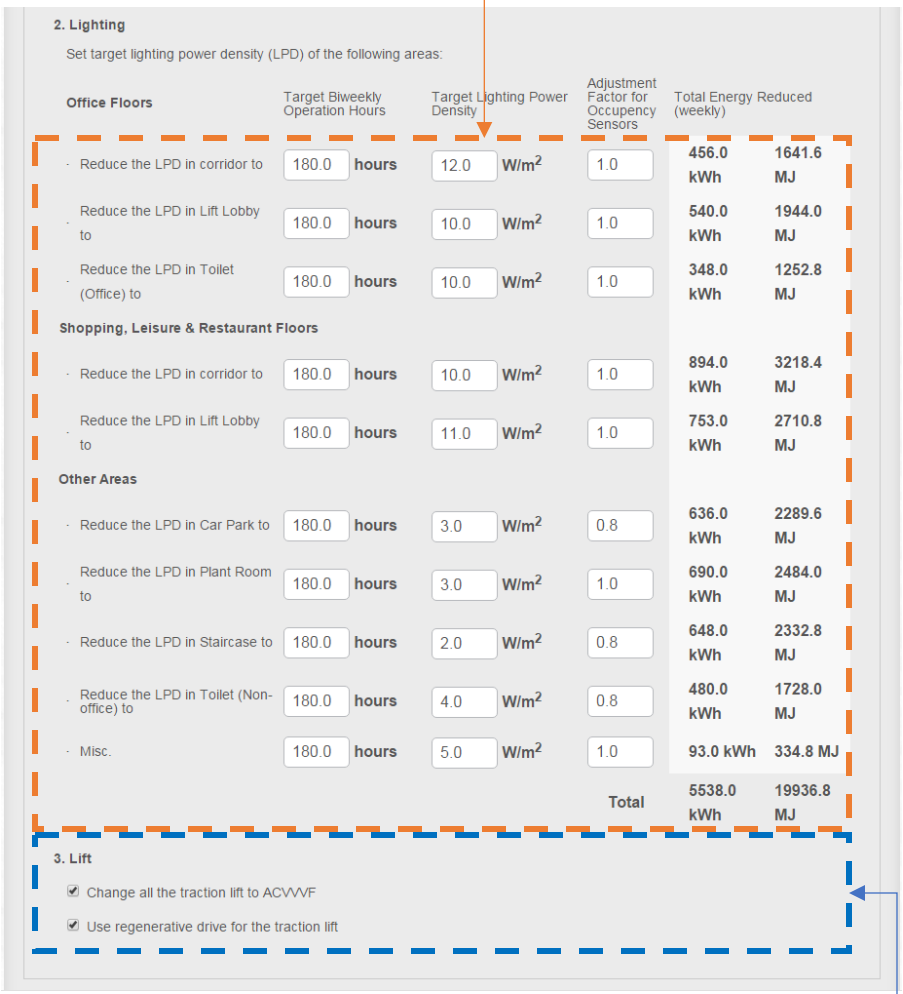
Recognition Scheme

Input for the "What-If" Function

More efficient system configuration

Based on the current system configuration, more efficient system configurations will be given for users to choose from.

The target operating hours, lighting power density (LPD) and adjustment factor for daylight sensor of a specific area.



User can choose more efficient systems for traction lifts

Recognition Scheme

"What-If" Function Result

After clicking the "Analyse" button, a potential rating will be given based on the selected improvement measures.

Certification

Calculated Percentile of Operational Energy Performance	Free Benchmarking Tool Rating	Certificate & Label Rating to be Obtained after the Verified Assessment
Reach Top 10th Percentile of range of data	Good	Platinum
Reach Top 20th Percentile of range of data		Gold
Reach Top 30th Percentile of range of data		Silver
Reach Top 40th Percentile of range of data	Average	Bronze
Reach Top 50th Percentile of range of data		Green
Below 50th Percentile of range of data	Below Average	No Rating

For more information…

- HKGBC Benchmarking and Energy Saving Tool – Commercial Buildings (Office/Retail) (HK BESTCOM)

http://hkbest.hkgbc.org.hk/com/index.html

- HKGBC Official Website

https://www.hkgbc.org.hk/eng/index.aspx

Acknowledgement

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CONSTRUCTION INDUSTRY COUNCIL 建造業議會

- Consultant Team

ARUP

Thank you