課程發展處 公民與社會發展科 教師專業發展課程
課程編號: CDI020240796
課程名稱: 邁向碳中和系列 (2): 通過綠色建築及低碳生活應對氣候變化

Green Buildings and Sustainable Built Development

Dr Benny CHOW
Hong Kong Green Building Council
Director of Sustainability at Aedas
(2023.11.21)

Search...

Font A A A | 繁體 简体

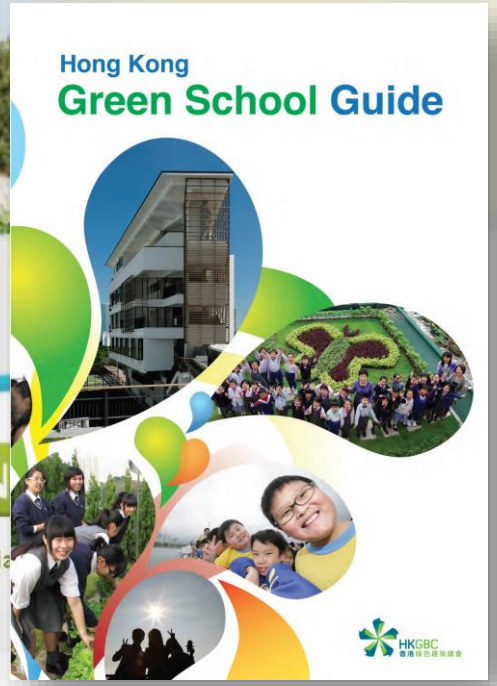
HKGBC 香港綠色建築議會

綠色空間

由我創造 MY Green space

MY GREEN SPACE

Student Competition 2022-2023



Latest News | About the Competition | Competition Schedule | Green Building Tour cum Training Workshop | Results Announcement | Albums | Video | Green Building Reference | Media

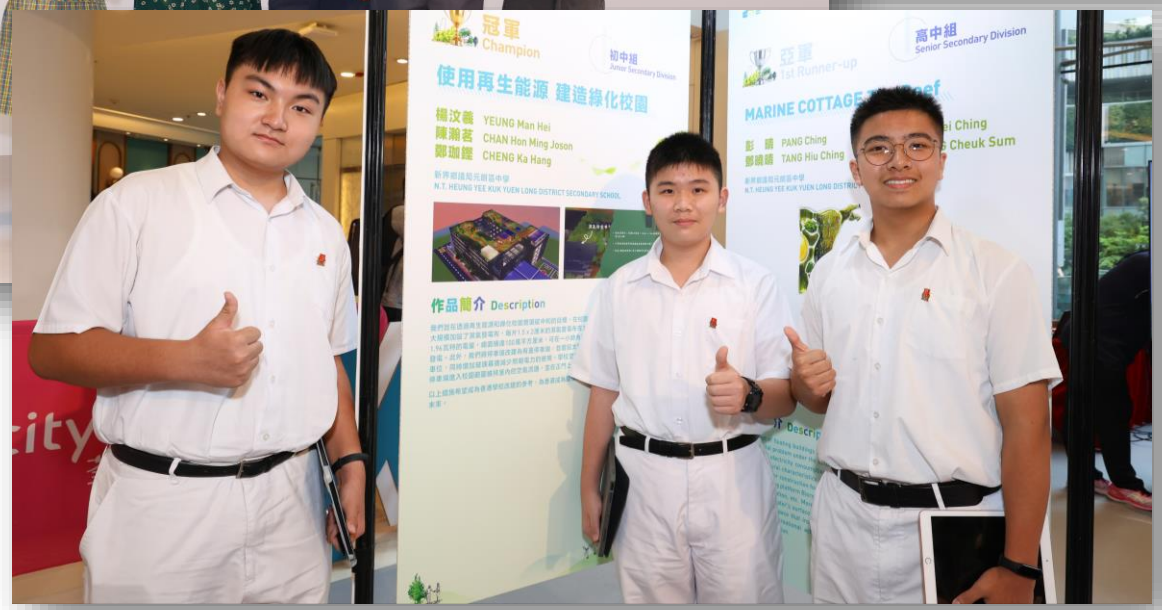
Tertiary Division Champion -


綠色空間
由我創造
MY Green space
主辦機構
HKGBC
香港綠色建築議會
獨家贊助
SINO GROUP
信和集團
綠色空間由我創造
學生比賽
2022-2023

綠色空間

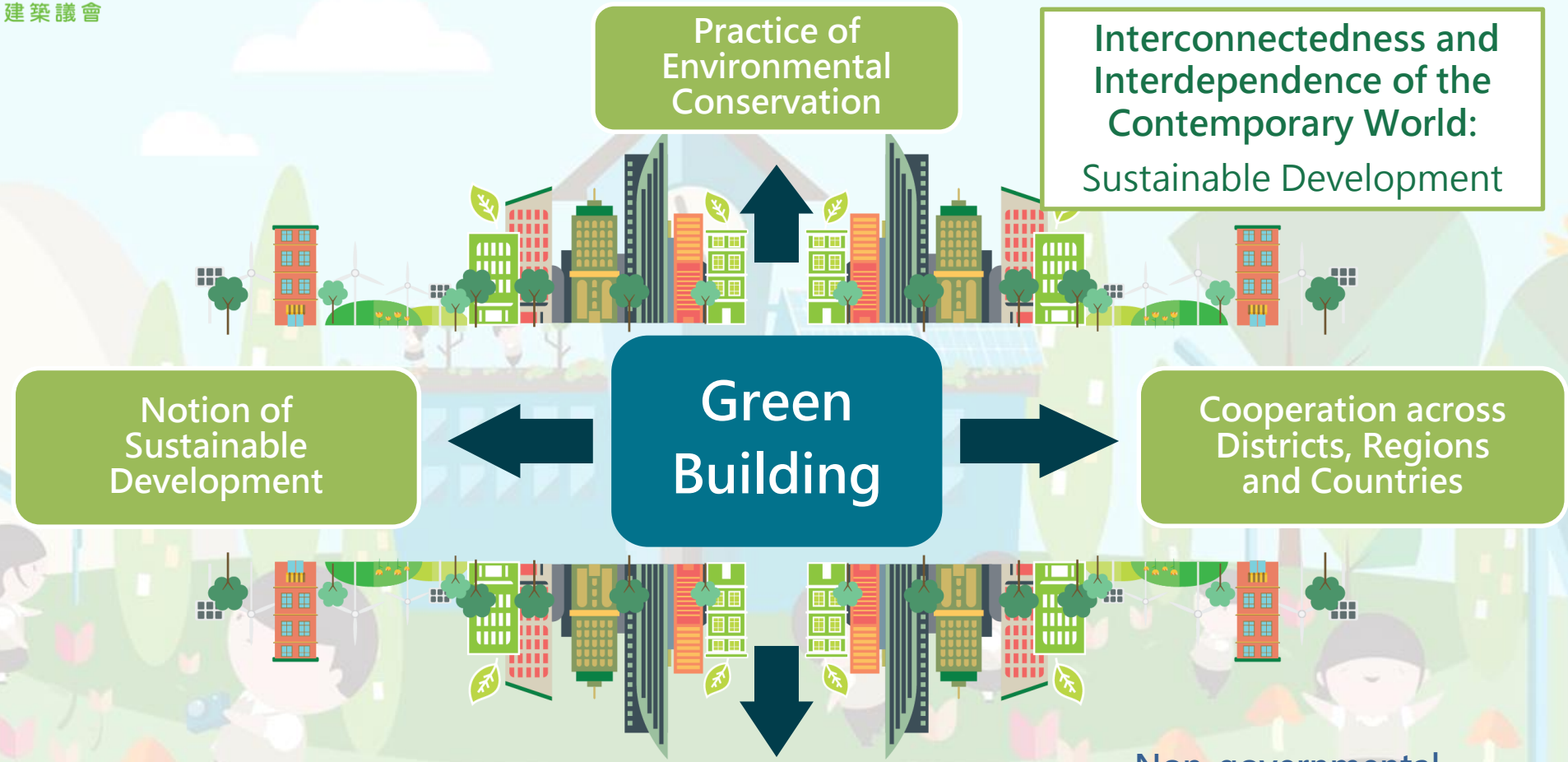
由我綠色空間創造

My Green Space




綠色空間
由我創造
MY Green space
FANCL
citywalk
荃新天地
PANDORA
皇玥
高小組得獎作品
HKGBC

Green Building and Citizenship and Social Development



https://www.edb.gov.hk/attachment/tc/curriculum-development/renewal/CS/CS_CAG_S4-6_Chi_2021.pdf

1 HKGBC's Climate Change Framework for Built Environment《建築環境氣候變化框架》Net-Zero Carbon Buildings

HKGBC
香港綠色建築議會

Climate Change Framework For Built Environment

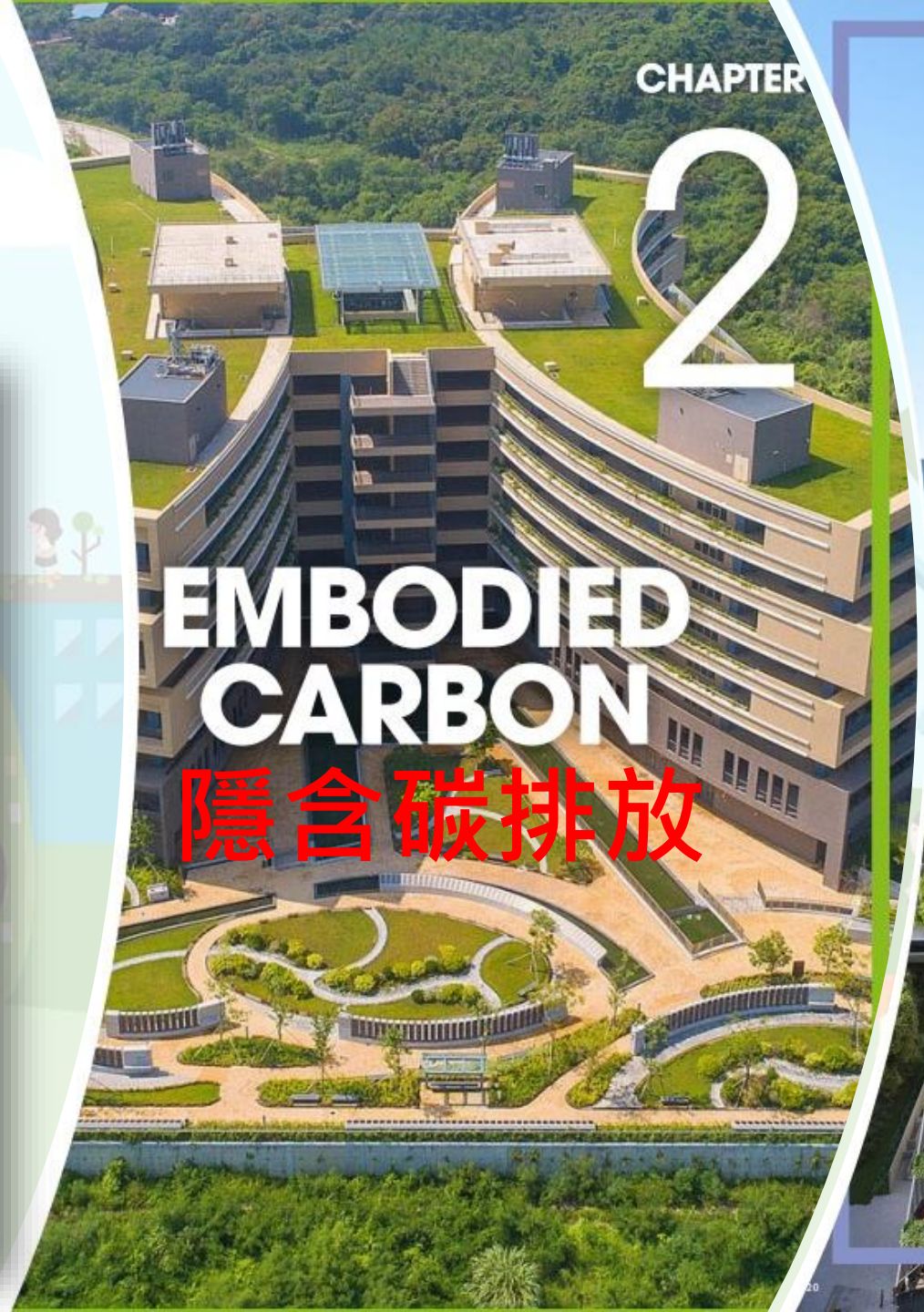
《建築環境氣候變化框架》

Download Link

HKGBC
香港綠色建築議會

Climate Change Framework for Built Environment

《建築環境氣候變化框架》



HKGBC
香港綠色建築議會

Climate Change Framework for Built Environment

《建築環境氣候變化框架》

CHAPTER 4

CLIMATE RISK ASSESSMENT & DISCLOSURE

氣候風險評估和披露

CHAPTER 5

ADAPTATION & RESILIENCE

適應和抵禦力

Role of Green Buildings in ESG Development

https://riskonnect.com/resources/esg-reporting/

Role of Green Buildings in ESG Development

環境、　　社會　　及企業治理

Environment, Social, and Governance Reporting

https://movingworlds.org/esg-reporting-guide

Role of Green Buildings in ESG Development

https://www.usgbc.org/resources/green-building-and-esg-what-you-need-know

2 What is Green Building?

What is Green Building?

Within the building life cycle, green buildings can **reduce impact to the environment** and **enhance the health and wellbeing of building occupants**.

The Concept of Green Building

- Save energy and water with efficient utilisation of resources to avoid profligacy
- Utilise renewable energy and eco-friendly construction materials to reduce carbon footprint and carbon emissions
- Reduce the production of waste and pollution of water, air, acoustics and land
- Achieve natural ventilation, lighting, enhancement of indoor air quality via building designs to provide better indoor environment for building occupants



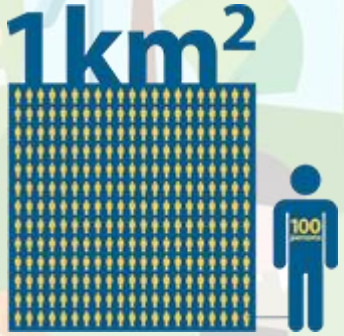
Hong Kong's Unique Built Environment

>42,000 buildings
in private sector

Our activities in buildings account for
90% electricity consumption or 60% greenhouse gas emissions

People live and work in
24% of HK's total area

About 12,188
high-rise buildings
and skyscrapers
(as of 31 Dec 2021)



Average population density of
built-up areas
28,000 persons/km²

Why Green Building?

Why do we build?

- Longer Asset Life
- Increase asset value
- Improve the Ability to Secure Finance
- Enhance Corporate Social Responsibility

Why do we choose?

- Enjoy Green Living
- Enhance Corporate Image
- Enhance Productivity
- Safeguard Health and Wellbeing

Developer / Owner

Reduce Life Cycle Cost

Building Users

Green Building Certification

Green building certification system is an independent tool to showcase and compare the environmental performance of buildings.

For example:

- BREEAM for United Kingdom , LEED for United States
- **"BEAM Plus" for Hong Kong**

➢Hong Kong Green Building Council: **Certification Body**

➢BEAM Society Limited: **Assessment Body**

BEAM Plus – a Holistic Assessment for Buildings

BEAM Plus is a **voluntary green building assessment scheme** developed locally for compact high-rise development in the subtropical region

6 *BEAM Plus Assessment Tools* 綠建環評

Masterplanning

BEAM Plus
Neighbourhood (ND)

社區

Building Design and Construction

BEAM Plus
New Buildings (NB)

新建建築

Post-Construction and Operation

BEAM Plus
Existing Buildings (EB)

既有建築

Fit-out

BEAM Plus
Interiors (BI)

室內建築

BEAM Plus
Data Centres

數據中心

BEAM Plus
Existing Schools

既有學校

Highest rating:

Assessment Aspects of BEAM Plus

綠建環評建築項目：

“更以人為本 + 整合的綠色建築設計”

1. 改善室內環境質素；
2. 令用家身心更健康，工作效率提升；
3. 減少對周遭環境的污染；
4. 具能源效益的樓宇、系統和設備，可再生能源；
5. 減少浪費食水、木材；
6. 發展更具成本效益且可持續的建築設計和建造流程；
7. 實行各種新措施以提升樓宇能源效益及環保表現。

Examples for BEAM Plus ***New Buildings*** (新建建築)

創新斗室|香港科學園

InnoCell Hong Kong Science Park

New Buildings V1.2, Final Platinum

RESIDENTIAL

戲曲中心|西九文化區

Xiqu Centre

New Buildings V1.2, Final Gold

GOVERNMENT, INSTITUTIONAL AND COMMUNITY

香港兒童醫院|啟德

Hong Kong Children's Hospital

New Buildings V1.2, Final Platinum

GOVERNMENT, INSTITUTIONAL AND COMMUNITY

Examples for BEAM Plus Existing Buildings (既有建築)

朗豪坊商場
Langham Place – Retail Tower

Existing Buildings V2.0, Final Platinum

COMMERCIAL

機電工程署總部大樓

Electrical and Mechanical Services Department Headquarters

Existing Buildings V1.2, Final Platinum

GOVERNMENT, INSTITUTIONAL AND COMMUNITY

EcoPark 環保園

Existing Buildings V2.0 (Selective Scheme)

Excellent

GOVERNMENT, INSTITUTIONAL AND COMMUNITY

Examples for BEAM Plus Neighbourhood（社區）

啟德體育園
Kai Tak Sports Park

Neighbourhood V1.0, Platinum

MIXED USE

元朗淨水設施
Yuen Long Effluent Polishing Plant

Neighbourhood V1.0, Platinum

MIXED USE

Examples for BEAM Plus Interiors（室內建築)

Construction Industry Council

Interiors V1.0, Platinum

OFFICE

The Building Information Centre at the New Headquarters of the Buildings Department

Interiors V1.0, Platinum

GOVERNMENT, INSTITUTIONAL AND COMMUNITY

Shell Siu Lam Station

Interiors V1.0, Final Gold

OTHER

3 What is a Green School?

HKGBC
香港綠色建築議會

What is a green school?

"A green school is about more than curriculum and more than bricks and mortar. It's a school where the community works together to support global sustainability and climate action. A green school prepares students to lead the world toward a healthier, cleaner, more sustainable future."

(Center for Green Schools, USGBC)

HKGBC
香港綠色建築議會

Three pillars of a green school

1. Reduce environmental impacts and costs.
2. Improve occupants' health and performance.
3. Effective sustainability education.

HKGBC
香港綠色建築議會

HKGBC
BEAM Plus
綠建環評

BEAM Plus Existing Schools
綠建環評既有學校

Sustainable Leadership and Learning (SLL)
可持續領導及學習

- High Level Commitment
  領導人員對實踐的承諾
- Environmental Learning
  環境學習
- Engagement
  參與/交流

Efficient Use of Resources (EUR)
有效資源運用

- Decarbonisation Actions
  減碳行動
- Benchmarking and Disclosure
  基準及披露

Sustainable Campus Environment (SCE)
可持續校園環境

- Biophilla
  親生物設計
- Neighbourhood Integration
  鄰里共融
- Climate resilience
  氣候抗禦力/復元力

Health, Comfort & Happiness (HCH)
健康，舒適，快樂

- Healthy Indoor Environment
  健康室內環境
- Healthy living
  健康生活
- Health Protection
  健康保障

Innovations and Additions (IA)
創新

- Innovations and Additions
  創新

GREEN
綠建學校

GREEN
綠建學校 ES 既有學校 V1.0 2023
HKGBC
BEAM Plus
綠建環評

Sustainable Leadership and Learning (SLL)
可持續領導及學習

Efficient Use of Resources (EUR)
有效資源運用

Sustainable Campus Environment (SCE)
可持續校園環境

Health, Comfort & Happiness (HCH)
健康，舒適，快樂

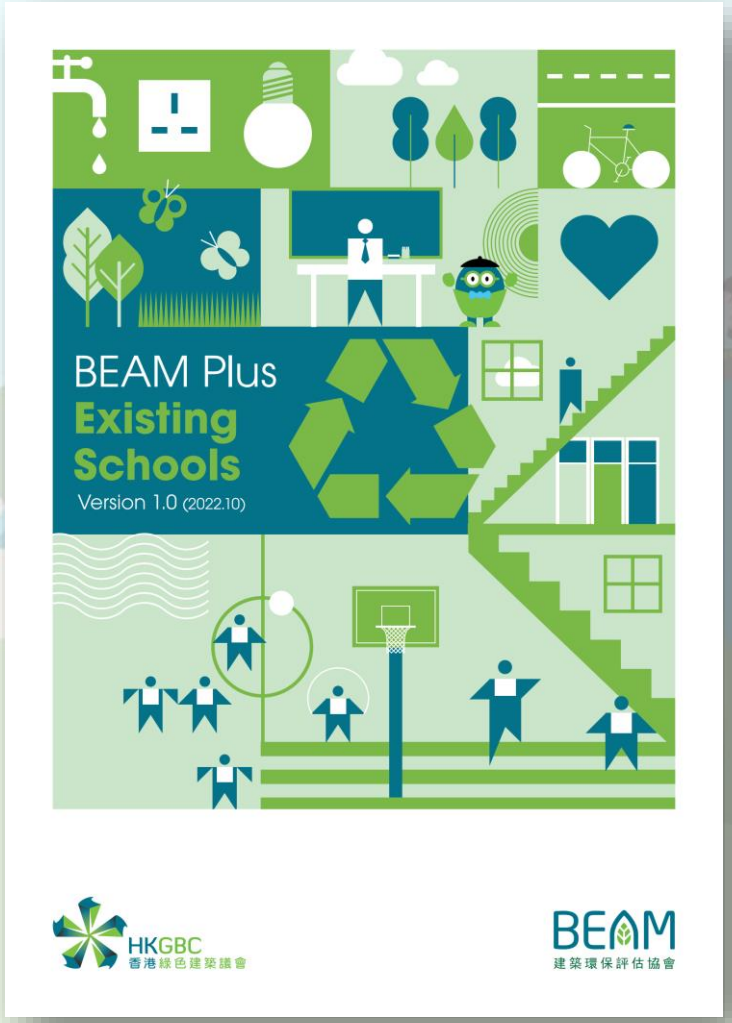
Assessment Criteria

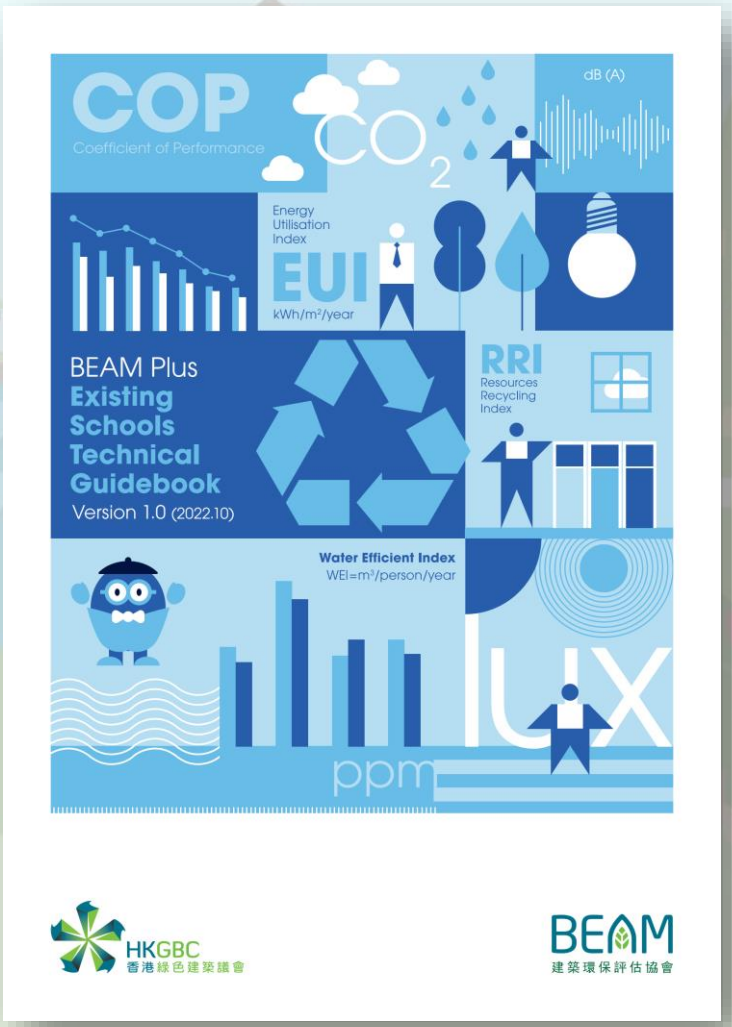
Performance Category	Performance Sub-Category	Credit Head Items		Credit Point(s)	
Sustainable Leadership and Learning (SLL)	High Level Commitment	SLL-01-01	Environmental Policy, Plan and Target	6	33
		SLL-01-02	Good Environmental Practices	15	
	Environmental Learning	SLL-02-01	Staff Awareness	1	
		SLL-02-02	Green Prefect	1	
		SLL-02-03	Extended Environmental Education	2	
		SLL-02-04	Other Learning Experiences	5	
	Engagement	SLL-03-01	Environmental Corner	2	
		SLL-03-02	Environmental Communication	1	
Efficient Use of Resources (EUR)	Decarbonisation Actions	EUR-01-01	Energy Efficient Equipment	5	36
		EUR-01-02	Energy Efficient Measures	6	
		EUR-01-03	Renewable Energy	2	
		EUR-01-04	Water Efficient Fixtures	4	
		EUR-01-05	Water Efficient Measures	5	
		EUR-01-06	Recycling Facilities	3	
	Benchmarking and Disclosure	EUR-02-01	School Environmental Performance	9	
		EUR-02-02	Carbon Audit	1	
		EUR-02-03	Data Disclosure	1	
Sustainable Campus Environment (SCE)	Biophilia	SCE-01-01	Campus Greening	5	15
		SCE-01-02	Agriculture Education	1	
	Neighbourhood Integration	SCE-02-01	Low Carbon Commuting	2	
		SCE-02-02	Neighbourhood Amenities	1	
		SCE-02-03	Shared-Use Facilities	1	
	Climate Resilience	SCE-03-01	Response to Extreme Weather	5	
Health, Comfort & Happiness (HCH)	Healthy Indoor Environment	HCH-01-01	Healthy Air	1	16
		HCH-01-02	Openable Windows	1	
		HCH-01-03	Illuminance Levels	1	
		HCH-01-04	Background Noise	1	
	Healthy Living	HCH-02-01	Drinking Water Quality	1	
		HCH-02-02	Healthy Lifestyle	6	
	Health Protection	HCH-03-01	Health Protection Measures	5	
Innovations and Additions	Innovations and Additions	IA-01-01	Innovations and Additions	10B	
Total Credit Points 100+ 10B					

綠建環評 既有學校

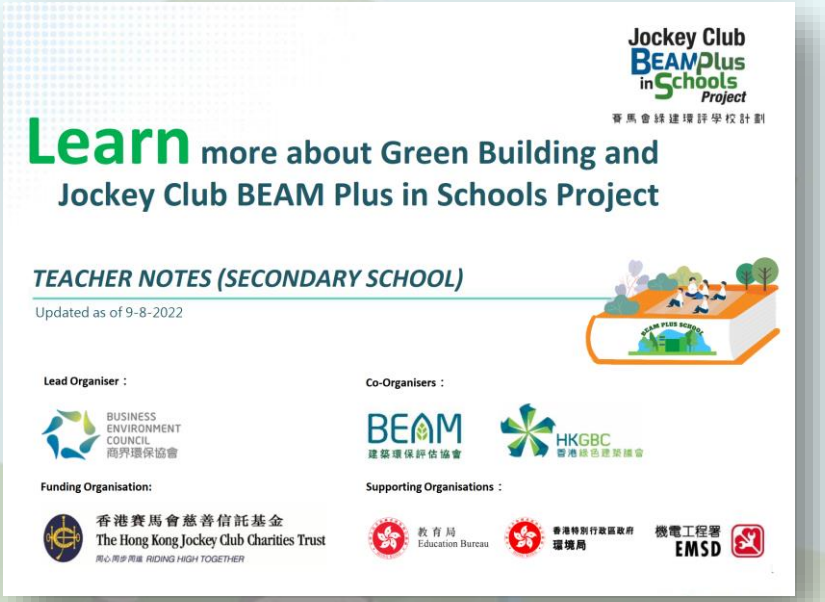
1. 可持續領導及學習 (SLL)
   (領導人員對實踐的承諾/環境學習)
2. 有效資源運用 (EUR)
   (減碳行動/基準及披露)
3. 可持續校園環境 (SCE)
   (親生物設計/鄰里共融)
4. 健康，舒適，快樂 (HCH)
   (健康室內環境/健康生活)
5. 創新 (IA)

Resources





賽馬會綠建環評學校計劃



Green Schools in Hong Kong


HKGBC
香港綠色建築議會

hereby certifies that 特此證明

S.K.H. St. Clement's Primary School
聖公會聖紀文小學
5 Fortune Street, Cheung Sha Wan, Kowloon
九龍長沙灣幸福街5號

has achieved **Green** rating under
BEAM Plus Existing Schools V1.0 Beta Version
獲得綠建環評既有學校 (1.0測試版本)「**綠建學校**」評級

GREEN
綠建學校 ES 既有學校 V1.0 Beta Version 2022
HKGBC
BEAM Plus
綠建環評

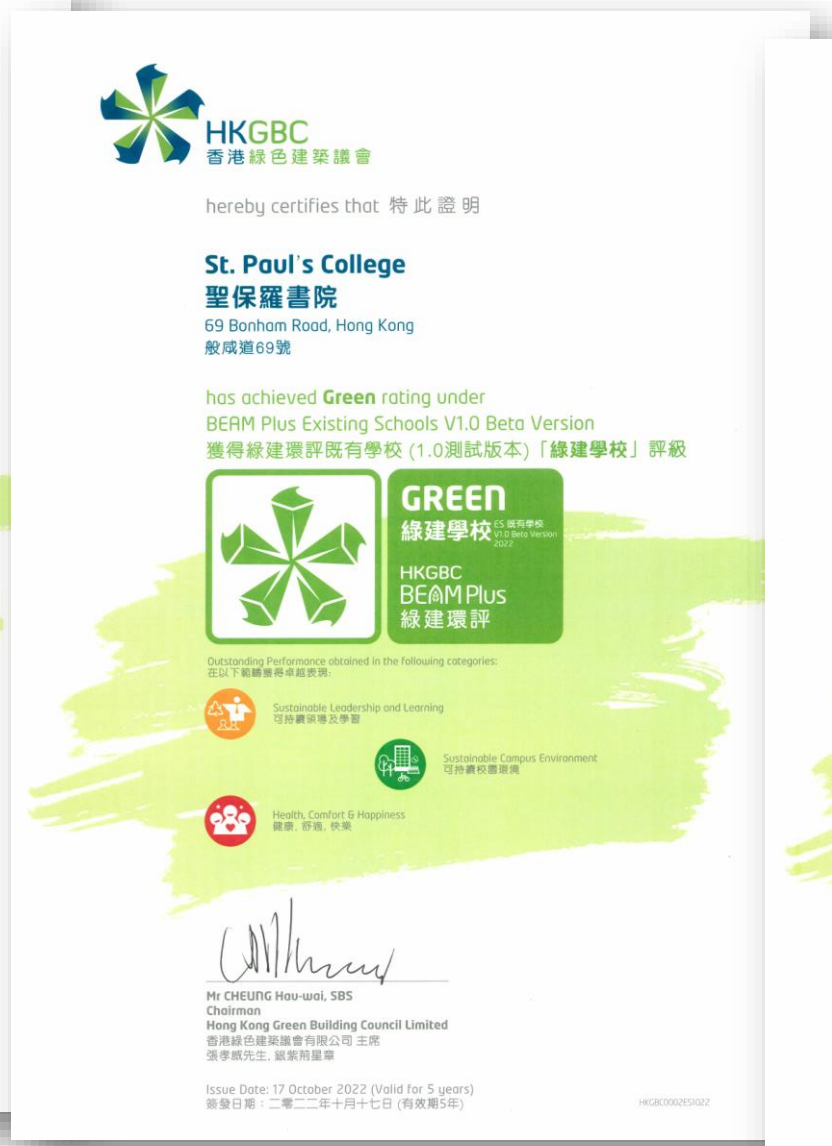
Outstanding Performance obtained in the following category:
在以下範疇獲得卓越表現:

Sustainable Leadership and Learning
可持續領導及學習

Mr CHEUNG Hau-wai, SBS
Chairman
Hong Kong Green Building Council Limited
香港綠色建築議會有限公司 主席
張孝威先生, 銀紫荊星章

Issue Date: 17 October 2022 (Valid for 5 years)
簽發日期：二零二二年十月十七日 (有效期5年)

HKGBC0001ES1022


HKGBC
香港綠色建築議會

hereby certifies that 特此證明

St. Paul's College
聖保羅書院
69 Bonham Road, Hong Kong
般咸道69號

has achieved **Green** rating under
BEAM Plus Existing Schools V1.0 Beta Version
獲得綠建環評既有學校 (1.0測試版本)「**綠建學校**」評級

GREEN
綠建學校 ES 既有學校 V1.0 Beta Version 2022
HKGBC
BEAM Plus
綠建環評

Outstanding Performance obtained in the following categories:
在以下範疇獲得卓越表現:

Sustainable Leadership and Learning
可持續領導及學習

Sustainable Campus Environment
可持續校園環境

Health, Comfort & Happiness
健康, 舒適, 快樂

Mr CHEUNG Hau-wai, SBS
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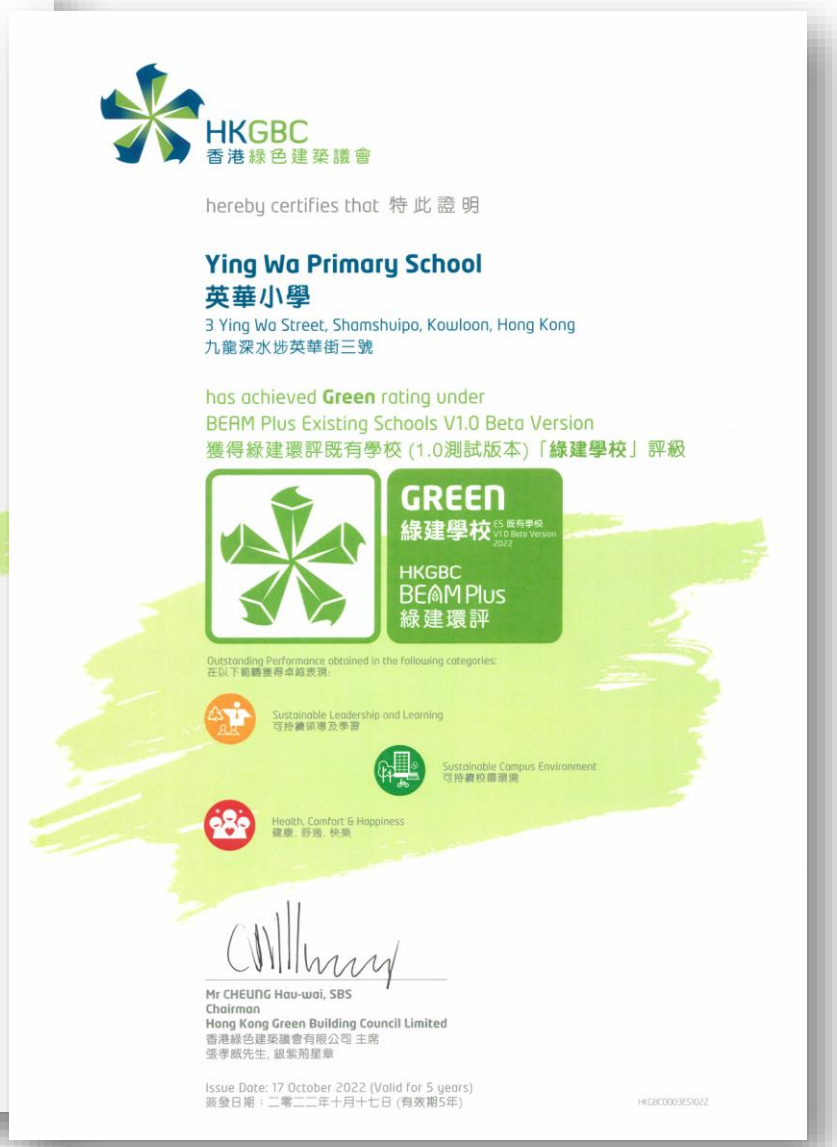
Issue Date: 17 October 2022 (Valid for 5 years)
簽發日期：二零二二年十月十七日 (有效期5年)

HKGBC0002ES1022


HKGBC
香港綠色建築議會

hereby certifies that 特此證明

Ying Wa Primary School
英華小學
3 Ying Wa Street, Shamshuipo, Kowloon, Hong Kong
九龍深水埗英華街三號

has achieved **Green** rating under
BEAM Plus Existing Schools V1.0 Beta Version
獲得綠建環評既有學校 (1.0測試版本)「**綠建學校**」評級

GREEN
綠建學校 ES 既有學校 V1.0 Beta Version 2022
HKGBC
BEAM Plus
綠建環評

Outstanding Performance obtained in the following categories:
在以下範疇獲得卓越表現:

Sustainable Leadership and Learning
可持續領導及學習

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張孝威先生, 銀紫荊星章

Issue Date: 17 October 2022 (Valid for 5 years)
簽發日期：二零二二年十月十七日 (有效期5年)

HKGBC0003ES1022

Green Schools in Hong Kong

TWGHs Tseng Hin Pei Primary School (東華三院曾憲備小學)

Green Features

Energy Use

GOLD 金級 NB 新建建築 V1.2 2022
HKGBC BEAM Plus 綠建環評

- Proper selection of building service equipment to reduce energy consumption, together with provision of PV system, resulting in **37.2% of annual energy & carbon emission reduction and 42.05% of maximum electricity demand reduction**.
- Meters are installed, allowing monitoring of different building services installations, including MVAC, lighting & small power, lift and plumbing & drainage systems

Green Schools in Hong Kong

Po Leung Kuk Stanley Ho Sau Nan Primary School
(保良局何壽南小學)

Green Features

Energy Use

GOLD 金級 NB 新建建築 V1.1 2020
HKGBC BEAM Plus 綠建環評

- Energy efficient air-conditioning system **(District Cooling System)** was adopted to reduce annual air-conditioning energy consumption
- Double-glazing was used for the building, as well as **architectural fins, trellises** and **balconies** to provide **shading** in order to lower energy consumption for air-conditioning.
- **Solar photovoltaic panels** were installed on the roof to harvest solar energy.

Green Schools in Hong Kong

Hong Kong International School, Lower Primary School

Green Features

Energy Use

GOLD 金級 NB 新建建築 V1.1 2019
HKGBC BEAM Plus 綠建環評

- High efficient water-cooled chiller system was adopted for the redevelopment, which also provides **district cooling to the opposite Upper Primary School** building within the Repulse Bay Campus.
- Low-E coated double-glazing was used for the building, as well as **architectural fins, trellises and balconies** to provide shading in order to lower energy consumption for air-conditioning.

4 Green Buildings Data in Hong Kong

BEAM Plus Project Directory & Statistics

Project Directory (List View) | Project Directory (Map View) | NB Registered | NB Assessed | EB Registered | EB Assessed | EB V2.0 Selective Scheme | BI Registered + Assessed | ND Registered + Assessed

Clear All Filters

BEAM Plus Project Directory and Statistics

Please click the button(s) below for selection

New Buildings (NB) | Existing Buildings (EB) | Interiors (BI) | Neighbourhood (ND) | New Data Centres (NDC) | Existing Data Centres (EDC)

NB V1.1 | NB V1.2 | NB V2.0 | EB V1.1 | EB V1.2 | EB V2.0 | EB V2.1 | BI V1.0 | BI V2.0 Pilot | ND V1.0 | NDC V1.0 | EDC V1.0 | ES V1.0

Comprehensive Scheme A (Comp. A) | Comprehensive Scheme B (Comp. B) | Selective Scheme (Sel.)

SA | MWA | EU | WU | MAN | IEQ

Project / Property Name, Address, GBC Label No

Support searching in Chinese

Search

Owner Name or BEAM Pro Name

Search

2011 — 2023

Slide the circles to select the registration / certification period

Current Certification Status: Expired | Valid

Final Assessment | Provisional Assessment | Registered

District: All

Project Type: All

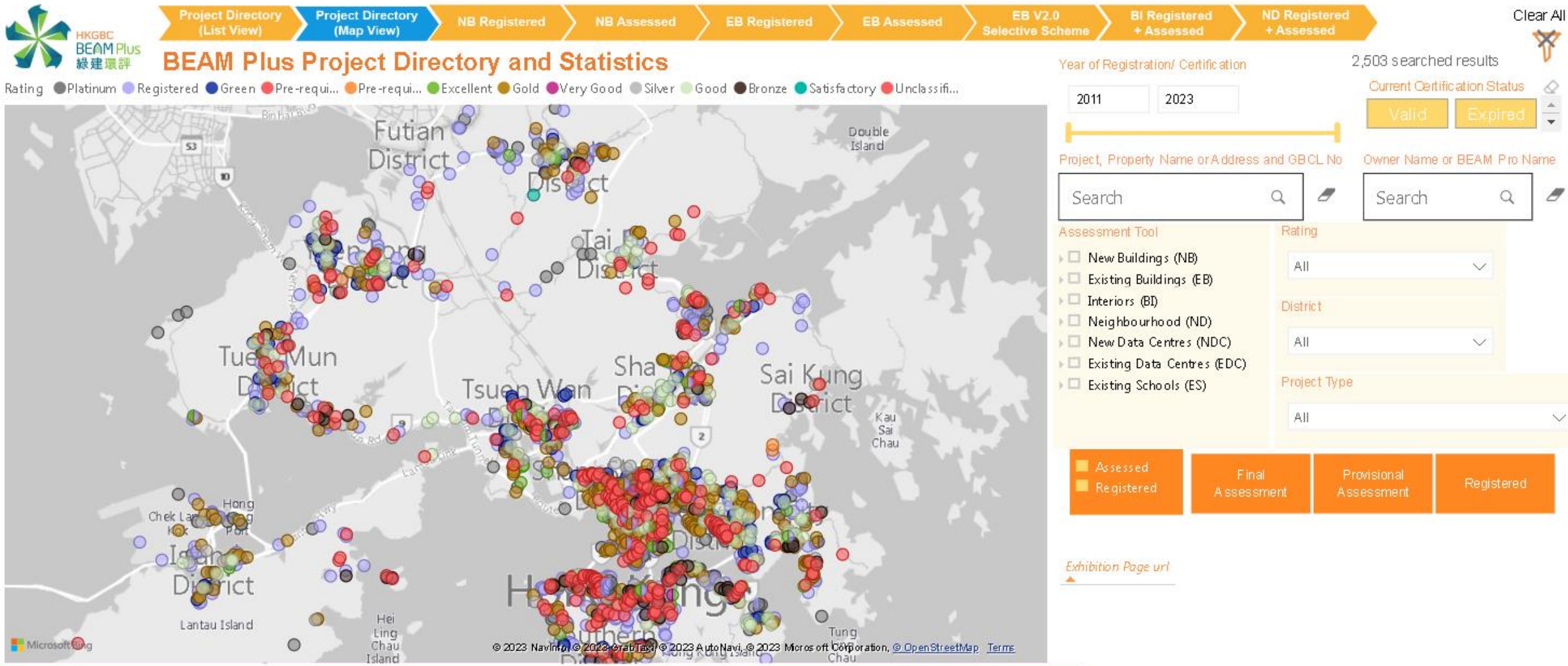
Rating: All

2,503 result(s)

Project Name (Eng)	Project Name (Chi)	Project Address	District	Project Type	Owner / Developer Name	BEAM Pro	Tool	Current Status	Year	Validity	Green Build Cert Label No	Online exhibition	Outstanding Performance in ES Cat
#LYOS		2 Hung Yuen Road, Hung Shui Kiu	NT - Yuen Long	Residential	Art Rich Investment Limited	Wong Man Sze	NB V1.2	Final Unclassified	2023	Valid	PAU0066/21		
+WOO	嘉湖	12 & 18 Tin Yan Road, Tin Shui Wai, Yuen Long, New Territories	NT - Yuen Long	Commercial	ARA ASSET MANAGEMENT (FORTUNE) LIMITED	POON Ka Man	EB V2.0 Sel. MAN	Good	2021	Valid			
1 Plantation Road		No. 1 Plantation Road, The Peak, Hong Kong	HK - Central & Western	Residential	HKRT Peak Properties Limited	NG Ka Wai	NB V1.1	Provisional Bronze	2014	Valid			
1 Tai Yip Street, Kwun Tong, Kowloon.		1 Tai Yip Street, Kwun Tong, Kowloon.	KLN - Kwun Tong	Hotel	Great Virtue Ventures Limited		NB V1.2	Registered	2021	Valid			
10 LaSalle	藺名	10 La Salle Road, Ho Man Tin, Kowloon, Hong Kong	KLN - Sham Shui Po	Residential	Smart Value Investments Limited & High Dynamic Holdings Limited	Hui Pui Shan	NB V1.2	Final Silver	2021	Valid	FAS0014/21		
11 Kwun Fung Street, Siu Lam, Tuen Mun, N.T		11 Kwun Fung Street, Siu Lam, Tuen Mun, N.T	NT - Tuen Mun	Residential	Fortune Loyal Development Limited	Fredrick Leong	NB V1.2	Final Unclassified	2023	Valid			
11 SKIES		8 Sky City Road East, Hong Kong International Airport	NT - Islands	Commercial	Roxy Limited	Ho Wing Hung	NB V1.2	Provisional Gold	2021	Valid			
1111 King's Road	英皇道1111號	1111 King's Road, Taikoo Shing, Hong Kong	HK - Eastern	Commercial	Gaw Capital Advisors Limited	MAK Kei Choi, Henry	EB V2.0 Comp. A	Final Platinum	2023	Valid		🔗	
116 Waterloo Road		No. 116 Waterloo Road, Kowloon	KLN - Kowloon City	Residential	Wellway Limited	Li Montgomery Hin Fung	NB V2.0	Registered	2022	Valid			
1-17 Hei Wo Street		1-17 Hei Wo Street	HK - Eastern	Mixed Use	Bright Rainbow Limited	N/A	NB V1.2	Registered	2017	Valid			
12 Tai Koo Wan Road & 14 Tai Koo Wan Road	太古灣道12號&太古灣道14號	12 Taikoo Wan Road & 14 Taikoo Wan Road, Taikoo Shing, Hong	HK - Eastern	Commercial	Harmony Lotus Limited	MAK Kei Choi, Henry	EB V2.0 Comp. A	Final Platinum	2023	Valid		🔗	

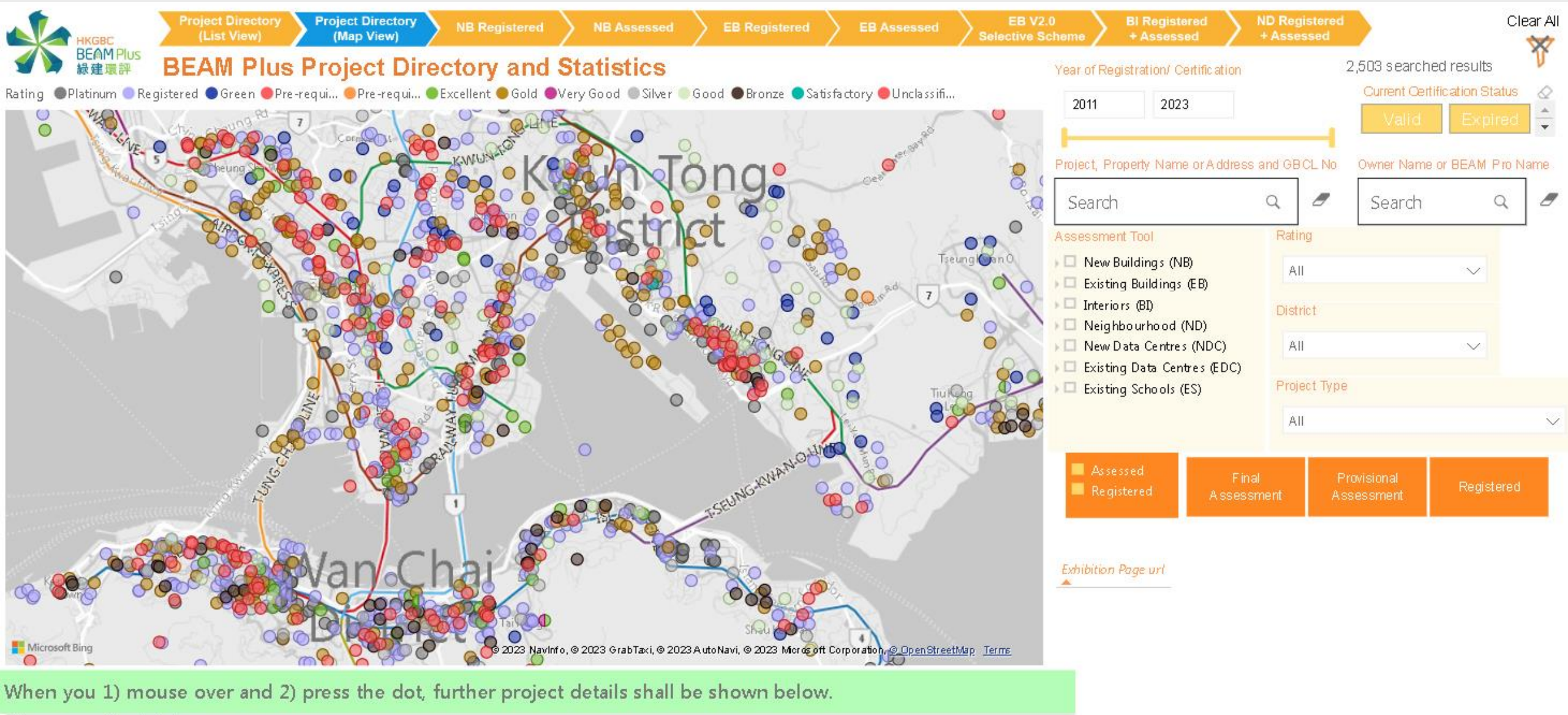
*The full list of projects can be downloadable in csv format by **clicking here**. Please email to **beamplus@hkgbc.org.hk** for enquiry.*

BEAM Plus Project Directory & Statistics



When you 1) mouse over and 2) press the dot, further project details shall be shown below.

BEAM Plus Project Directory & Statistics



When you 1) mouse over and 2) press the dot, further project details shall be shown below.

BEAM Plus for New Buildings

BEAM Plus for New Buildings

The assessment of a building's performance covers the following aspects:

New!
Integrated Design and Construction Management

Rebranded!
Health and Wellbeing

Sustainable Sites

Materials and Waste

Energy Use

Water Use

Innovations and Additions

BEAM Plus for New Buildings

Table of Cor

BEAM Plus for Existing Buildings

BEAM Plus for Existing Buildings

The assessment of a building's performance covers the following aspects:

Site Aspects

New!
Management

New!
Materials and
Waste Aspects

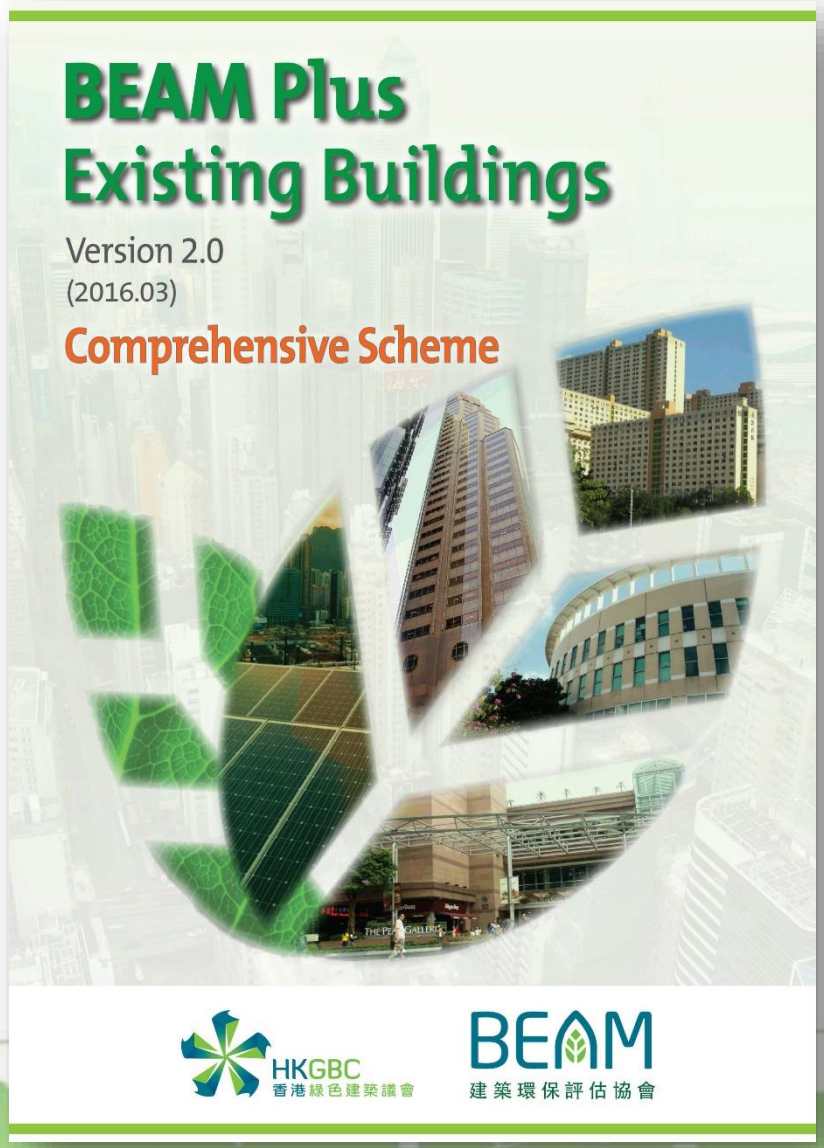
Energy Use

Water Use

Indoor Environmental
Quality

Innovations and Additions

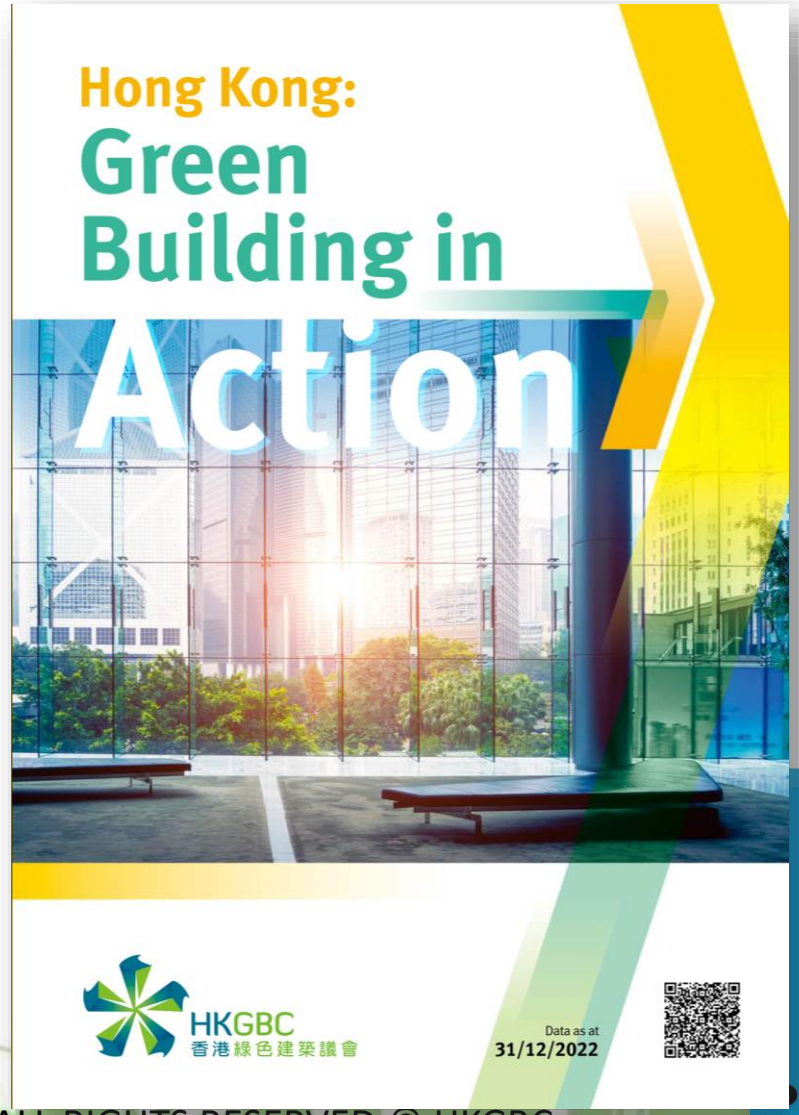
BEAM Plus Assessment Aspects

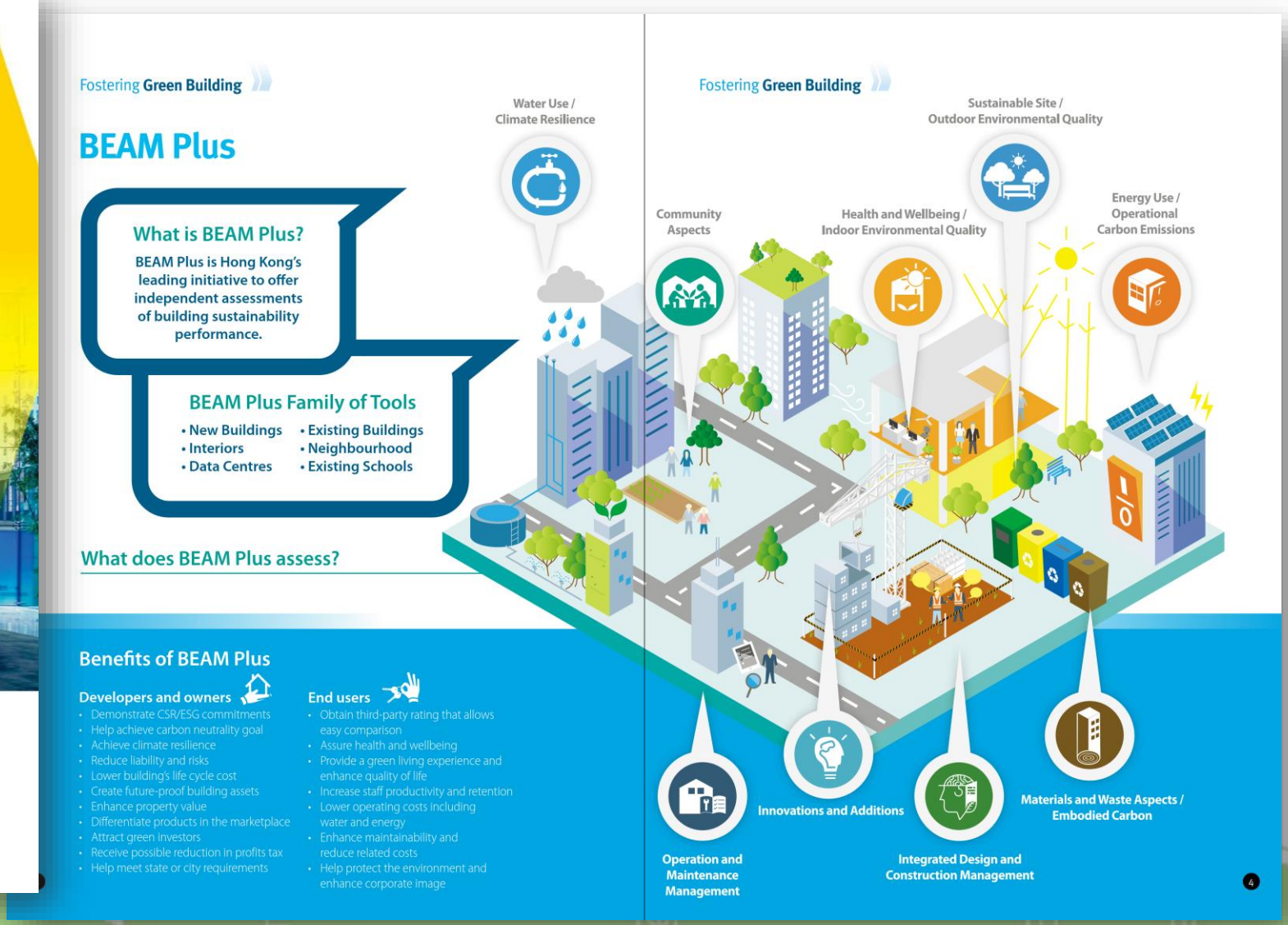


5 HKGBC's Green Buildings in Action

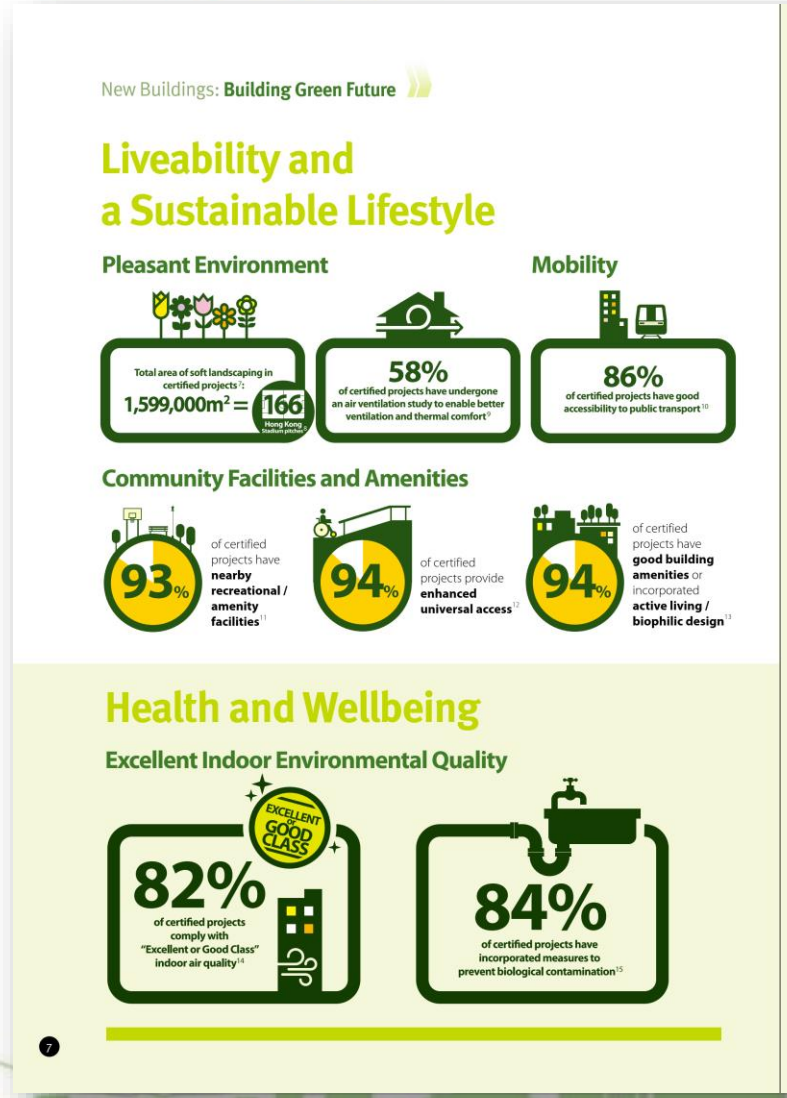
Green Building in Action

Download Link





BEAM Plus Project Directory & Statistics



ECF Green Building Education Video Series

Project Home Pages

6 Principal Strategies for Smart Green Buildings

HK Smart Green Building Design – Best Practice Guidebook

Launched by **Hong Kong Green Building Council (HKGBC)**, the Hong Kong Smart Green Building Design Best Practice Guidebook is a timely publication which provides **practical design**, **operation guidelines** and **strategies for advancing smart green buildings** with a view to optimise the performance of new and existing buildings. This Guidebook reinforces the objective of the **Smart City Blueprint for Hong Kong 2.0**, to highlight opportunities to I&T in enhancing performance of green buildings.

The Guidebook has presented **fundamental design principles** that improves resilience in smart green buildings, and **32 strategies for smart green buildings** categorised under **6 key themes**: **building design & operations, health & wellbeing, energy performance, material & waste management water performance, and mobility & transportation.** Best practices are also demonstrated through **overseas and local case studies.**

CHAPTERS

Chapter 1

Introduction

Chapter 2

Practical Strategies for Smart Green Buildings

Chapter 3

Overseas Case Studies

Chapter 4

Local Case Studies

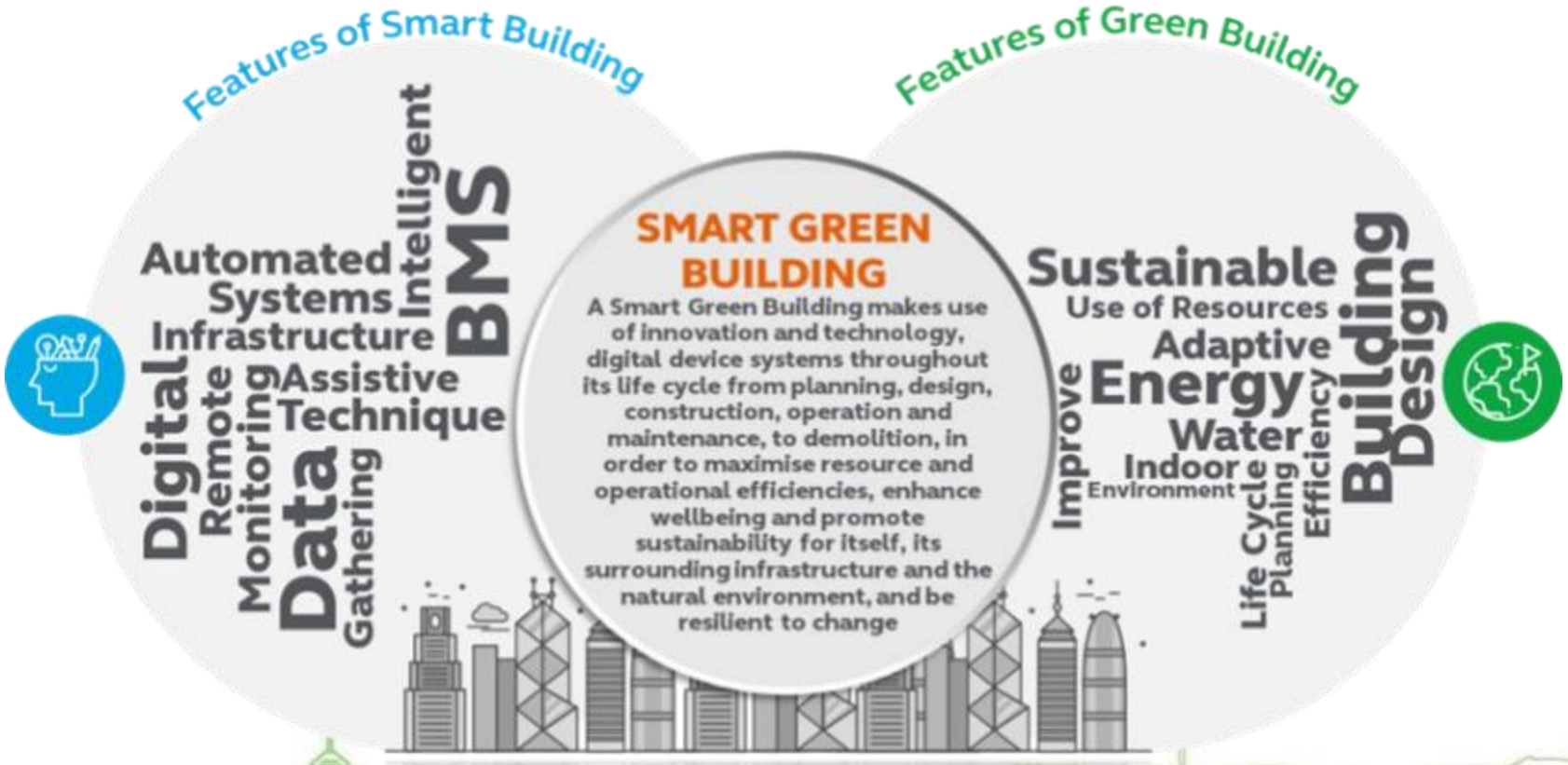
Chapter 5

Way Forward

HKGBC
香港綠色建築議會

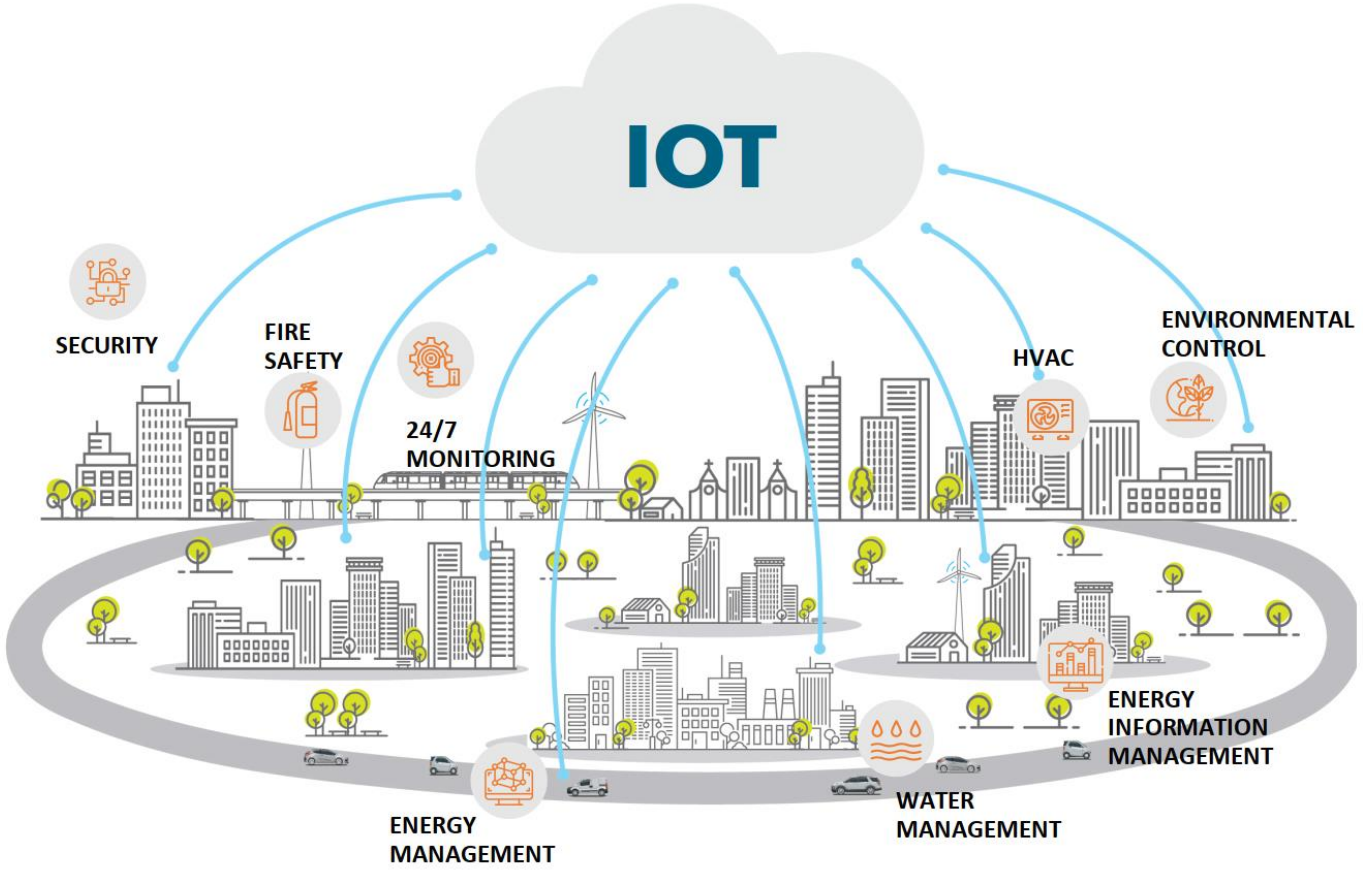
Integration of Smart Green Building Technology

- The Interface between the Smart and Green Buildings



Integration of Smart Green Building Technology

- The Internet of Thing (IOT) is the "Backbone" to Smart Green Buildings



Overview of Smart Green Strategies

- This chapter provides an overview of **32** recommended smart green strategies categorised into **6** key themes which can be implemented in new and/or existing buildings.
- Each theme is presented in an easy to read and practical manner; supported with infographics to illustrate how the various strategies can be applied and their key functions.

Building Design & Operations

Material & Waste Management

Health & Wellbeing

Water Performance

Energy Performance

Mobility & Transportation

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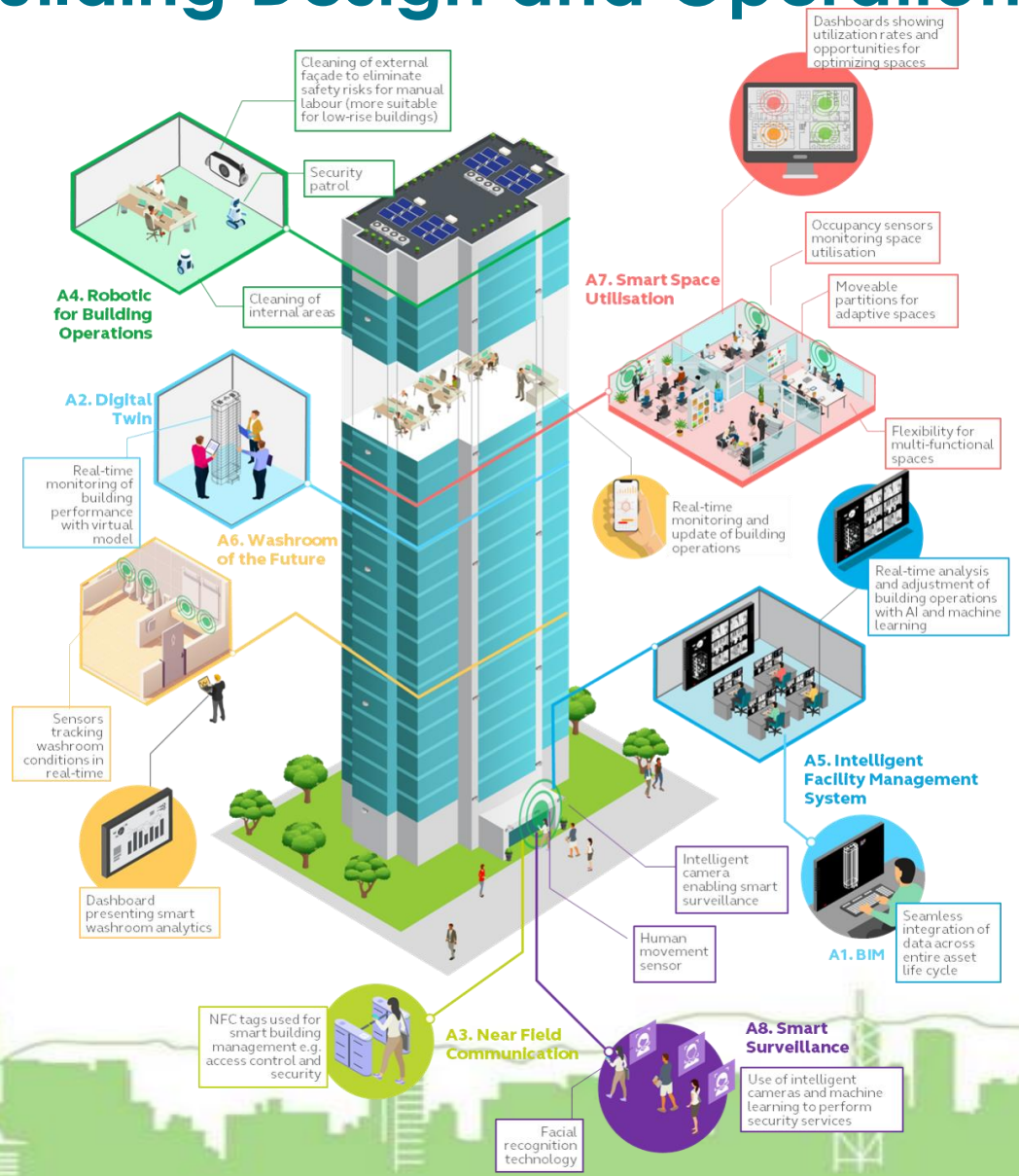
Principal Strategies for Smart Green Buildings

1) Building Design and Operations

- A1. **BIM**
- A2. **Digital Twin**
- A3. Near Field Communications **(NFC)**
- A4. **Robotics** for Building Operations
- A5. Intelligent Facility Management **(iFM)** System

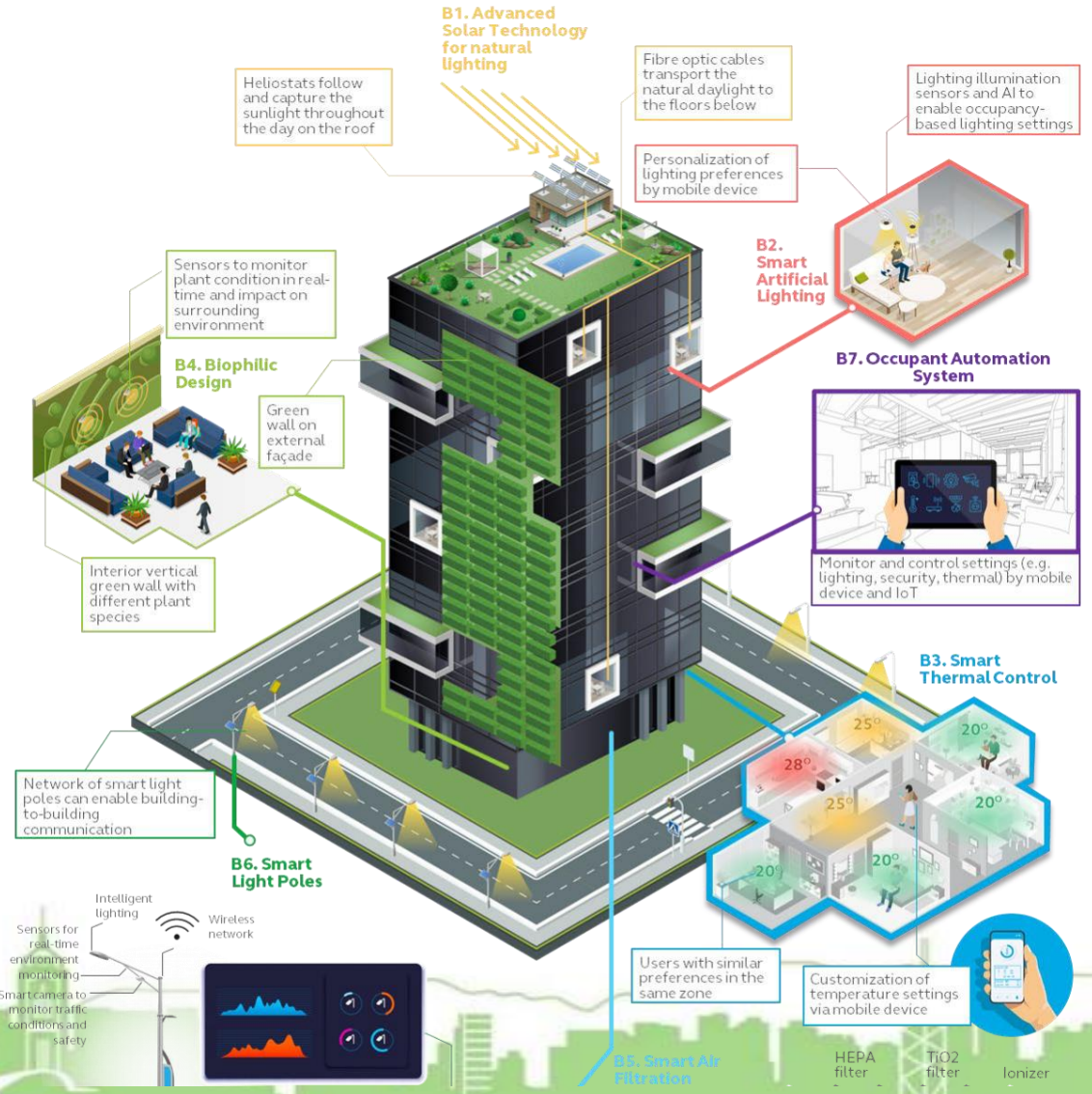


- A6. **Washroom** of the Future
- A7. Smart **Space Utilisation**
- A8. Smart Surveillance

Principal Strategies for Smart Green Buildings

2) Health and Wellbeing

- B1. Advanced **Solar Technologies** for Natural Lighting
- B2. **Smart Artificial Lighting**
- B3. **Smart Thermal Control**
- B4. **Biophilic Design**

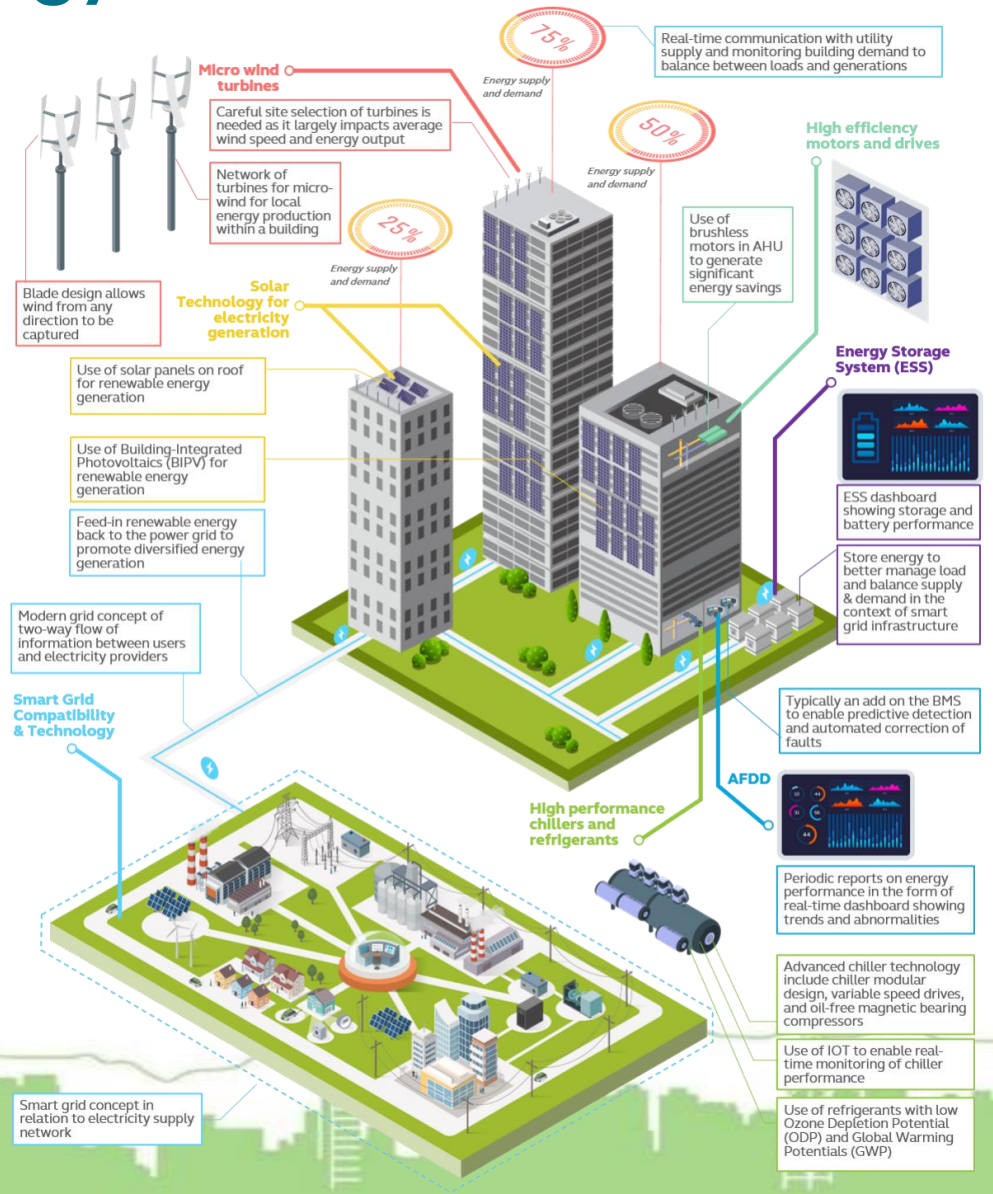


- B5. Smart **Air Filtration**
- B6. Smart Light Poles
- B7. **Occupant Automation System**

Principal Strategies for Smart Green Buildings

3) Energy Performance

- C1. AFDD (**Automatic Fault Detection and Diagnostics**)
- C2. **Smart Grid** Compatibility & Technology
- C3. **Energy Storage** System
- C4. **High Performance Chillers and Refrigerants**

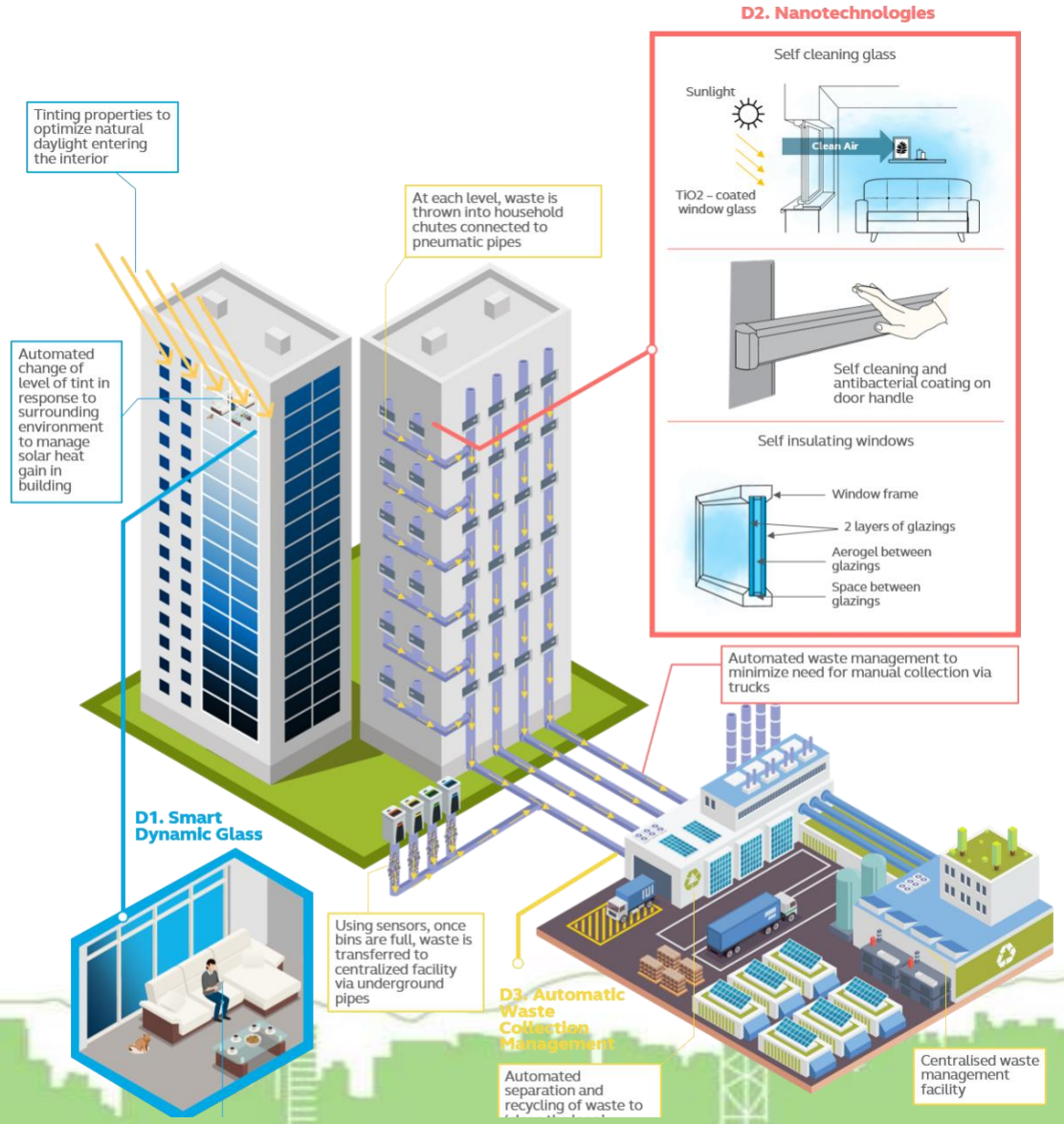


- C5. High Efficiency Motors and Drives
- C6. Solar Technology for **Electricity Generation**
- C7. **Micro Wind Turbines**

Principal Strategies for Smart Green Buildings

4) Material and Waste Management

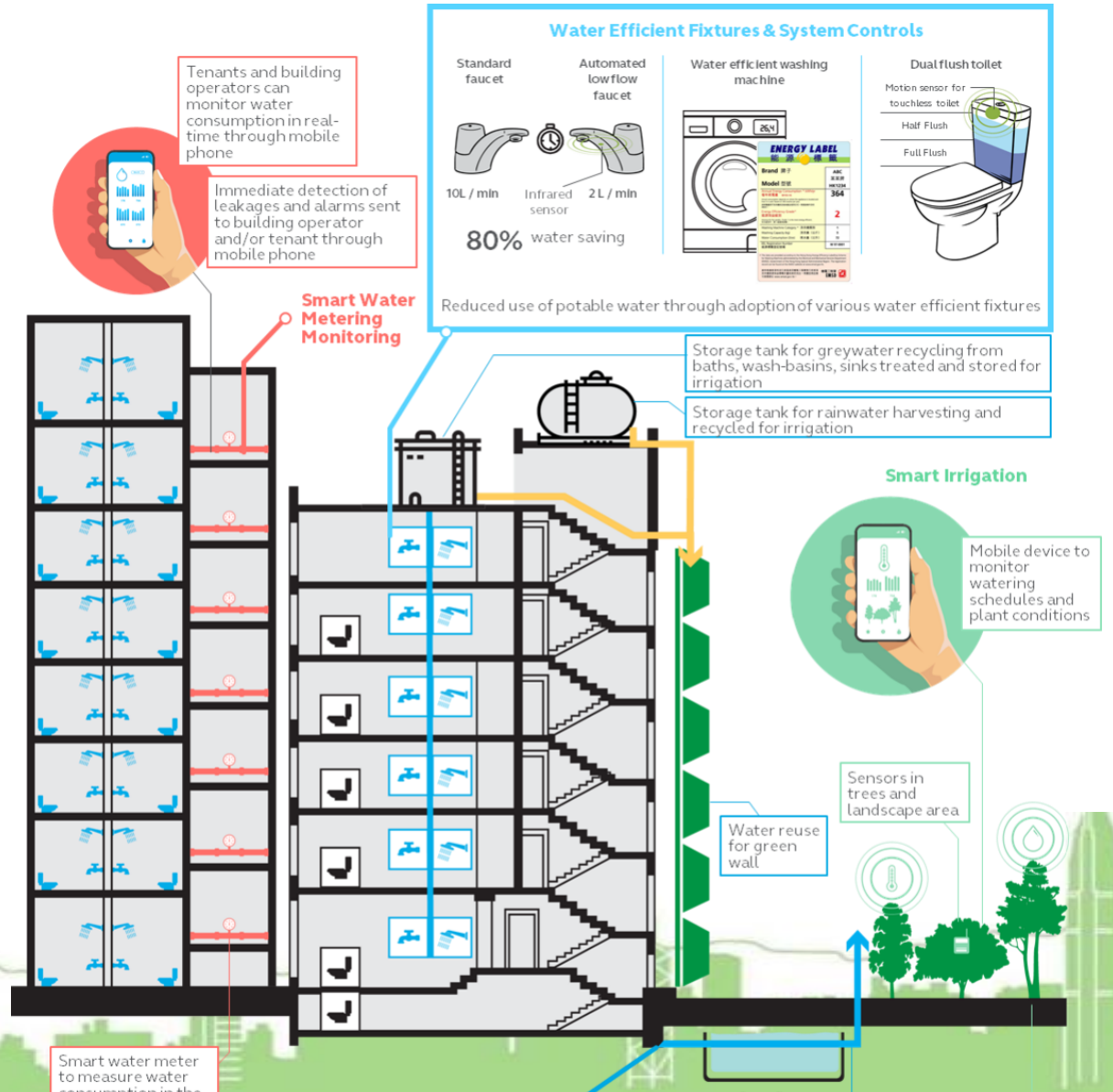
- D1. **Smart Dynamic Glass**
- D2. **Nanotechnologies**
- D3. **Automatic Waste Collection System**



Principal Strategies for Smart Green Buildings

5) Water Performance

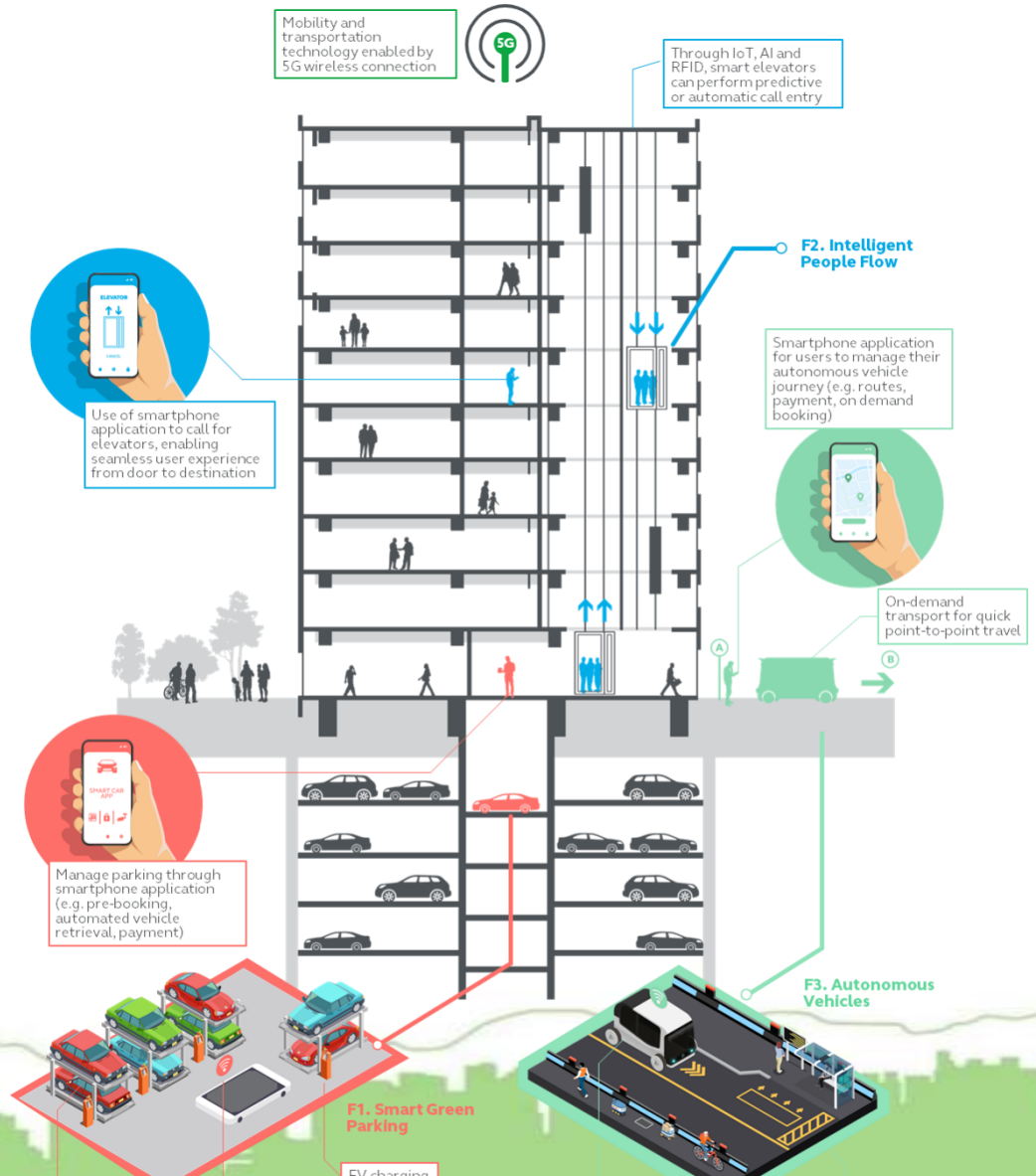
- E1. **Smart Water Metering and Monitoring**
- E2. **Water Efficient Fixtures and System Controls**
- E3. **Grey Water Reuse & Harvesting Rainwater**
- E4. **Smart Irrigation**



Principal Strategies for Smart Green Buildings

6) Mobility and Transportation

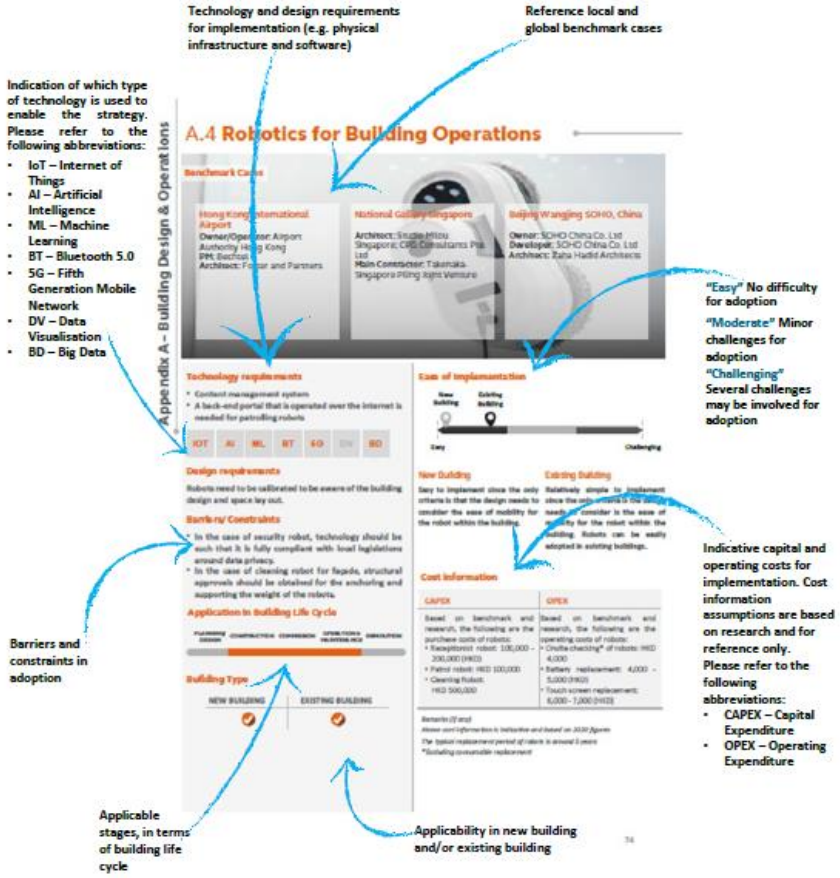
- F1. **Smart Green Parking**
- F2. **Intelligent People Flow**
- F3. **Autonomous Pods**



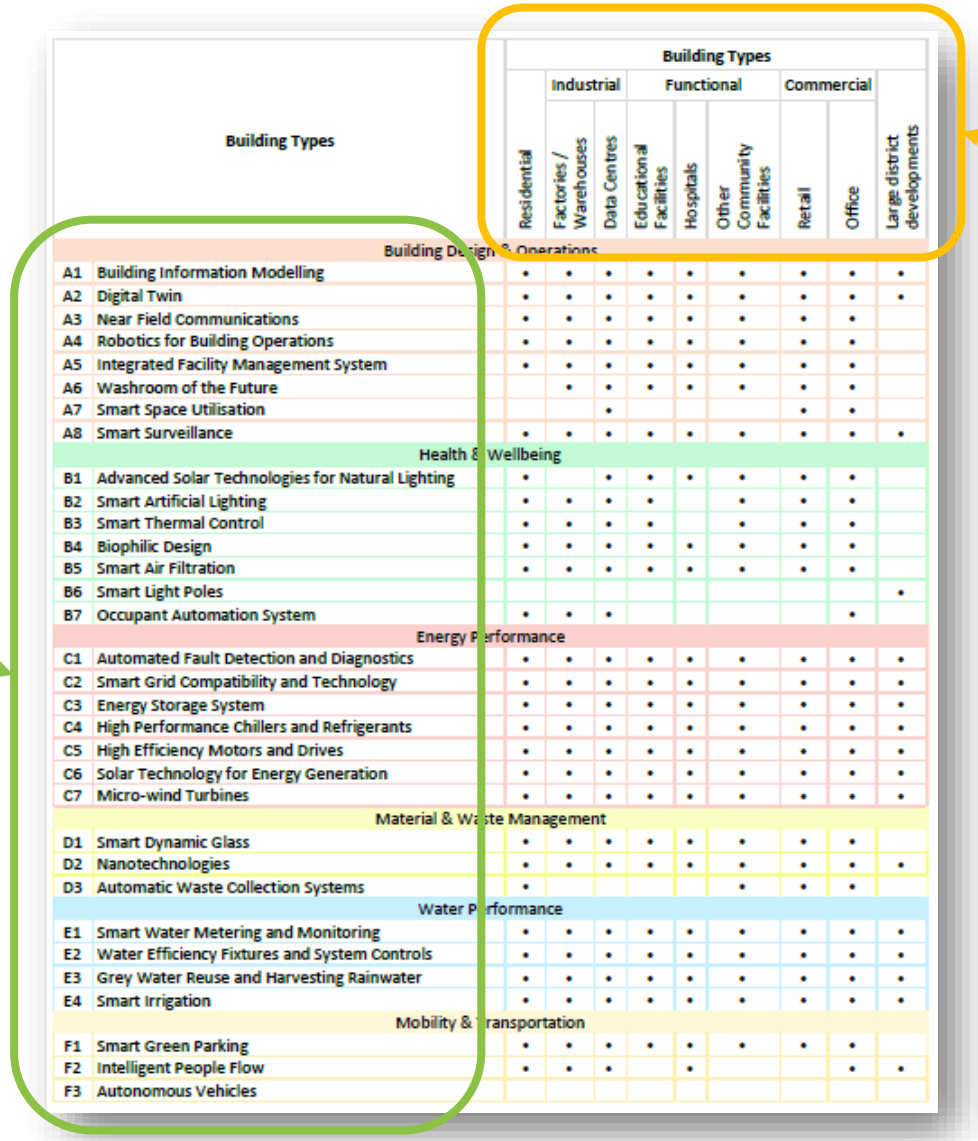
Appendix A – Building Design & Operations
A1. Building Information Modelling (BIM)
A2. Digital Twin
A3. Near Field Communications (NFC)
A4. Robotics for Building Operations
A5. Integrated Facility Management System
A6. Washroom of the Future
A7. Smart Space Utilisation
A8. Smart Surveillance
Appendix B – Health & Wellbeing
B1. Advanced Solar Technologies for Natural Lighting
B2. Smart Artificial Lighting
B3. Smart Thermal Control
B4. Biophilic Design
B5. Smart Air Filtration
B6. Smart Light Poles
B7. Occupant Automation System
Appendix C – Energy Performance
C1. Automated Fault Detection and Diagnostics (AFDD)
C2. Smart Grid Compatibility and Technology
C3. Energy Storage System (ESS)
C4. High Performance Chillers and Refrigerants
C5. High Efficiency Motors and Drives
C6. Solar Technology for Electricity Generation
C7. Micro-wind Turbines
Appendix D – Material & Waste Management
D1. Smart Dynamic Glass
D2. Nanotechnologies
D3. Automatic Waste Collection Systems
Appendix E – Water Performance
E1. Smart Water Metering and Monitoring
E2. Water Efficient Fixtures and System Controls
E3. Grey Water Reuse and Harvesting Rainwater
E4. Smart Irrigation
Appendix F – Mobility & Transportation
F1. Smart Green Parking
F2. Intelligent People Flow
F3. Autonomous Vehicles

Overview of Smart Green Strategies

- **32** smart green strategies were listed for easy reference and the details of these strategies can be found in appendices.



Linkage to building types



Building Types		Building Types								
			Industrial		Functional			Commercial		
		Residential	Factories / Warehouses	Data Centres	Educational Facilities	Hospitals	Other Community Facilities	Retail	Office	Large district developments
	Building Design & Operations									
A1	Building Information Modelling	•	•	•	•	•	•	•	•	•
A2	Digital Twin	•	•	•	•	•	•	•	•	•
A3	Near Field Communications	•	•	•	•	•	•	•	•	
A4	Robotics for Building Operations	•	•	•	•	•	•	•	•	
A5	Integrated Facility Management System	•	•	•	•	•	•	•	•	
A6	Washroom of the Future		•	•	•	•	•	•	•	
A7	Smart Space Utilisation			•				•	•	
A8	Smart Surveillance	•	•	•	•	•	•	•	•	•
	Health & Wellbeing									
B1	Advanced Solar Technologies for Natural Lighting	•		•	•	•	•	•	•	
B2	Smart Artificial Lighting	•	•	•	•		•	•	•	
B3	Smart Thermal Control	•	•	•	•		•	•	•	
B4	Biophilic Design	•	•	•	•	•	•	•	•	
B5	Smart Air Filtration	•	•	•	•	•	•	•	•	
B6	Smart Light Poles									•
B7	Occupant Automation System	•	•	•					•	
	Energy Performance									
C1	Automated Fault Detection and Diagnostics	•	•	•	•	•	•	•	•	•
C2	Smart Grid Compatibility and Technology	•	•	•	•	•	•	•	•	•
C3	Energy Storage System	•	•	•	•	•	•	•	•	•
C4	High Performance Chillers and Refrigerants	•	•	•	•	•	•	•	•	•
C5	High Efficiency Motors and Drives	•	•	•	•	•	•	•	•	•
C6	Solar Technology for Energy Generation	•	•	•	•	•	•	•	•	•
C7	Micro-wind Turbines	•	•	•	•	•	•	•	•	•
	Material & Waste Management									
D1	Smart Dynamic Glass	•	•	•	•	•	•	•	•	
D2	Nanotechnologies	•	•	•	•	•	•	•	•	•
D3	Automatic Waste Collection Systems	•					•	•	•	
	Water Performance									
E1	Smart Water Metering and Monitoring	•	•	•	•	•	•	•	•	•
E2	Water Efficiency Fixtures and System Controls	•	•	•	•	•	•	•	•	•
E3	Grey Water Reuse and Harvesting Rainwater	•	•	•	•	•	•	•	•	•
E4	Smart Irrigation	•	•	•	•	•	•	•	•	•
	Mobility & Transportation									
F1	Smart Green Parking	•	•	•	•	•	•	•	•	
F2	Intelligent People Flow	•	•	•		•			•	•
F3	Autonomous Vehicles									

Building types

32

Strategies

The table shows the linkage between the recommended smart green strategies and the applicable building types for implementation.

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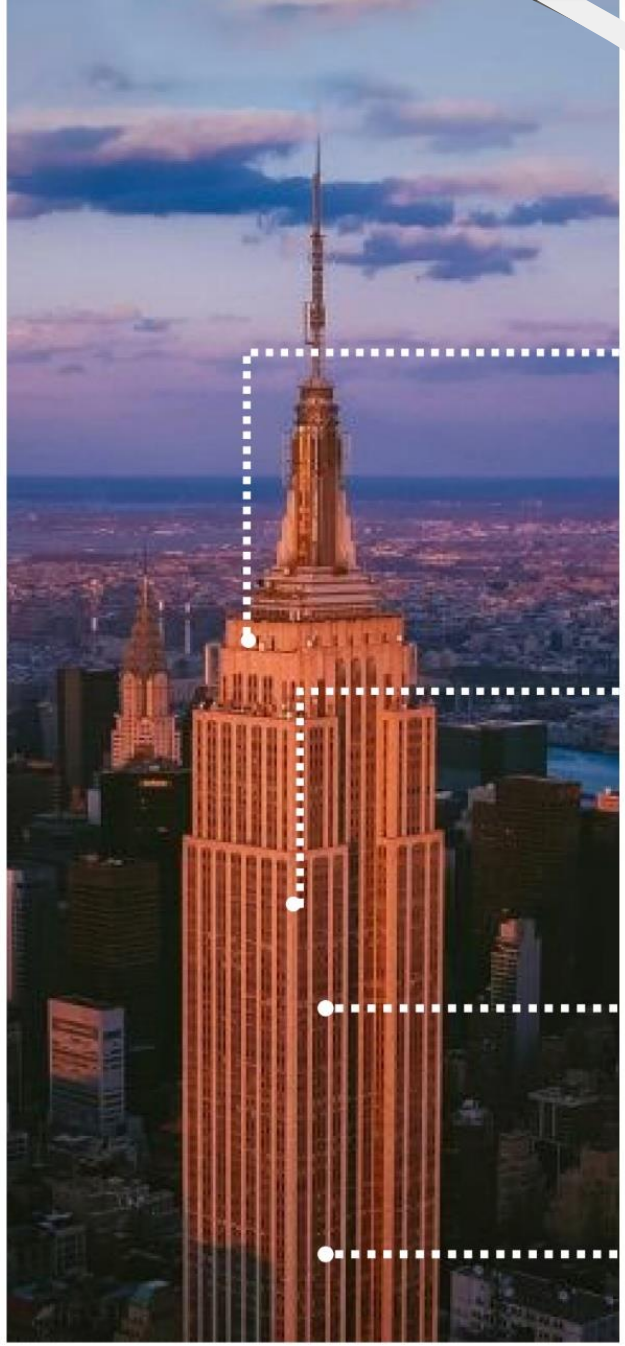
7 Overseas Case Studies

Overseas Case Studies



EMPIRE STATE BUILDING

...e of high-recycled
...nt construction
materials

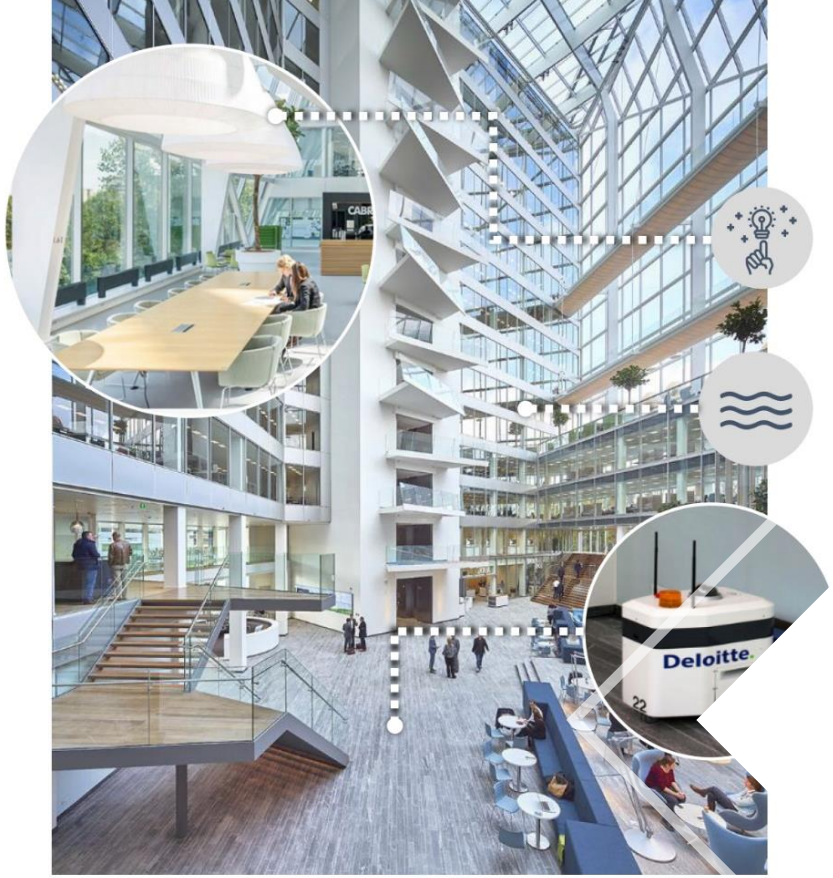
High-efficie... triple-glazed windo... replacement fo... 6,500 windows

Enhanced thermal comfort from better windows

Over 6,000 radiators retrofitted to reduce heat loss

Modernised el...ators with regenerative ...chnology reducing e...rgy usage b... 50% to ...

...conic Empire State Building, completed in 1931, is a 102-storey building located in New ...k's midtown area. Similar to many buildings of its generation, it has fallen behind in terms ...f energy efficiency and system intelligence. In 2009, Empire State Realty Trust and Clinton Climate Initiative Cities program formed a partnership with the purpose of bringing the building up to modern environmental standards and collaborate on the retrofit project



LED-lighting system powered by Ethernet and 100% IP based

Every workspace is within 7 metres window

Overseas Case Studies

THE EDGE

65,000 sq. ft of solar panels

of

and

itation

The Edge, designed for the global financial firm and primary tenant Deloitte, opened in 2015. The aim of the project was to consolidate Deloitte's employees from multiple sites into a single environment, and to produce a smart building to accelerate Deloitte's transition into the digital age. The Edge offers an entirely new working environment, with the world's highest BREEAM rating (98.4%).

The building integrates various diverse smart technologies to promote collaboration and sustainability. The Edge's concept is "the new way of working" which entails resource efficiency in the traditional sense - it generates 102% of its own energy, but it is also about the most efficient use of the humans. It creates a new working environment powered by adaptable and intelligent workspaces. Deloitte workers share desks, under a concept known as "hot desking", workers may choose a work booth, meeting room, a "concentration room", or a standing desk, depending on their needs that day. Employees also make use of a smartphone app to help navigate the building.

15-storey atrium creating a loop of natural ventilation

"Digital ceiling" packed with 30,000 sensors

THE EDGE

THE EDGE

Overseas Case Studies

Other smart green building strategies were listed and explained in details

EMPIRE STATE BUILDING

1. Building Design & Operations

- Efficient DDC system - largest wireless network to a single building allowing valves and vents to be monitored and centrally controlled
- Advanced digital monitoring and BMS with sensors throughout the building to monitor air quality and heating and cooling loads
- Enhanced space utilisation with 300 tenants – Tenants build out space in accordance with the building's high performance healthy sustainable interior design guidelines to optimise cost and energy savings
- Compulsory green requirements in lease contracts
- Through AI-enabled building infrastructure, produces an estimated USD 3.4 million worth of health and climate value

DDC System

2. Health & Wellbeing

- Enhanced thermal comfort from retrofitted windows
- Tenant demand-controlled ventilation enhancing air quality
- Smart lighting automatically adjusts lighting intensity according to daylight availability monitored by photo sensors
- Over 6,000 radiators embedded with heat-reflecting barriers along the exterior walls of the building to minimise heat lost directly through the wall
- New variable air volume (VAV) air handling layout to improve tenant comfort
- MERV 13 filters installed in the HVAC system
- Sensors (including CO_2 sensors) for real-time monitoring of fresh air in the building to reduce unnecessary heating and cooling load and ensure healthy ventilation levels for Indoor Environmental Quality (IEQ)

Intelligent lighting

3. Energy Performance

- Chiller plant retrofit and upgrades to controls, variable speed drives, and primary loop bypasses
- Tenant energy management - A EnNET/Active Energy Management (AEM) platform collecting 15-minute meter data and integrated with property management software for analysis/ evaluation (e.g., time series analysis)
- Individual tenants are metered separately for their energy consumption and are responsible for their own bills. With access to the building's energy information, they can compare their performance with other tenants
- Carbon-neutral building with carbon offsets of approximately 55 million kilowatt hours per year of renewable wind energy
- Energy-efficient modernisations made to existing equipment, such as use of a smaller air-conditioning plant instead due to the decreased cooling load
- Reduce cooling load requirements by 33% and peak electrical demand by 3.5 megawatts

Chiller plant retrofit

4. Material & Waste Management

- High-efficiency triple-glazed window replacement - inserting low emissivity film and reusing existing glazing of over 6,500 windows for enhanced energy efficiency and heat retention; reducing heat loss by 33% and solar heat gain by 50%. Reused over 96% of existing window units and all work was performed on site
- Use of high-recycled content construction materials and recycled content carpets, low off-gassing wall coverings, paints, and adhesives

Triple-glazed window

5. Water Performance

- Waterless urinals, ultra-low-flow toilets and hand-sensing faucets reducing water usage by over 40% below Energy Policy Act Standards
- Condenser water system upgrades
- All water systems submetered with AI software to monitor and control water use in real time

Waterless urinals

6. Mobility & Transportation

- Modernised elevators equipped with regenerative technology, which captures energy that would otherwise be lost as heat and is fed back to the building's power grid system for other use. This technology utilises 50% to 75% less energy than the original system.

THE EDGE

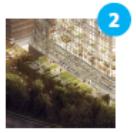
1. Building Design & Operations

- Smart building orientation based on sun path and each façade is uniquely designed (e.g., load bearing walls, louvers, solar panels)
- Single IP backbone for all building ecosystems to enable performance tracking and manage data analytics; and employees to control room comfort with smartphone app
- "Digital ceiling" packed with 30,000 sensors
- Central dashboards continuously measure and track building performance
- Use of RoboCop equipped with sensors for security patrolling and cleaning
- EcoStruxure™ BMS enables real-time access to critical building data on-site or remotely
- Hot desking and space utilisation (~2,500 employees share 1,000 desks)
- Use of BIM for effective project execution and sharing of data

RoboCop

2. Health & Wellbeing

- 15-storey atrium - Mesh panels between each floor let stale office air spill into open space creating a loop of natural ventilation
- Ecological corridor - Rich diversity of vegetation/birds/insects/bats on the north-facing terrace
- Every workspace is within 7 meters of a window
- Load bearing walls to the south, east and west have smaller openings to provide thermal mass and shading, and solid openable panels for ventilation



Ecological Corridor

3. Energy Performance

- 65,000 sq. ft. of solar panels making use of neighbourhood level energy sourcing
- Energy-efficient temperature control systems
- Net zero energy building
- Uses 70% less electricity than typical office buildings
- Energy generation for heating and cooling from an aquifer thermal ESS with two 129 meters deep wells
- LED lighting system, co-developed with Philips, is powered by Ethernet and 100% IP based
- LED system reduced energy requirement by approx. 50% compared to traditional TL5 lighting
- ~6,000 luminaires installed with multi-sensors for movement, lighting, infrared and temperature detection
- Renewable energy production (PV): 3 kWh PE/m² year

Solar Panels

4. Material & Waste Management

- North facades are highly transparent and use thicker glass for noise reduction from external traffic
- Transparent atrium façade allowing natural lighting
- 95% of the materials used have a responsible origin

Thicker Glass

5. Water Performance

- Rainwater collection on roof for toilet flushing and landscape irrigation
- Estimated water consumption 4.1 m³/person a year, of which 20% is from greywater

Landscape irrigation

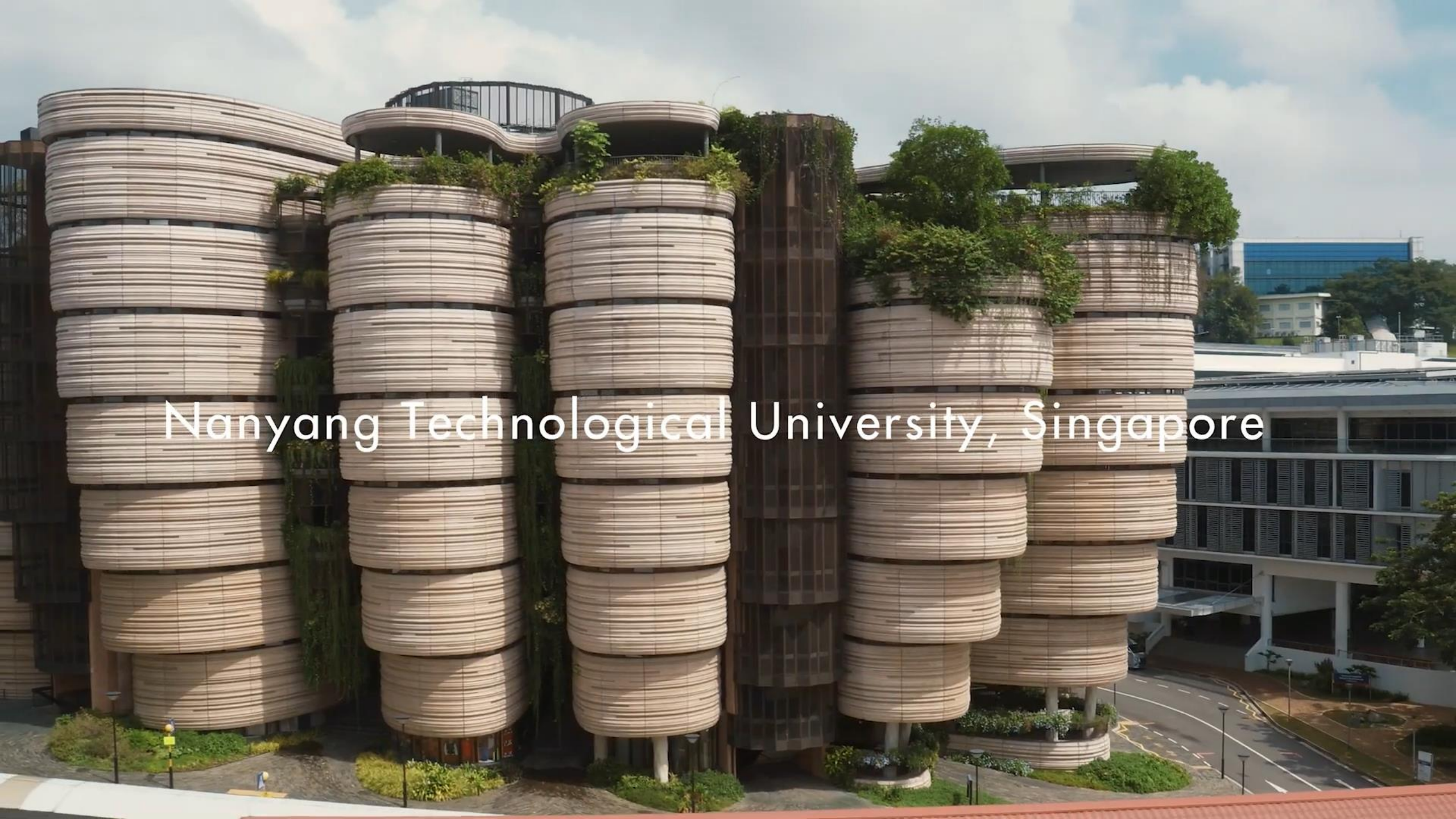
6. Mobility & Transportation

- 500 bicycle parking spaces on-site
- Automated garage entry with license-plate/employee recognition
- EV charging

Bicycle Parking Spaces

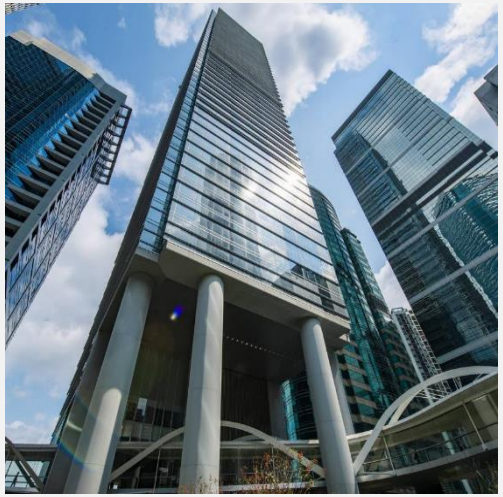
Hive – National University of Singapore

Hive – National University of Singapore


Nanyang Technological University, Singapore

8 Local Case Studies

Local Case Studies

One Taikoo Place	Double Cove	Victoria Dockside	Exchange Square
			

These case studies highlight the implementation of different strategies and associated benefits.

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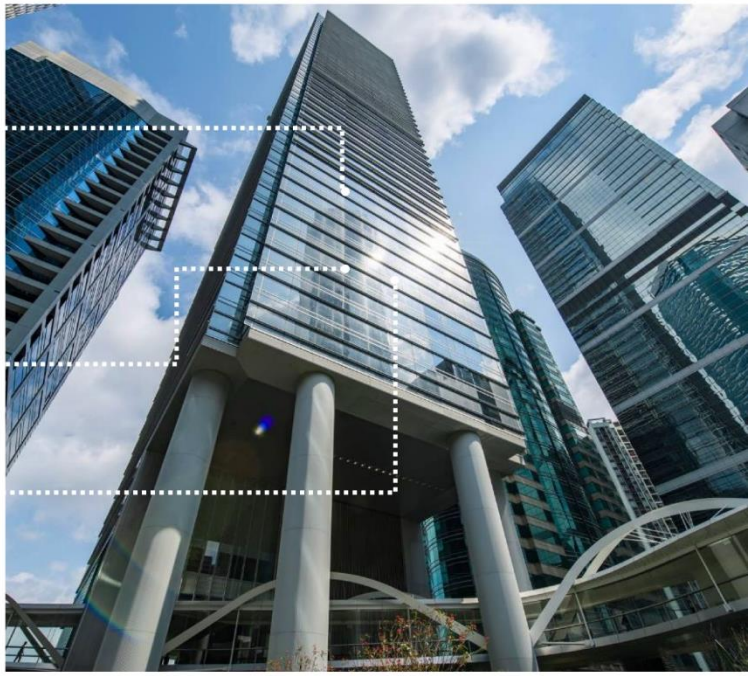
Local Case Studies

ONE TAIKOO PLACE



High performance façade

Curtain walls equipped with extra wide panels maximizing sunlight

Solar responsive façade

One Taikoo Place, completed in 2018, is part of a redevelopment project of Taikoo Place, featuring eight other properties to create one of Hong Kong's best-planned business hubs. The redevelopment is an ongoing milestone project to realise Swire Properties' long-term vision to creative planning and community building. Through collaboration with international designers, Taikoo Place has become a vibrant office space surrounded by landscaped gardens, water features, restaurants, and cafes.

As part of the redevelopment project, One Taikoo Place was designed to the highest standards of efficiency and sustainability, combining the latest and most advanced sustainable/green technologies. During development, over 78% of the demolition debris was recycled in compliance with BEAM Plus requirements, and 68% of the construction waste was also recycled. The building is committed to elevating human health and the wellbeing of its occupants through implementing WELL Certification, and other smart and sustainable endeavours.

2.5% renewable energy generated

33% energy reduction annually

Adoption of high efficiency chiller and AHU with EC plug fan

Adoption of Neuron, AI smart building console

69,000 sq. ft. of green space/ landscaped plazas

Rainwater collection

Local Case Studies

DOUBLE COVE

Adoption of rainwater recycling system

BIM to achieve better planning, design and quality of construction and minimize waste

Use of low-VOC materials for enhanced indoor air quality

Hybrid ventilat shopping arcad

Woodland and total landscape area is over 40% of total site area

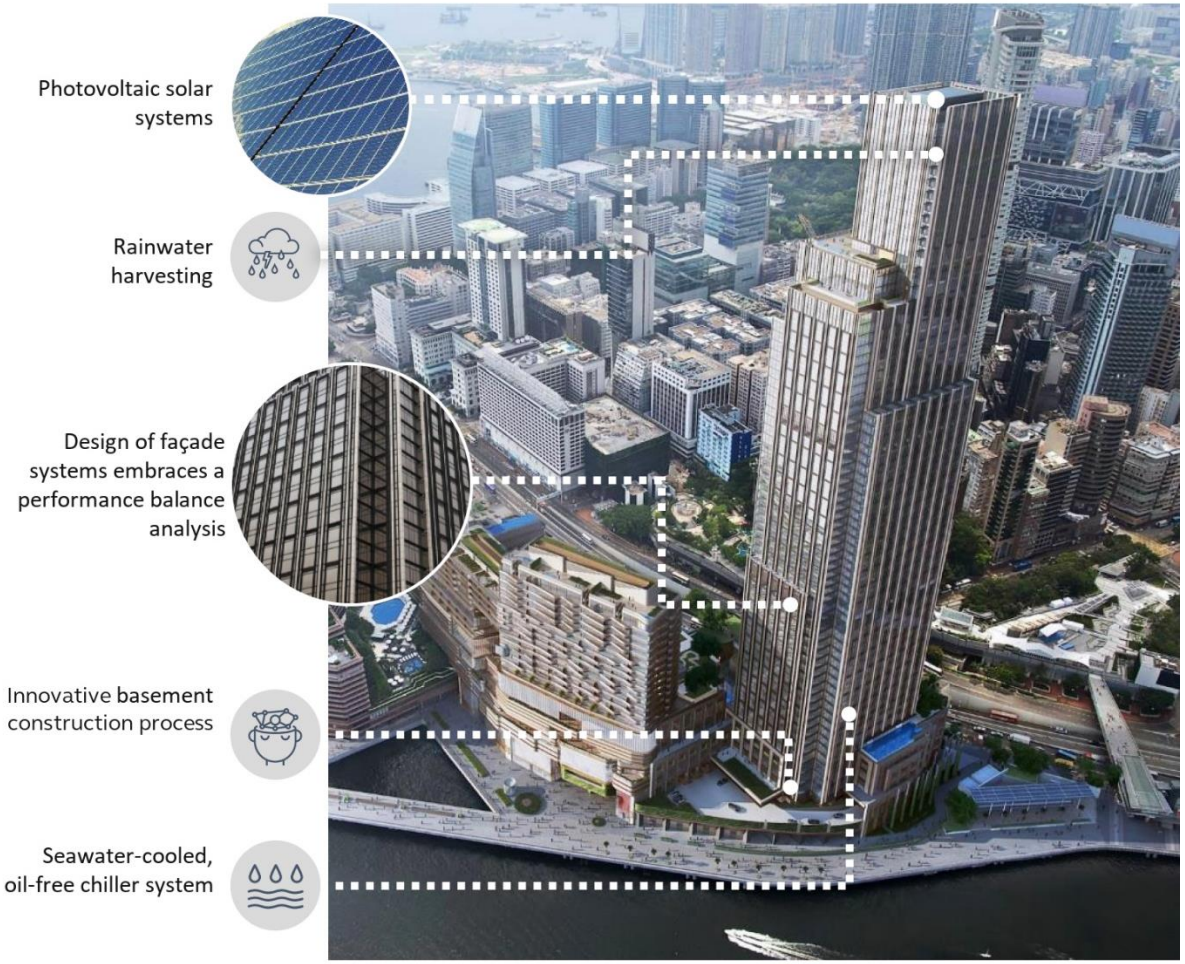
Communal bike rental services an over 80% EV char stations

Indoor air quality sensors and ventilation control

Home automation system accessed from smart devices

Local Case Studies

K11 (Victoria Dockside)



Local Case Studies

EXCHANGE SQUARE

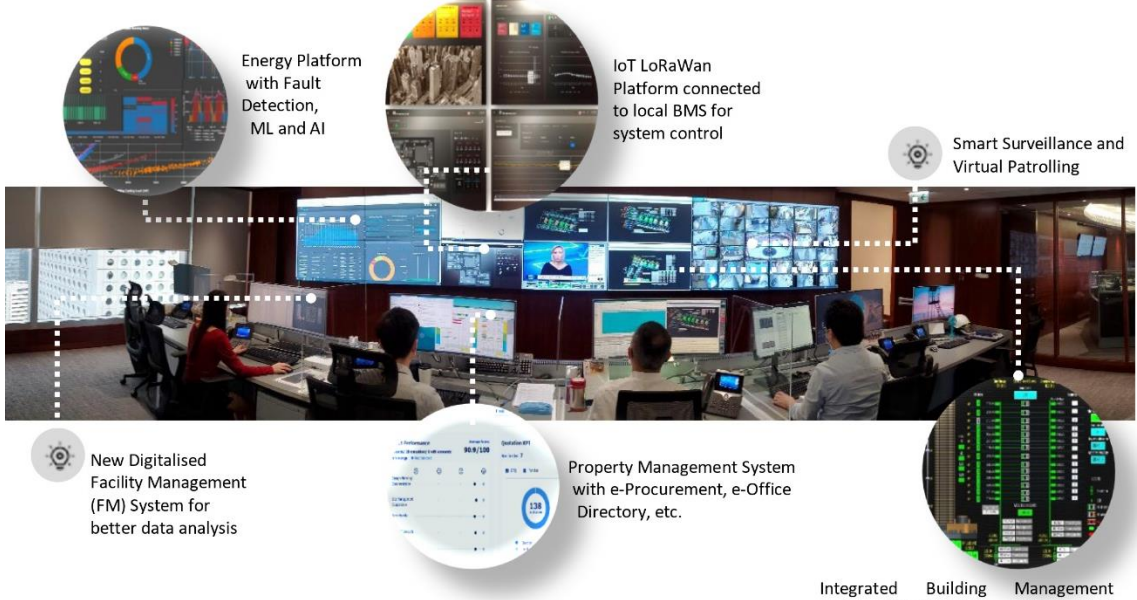
In App IAQ monitoring and smart thermal comfort

Smart LED lights with season colour mode

Cadmium Telluride (CdTe) power glass

Smart escalator monitoring for predictive maintenance

Nanotechnology for enhancing hygienic and cleaning conditions



Energy Platform with Fault Detection, ML and AI

IoT LoRaWan Platform connected to local BMS for system control

Smart Surveillance and Virtual Patrolling

New Digitalised Facility Management (FM) System for better data analysis

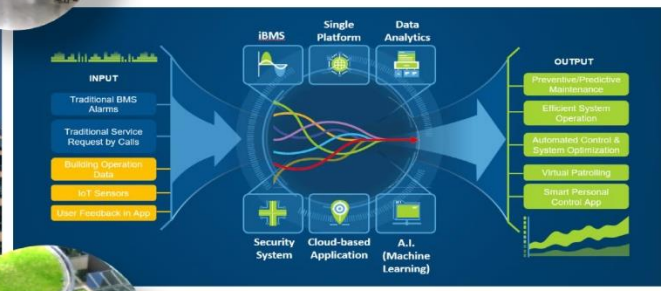
Property Management System with e-Procurement, e-Office Directory, etc.

Integrated Building Management System (iBMS) Platform for central monitoring, predictive and preventive maintenance

Integrated Smart Management Concept

Smart Thermal Comfort Control with Self-Learning on Users Preferences

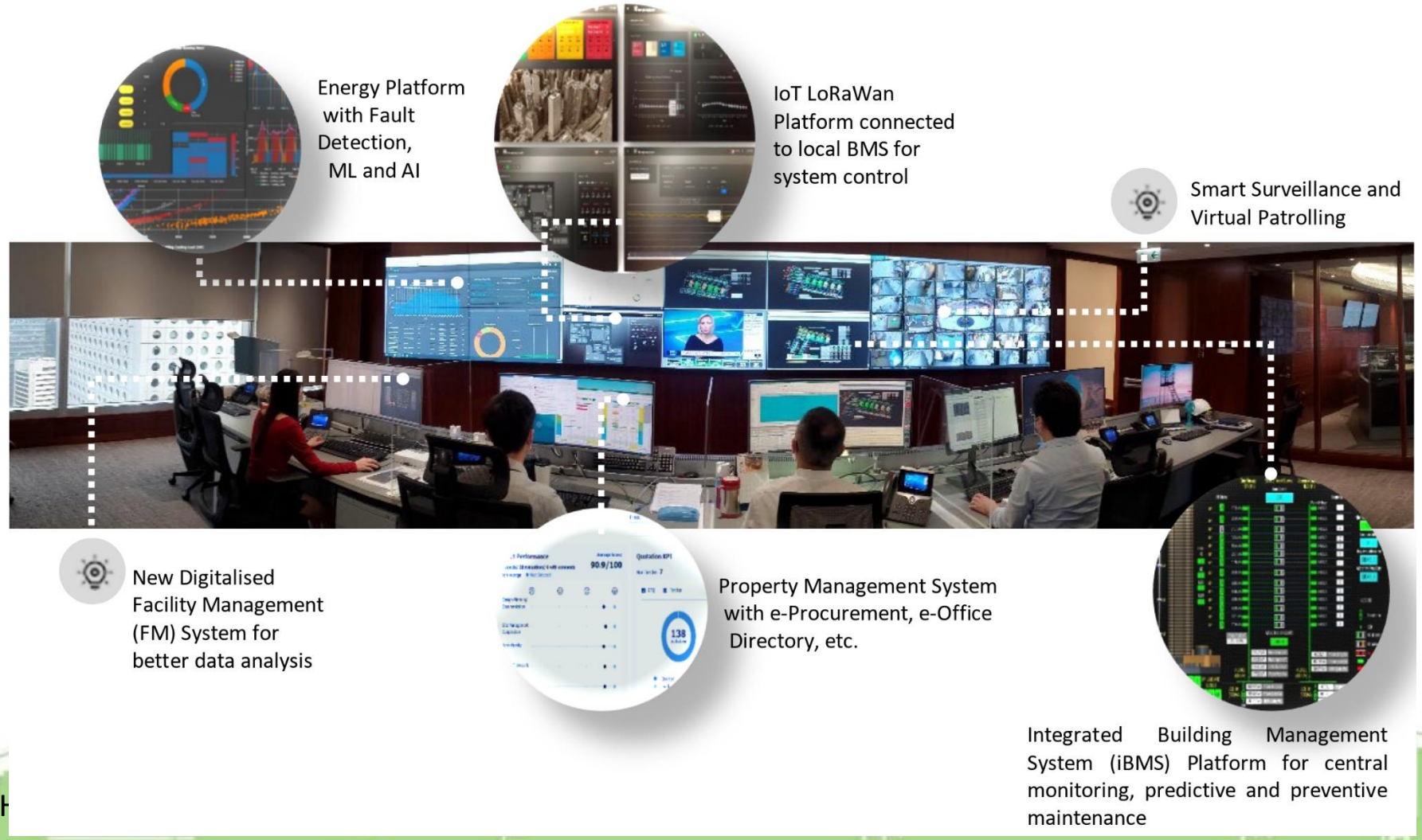
Energy Efficiency Equipment, Smart Metering and Innovative Technologies are widely adopted during upgrades, renovations and retrofitting works, applying an integrated smart management concept



Green ideas such as Green Roof, PV System, Food Waste Decomposer, Water Saving Faucets, etc. are in place

Local Case Studies – Exchange Square

Centralised Monitoring Centre at Exchange Square

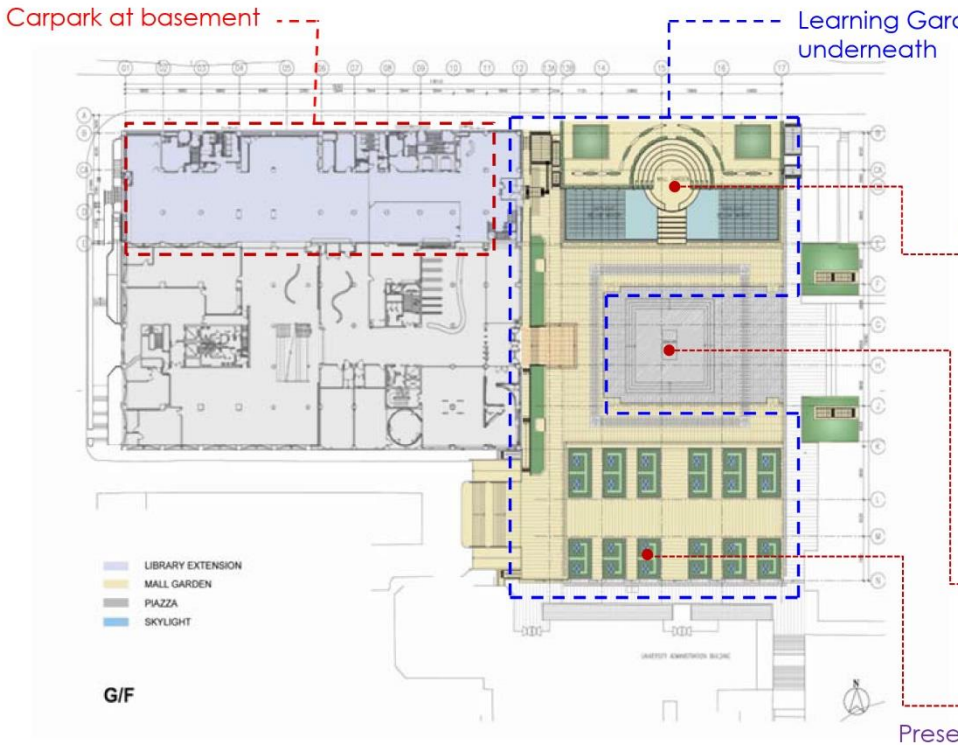


9 Green Campus & Learning Commons

University Library Extension Building, The Chinese University of Hong Kong

Preserve our History & Collective Memory

Piazza, Mall Garden and Landscaping preserved with about 3,000sq.m. CFA new Basement underneath



Mall Piazza

Restore Mall Garden

Mall Garden restored with Pools & Skylights

Beacon kept intact

Preserve Historical Bushes Patterns with new In-filled Skylights

Mall Piazza

Preserve our History & Collective Memory

Innovative Basement Design

After renovation

During construction

Before renovation

Innovative Learning Garden

Creative Environment at LG with Under-pool Skylights;

Natural light provision for underground space
Dynamic natural light effect to enhance creativity
Visual connection to outdoor nature
Water feature to mitigate heat island effect

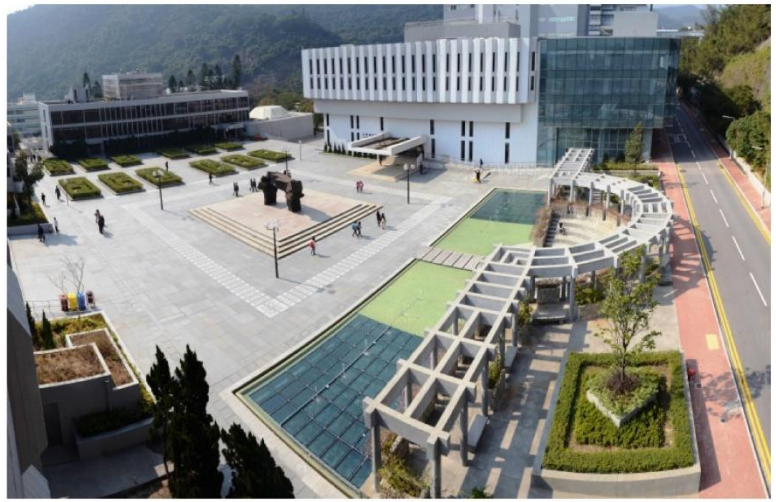


Photo by ULS, CUHK

Electrical roller blinds

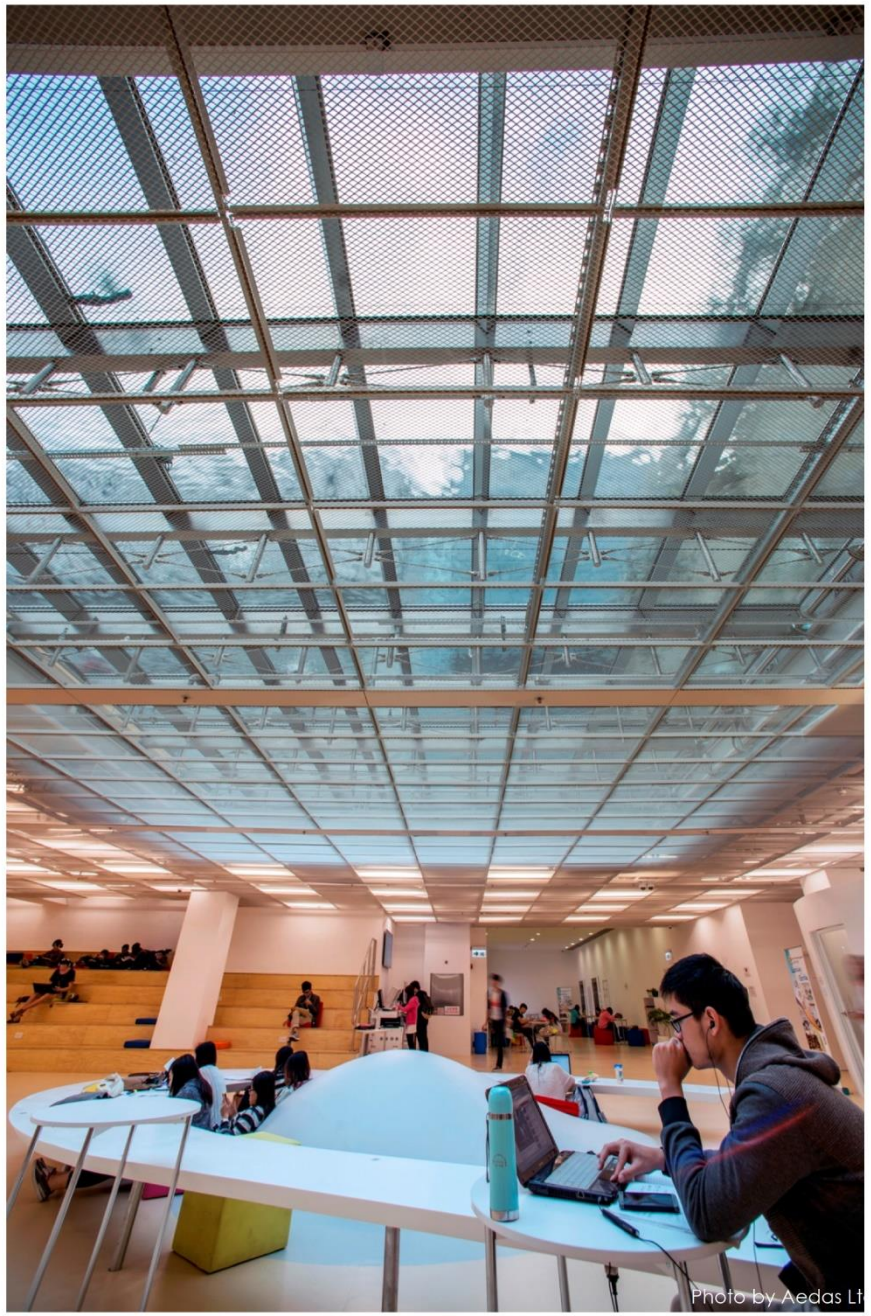


Photo by Aedas Lt

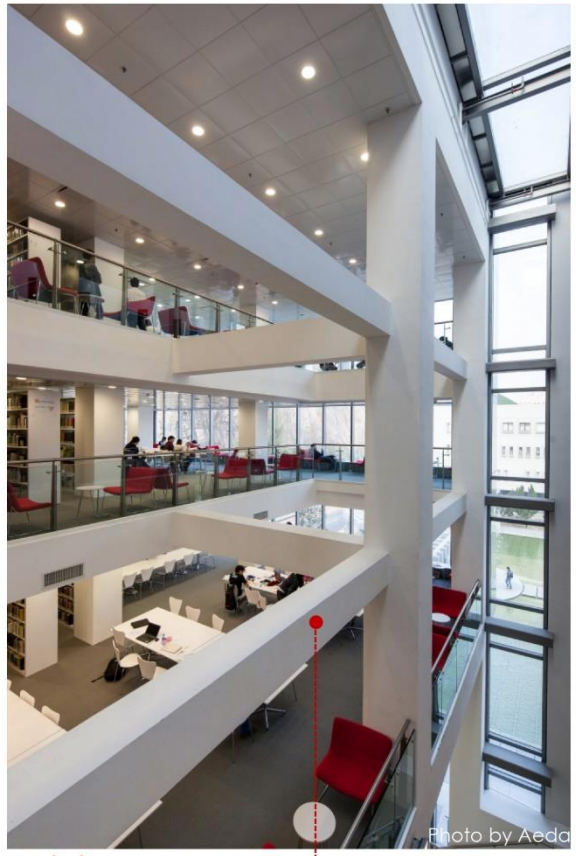
Miniature District Cooling System to save energy

- **Shared the cooling capacity** of the chiller plant system from adjacent buildings;
- **Diversify the loading profile** via utilizing different operation schedule of buildings
- **Reducing the peak electricity demand**

Life Cycle Perspective

Share facade with the existing adjoining buildings

Less one major façade and to **save construction materials**



No south façade in extension building

Existing building facade

Before construction of the Extension Building

Adaptive Reuse of Existing Materials

Adaptive reuse of existing stones cladding for the Forum, hence reduce the waste disposal

Adaptive re-use of old furniture to reduce waste disposal

Furniture layout plan at typical floor

Preserve Existing Façade & Mall Garden

After renovation

Before renovation

RESTORE THE HISTORICAL MALL GARDEN

Photo by Aedas Ltd

PRESERVE THE EXISTING HISTORICAL FACADE

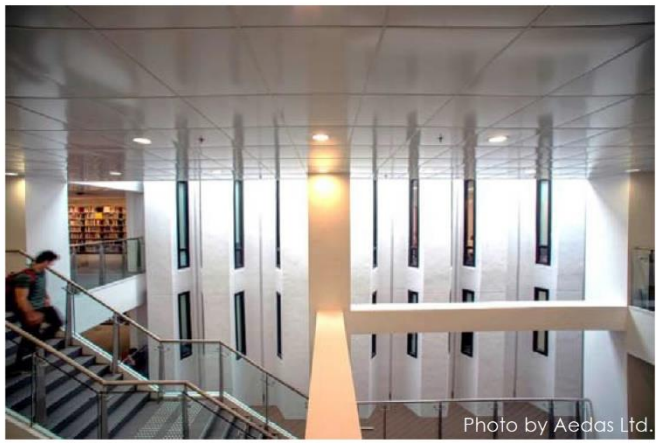
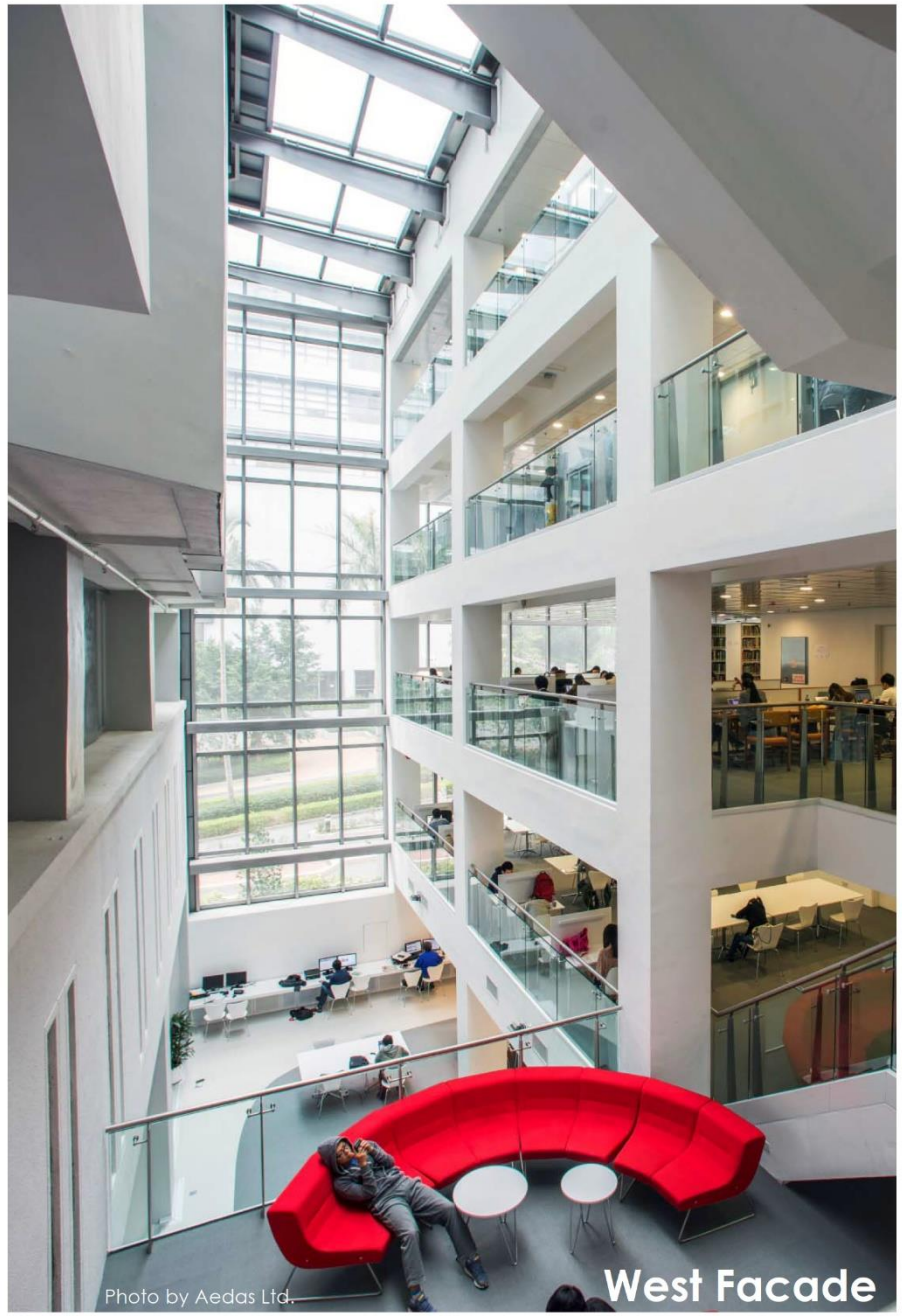


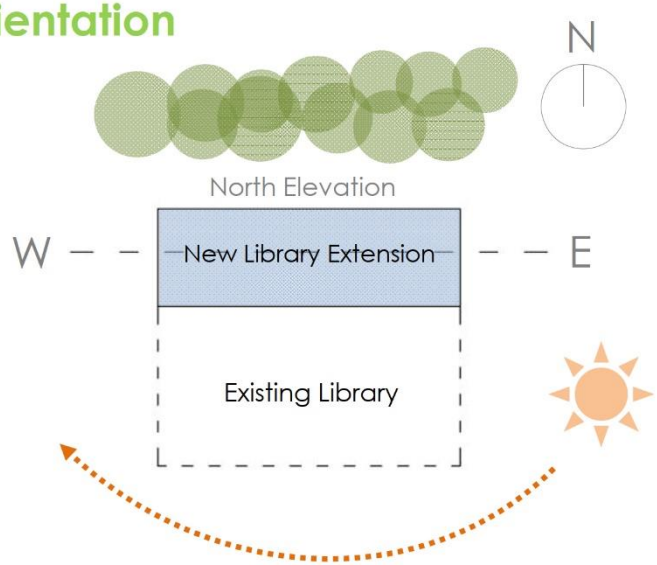
Photo by Aedas Ltd.

Photo by ULS, CUHK

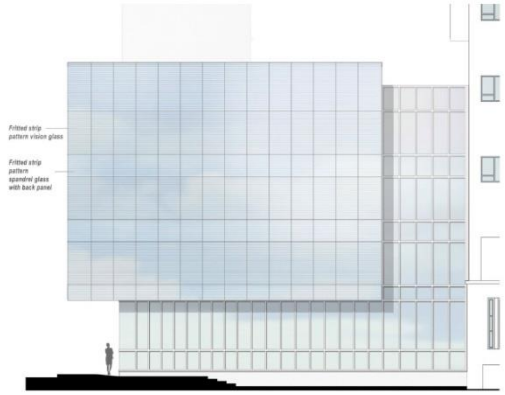


Passive Building Design

Orientation



Building elongated along the East-West axis so as to minimize heat gain

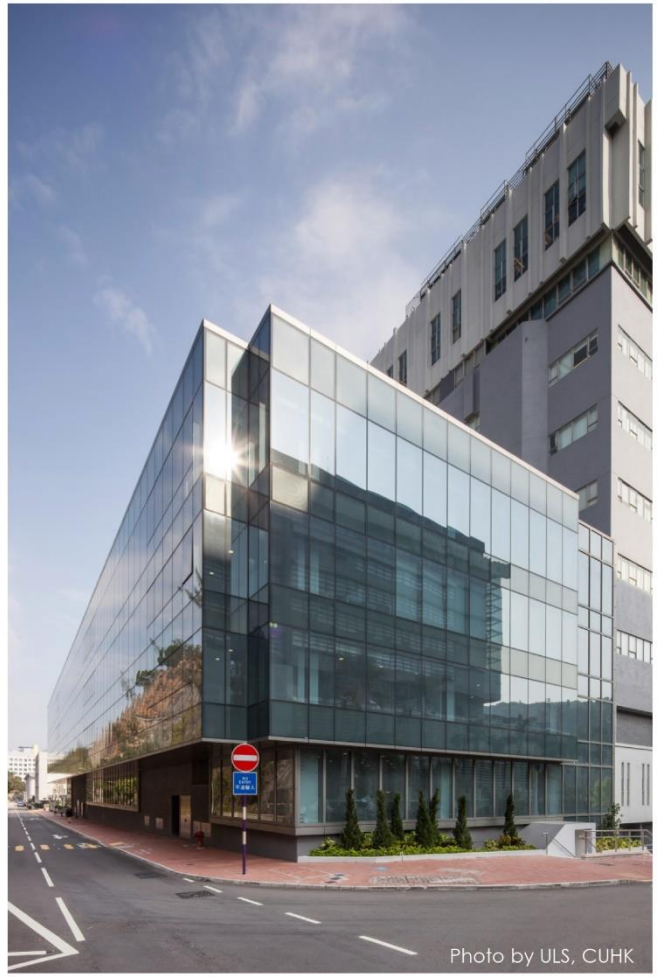


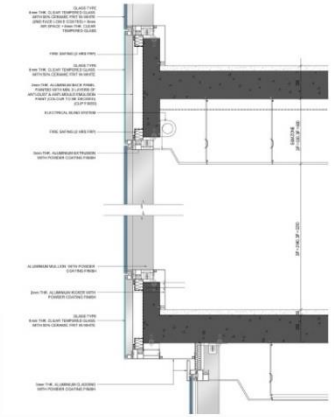
Shorter length at East & West Facades

Indoor Environmental Qualities

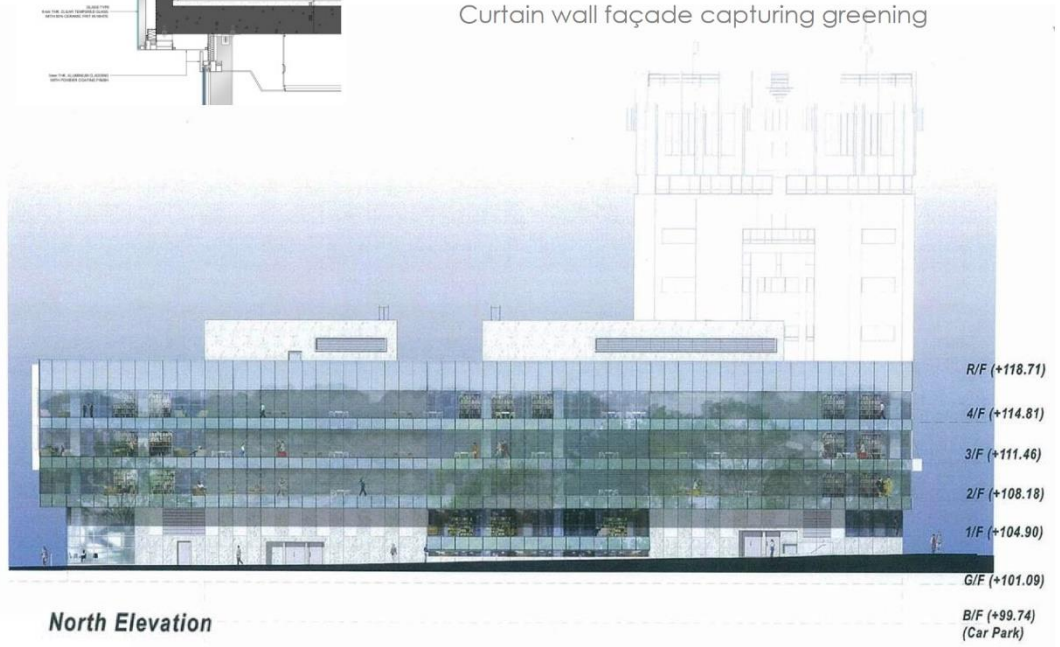
Long elevation along North to **capture greening** and **diffused day light**

North – facing main façade to minimize glare and heat penetration





Curtain wall façade capturing greening



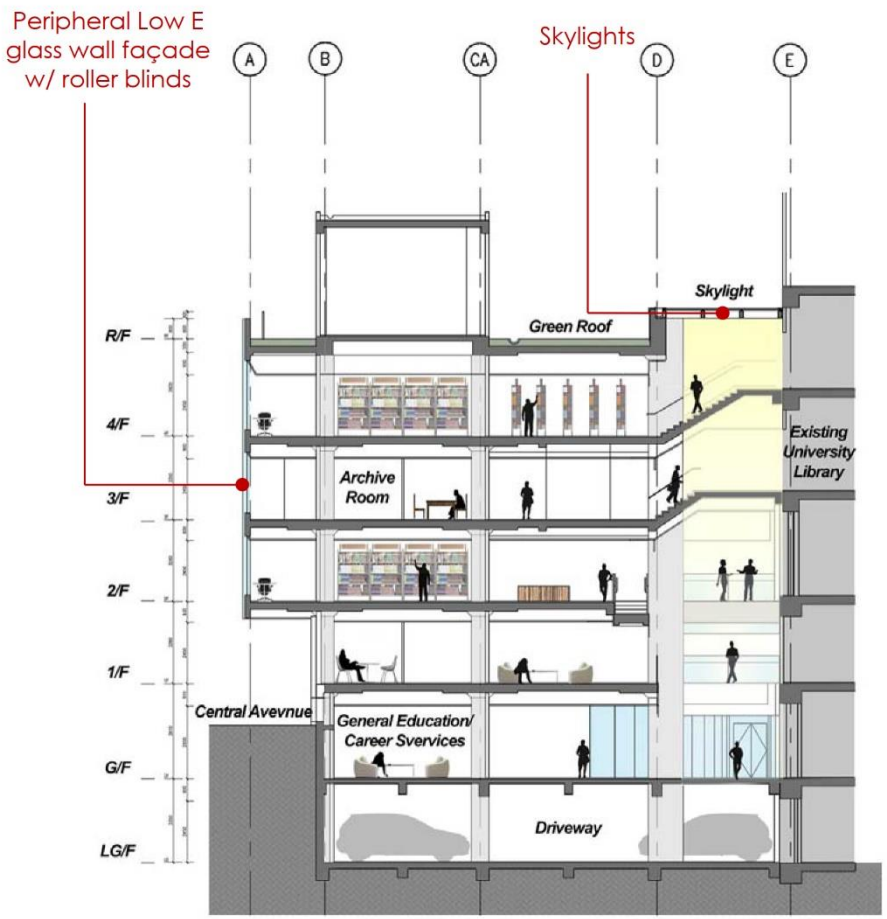
Indoor Environmental Qualities

Bring **natural daylight** and **natural environment** into the interior

Low-E insulated glass panels with fritted dot pattern to reduce heat gain

Indoor Environmental Qualities

Natural Daylight



Under-pool skylights at LG/F with sun shading device, and the water also provides cooling effect to underground space

Skylights and **Low-E glass** walls between new and existing building

Indoor Environmental Qualities

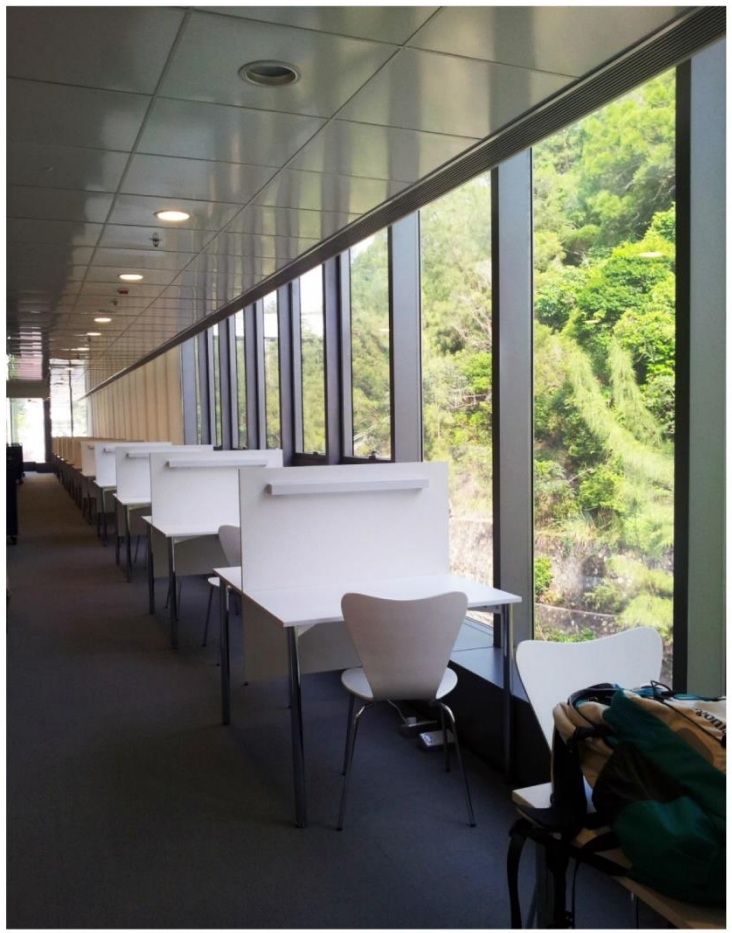
Acoustics

- Façade: **Double glazing** provide effective acoustic insulation from the adjacent road traffic, provide a quiet learning ambience

- Adopted low flow low noise **variable air volume** (VAV) A/C system

- Noise level reduced from ambient of **80dBA** road traffic noise with busy school buses to **35dBA** measured inside Library space

Adopted low flow low noise VAV A/C system



Water Conservation and Material Used

Rainwater and Condensate Water Collection System

Central collection of rain water and condensate water to Lake ad Excellentiam at Chung Chi College for irrigation/cooling tower/flushing

Lake ad Excellentiam

Filtration Plant

Sand filters

Water Conserving Sanitary Fittings

Dual flush for WC

Sensor tap

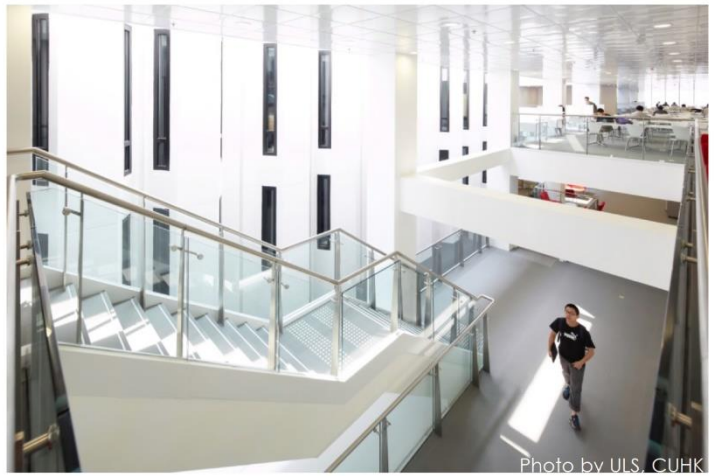
Sensor flushing for urinals

Environmental Friendly Building Materials

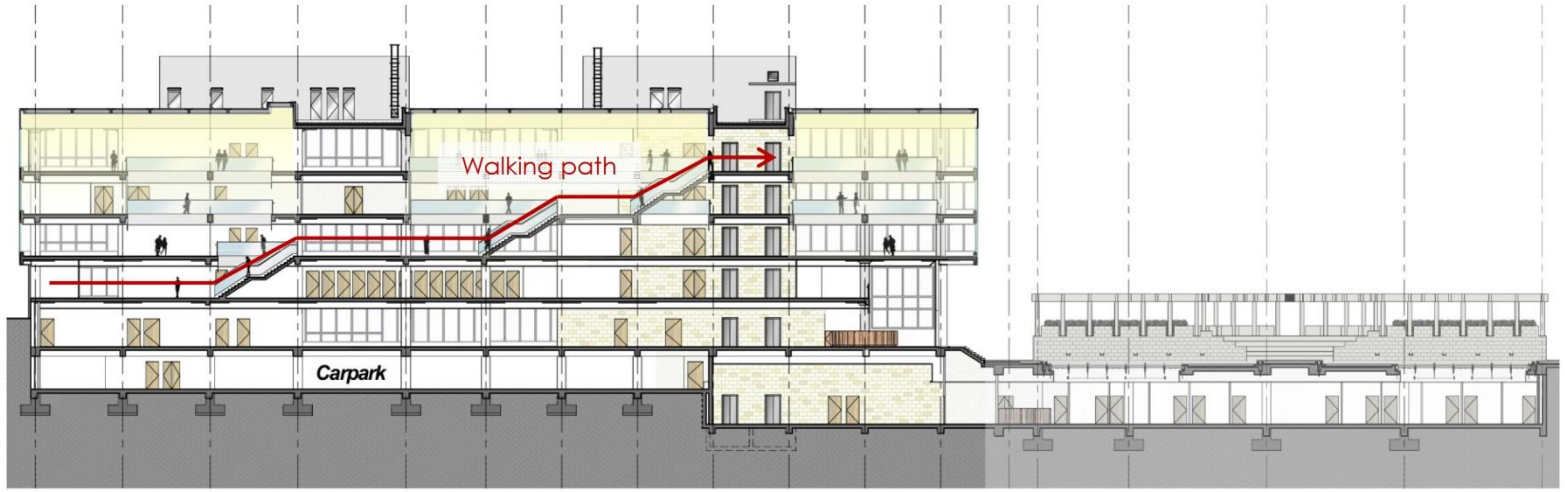
Rubber Flooring

Vertical Circulation

Voids and Grand Stairs to connect and encourage walking between floors



Reduce the use of mechanical services and energy consumption



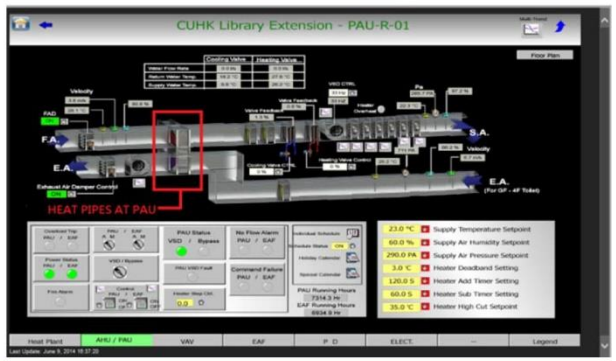
Green Features

Thermal comfort

- **Fresh Air Control** by means of CO_2 sensors and Heat Pipe
- **Car Park Ventilation Control** by means of NO_2/CO sensors

CO_2 sensors at occupied space to minimize fresh air supply to reduce energy consumption

CO_2 sensors at nose level



Heat pipe at Primary Air Handling Unit for heat recovery of exhaust air from building

High efficient **heat pump unit** for dehumidification and space heating

Green Features

Natural Lighting and Photo sensors

along perimeter of the building

Photo sensors installed along windows

Perimeter zone Lighting off during daytime, and natural daylight is also diffused into the library.
The measured lux level is over 1000 lux during daytime in general even lightings are off.

Solar landscape lighting

Green Features

Provisions for energy management

Lighting off during unoccupied condition

Task lighting
To reduce the background lux level at study carrels

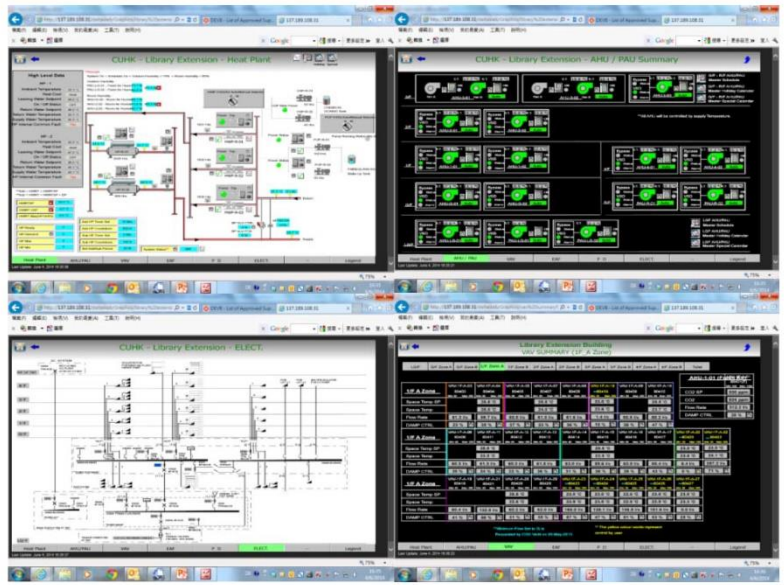
Lighting on when people walk-in

Motion sensors
along bookshelves

Motion sensors
inside toilets

LED spot lights

Building Amenities



Web-based Building Management System for effective control and monitoring of M/E services ;

provides flexibilities to fine tune performance zones and modes

Web-based energy meters to monitor power consumption:

- for major sub-main distributions
- for air conditioning plants

Innovation – Spatial Adaptability for Sustainable Use

Open Plans for Flexible Learning Spaces

- **Flexible lighting zonings**
  Over hundred small zonings for flexible arrangement for future partitioning

- **Flexible furniture layout**
  Tables and chairs can rearrange by user in different situation

- **Flexible air-conditioning zonings**
  Over 40 zones Variable Air Volume Boxes for cool air distribution at each floor for flexible A/C arrangement for future partitioning

- **Flexible furniture layout**
  Raised floor with evenly distributed floor sockets inside floor boxes

Photo by ULS, CUHK

Flexible Learning Spaces with IT Infrastructure and Wide Structural Grids
provide different study modes and space utilization

Private self-study space

Self-learning space

Idea exchange corner

Group study space

Lecture

Forum & workshop

Photo by ULS, CUHK

University Library Extension Building, The Chinese University of Hong Kong

HKGBC
香港綠色建築議會

Green Buildings and Sustainable Built Development

Dr Benny CHOW
Hong Kong Green Building Council
Director of Sustainability at Aedas