

IEA Roundtable Advancing Super Low Energy Buildings in the Tropics

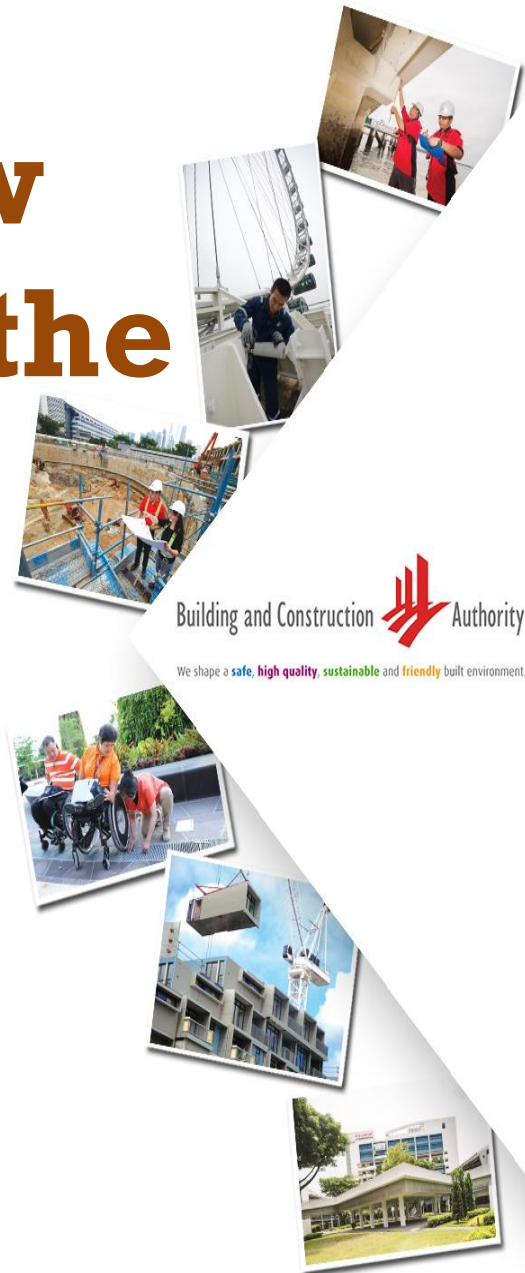
Singapore International Energy Week

29 Oct 2020

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Principal Manager (Green Building Technology)

Building & Construction Authority



Building and Construction Authority
We shape a **safe**, **high quality**, **sustainable** and **friendly** built environment.

OUTLINE

- Challenges and Opportunities
- SLE Strategies
- Green Buildings Innovation Cluster Programme

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Local Building Landscape



Climate : **Hot & Humid**

Land area: **Scarce**

Renewable Energy Options: **Limited**

Physical : **High-rise & Dense**

Roof Space: **Small & competing services**

BUILDINGS

Behaviour: **Reliance on air-conditioners**

Energy consumption: **High**



LIFESTYLE

Singapore's context:
High Rise High Density Urban Tropics



Solar as
Renewable Energy source

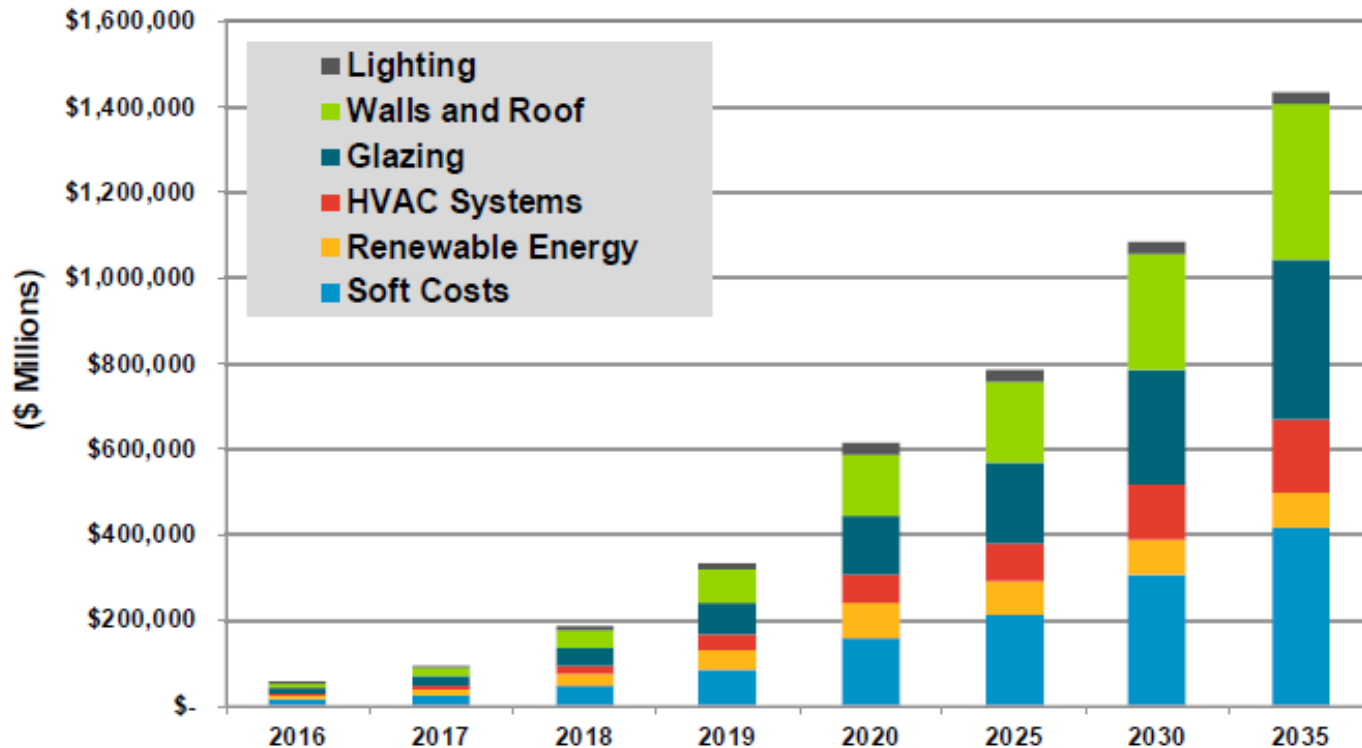
All new buildings must operate at net zero carbon from 2030

100% of buildings must operate at net zero carbon by 2050



World GBC

Chart 1 *Total Zero Energy Building Revenue by Product/Service, World Markets: 2016-2035*



(Source: Navigant Research)

OUTLINE

- Challenges and Opportunities
- **SLE Strategies**
- Green Buildings Innovation Cluster Programme

Super Low Energy (SLE) Programme

BCA launched the SLE Programme to encourage cost-effective and energy-efficient building designs

Towards 60-80% energy efficiency improvement over 2005 levels by 2030



International Built Environment Week , Sept 2018



SLE Technology Roadmap

- Leveraging on Research & Innovation
- Green Building Innovation Cluster (GBIC)



Green Mark for SLE

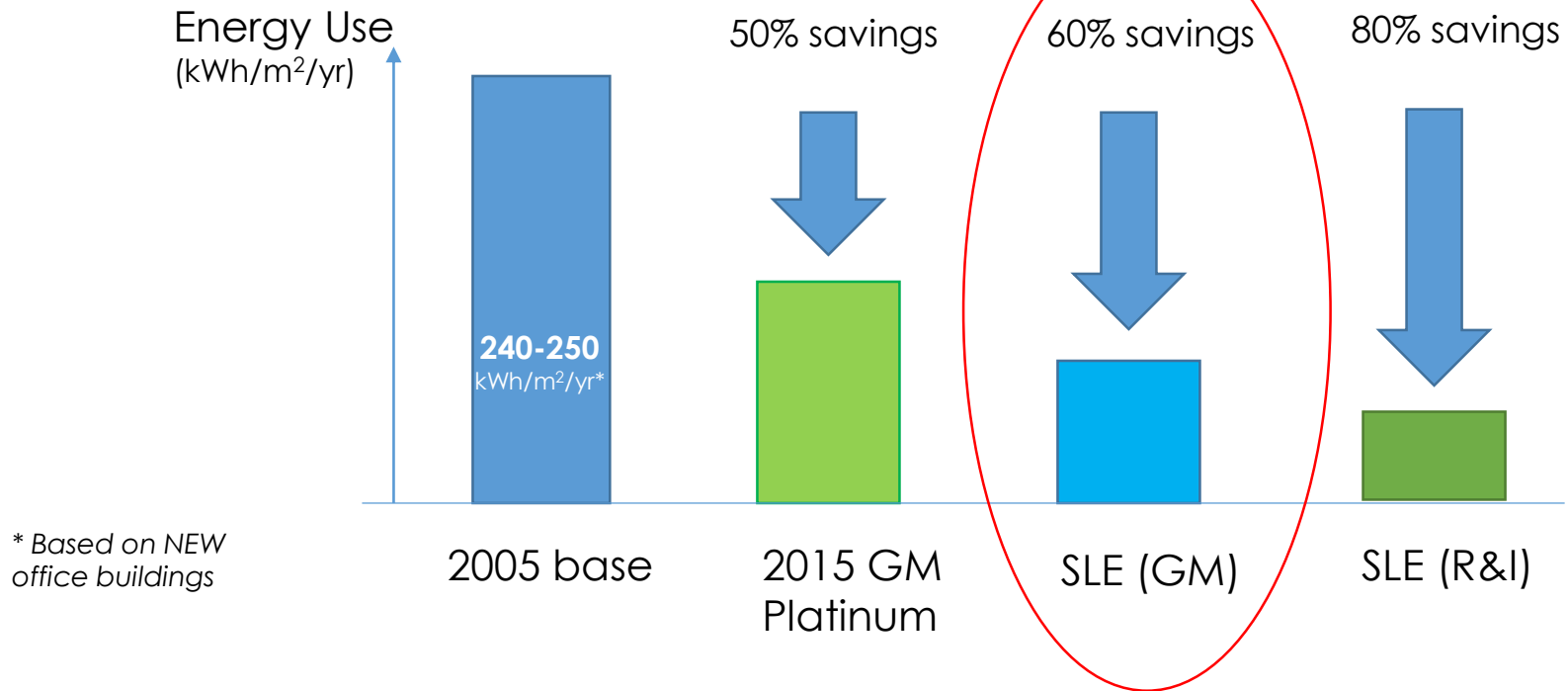
- SLE Challenge
- Recognition for SLE projects to facilitate mass deployment



Raising Industry Capability & Awareness

- SLEB Smart Hub
- Case studies & technical workshops & courses

What is SLE Building?



Super Low Energy Building (SLEB)

“The best-in-class energy performing Green Mark Building that achieve at least 40% energy saving based on prevailing code”

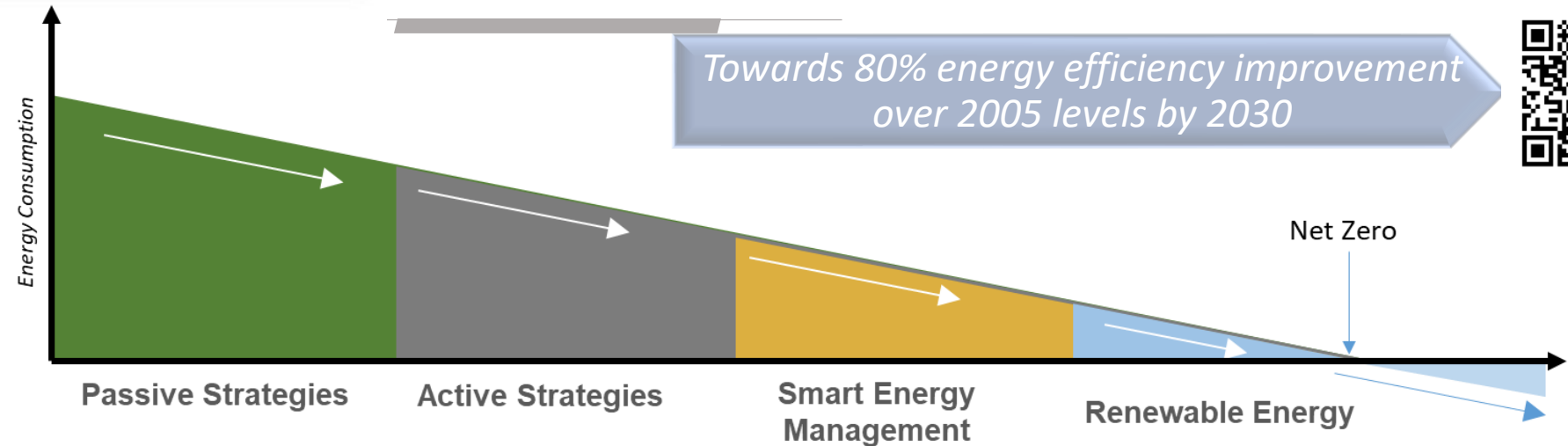
Zero Energy Building (ZEB):

“The best-in-class energy performing Green Mark Building with all of its energy consumption, including plug load, supplied from renewable source”

Super-Low Energy Technology Roadmap



Towards 80% energy efficiency improvement over 2005 levels by 2030



Sunlight Shading

- Solar analysis
- Shading devices
- Interblock shading

Natural Ventilation

- Site planning & orientation
- Building massing
- Cross ventilation
- Induced ventilation
- Thermal comfort modelling

Facade & Daylighting

- High performance glass & wall
- Cool materials/greenery
- Air-infiltration control
- Air-con space reduction
- Daylight redirection

Air-conditioning

- High COP chiller with low lift & friction
- Non-compressor cooling
- Decoupled latent & sensible cooling with desiccant/membrane
- High temperature cooling using radiant / convective / hybrid effect

Mechanical Ventilation

- Displacement ventilation
- Personalised ventilation
- High Volume Low Speed fan
- Brushless DC motor

Lighting Technologies

- High efficiency LED
- Dimmable lighting
- Digitally addressable lighting

Building Automation

- Fault detection and diagnostics (FDD)
- Energy Management System
- Occupancy sensing & demand control
- Weather sensing & system resetting

Smart Control

- Model predictive control
- Machine learning
- IOT integration with BMS
- Personalised control of lighting/ACMV

Plug Load Management

- Smart plug
- Load monitoring and tracking
- Sleep mode optimisation

Roof & Site Optimisation

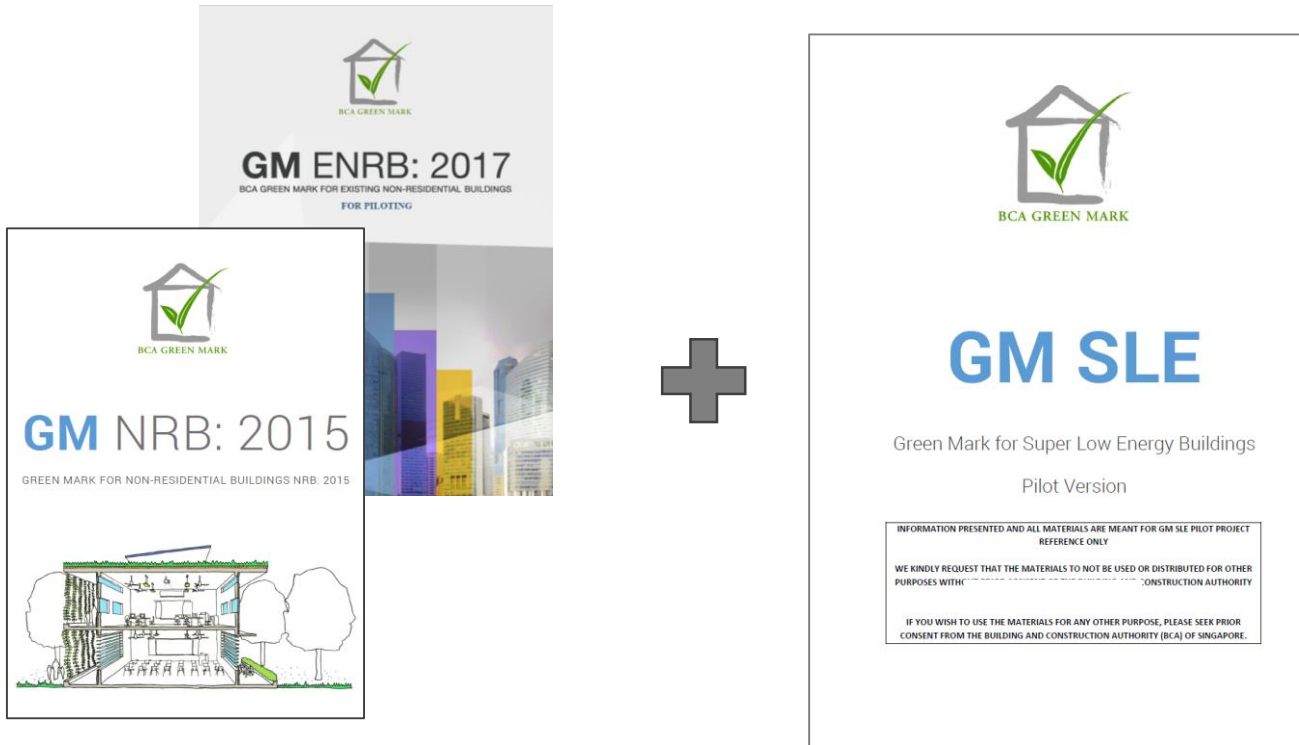
- Maximising roof and façade spaces
- Site planning for solar utilization

PV Technologies

- Highly efficient module
- Anti-shading design
- Anti-degradation system
- High performance BIPV
- PV integration with greenery
- PV energy management

**> 60 Key Technologies
in 4 Broad Strategies**

Green Mark for Super Low Energy (SLE) Buildings



41 new and existing projects have been awarded SLE certification with 14 on-going SLEB projects

Raising Industry Capability and Awareness



Seminars and Workshops conducted for Academia and Industry



Please click on each title (if available) to view the full information for each content.

Issued by GBIC Secretariat Singapore



Site visits and Publications

OUTLINE

- Challenges and Opportunities
- SLE Strategies
- Green Buildings Innovation Cluster Programme

Industry Clients' involvement with IHLs/RIs

Roadmaps

Applied
Research

Prototype
& Testing

Pilot &
Demo

- Guidelines & Standards
- Projects Adoption

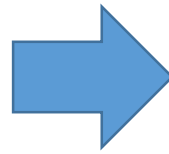
Building and Construction Authority

SUPER LOW ENERGY BUILDING
TECHNOLOGY ROADMAP



Green Buildings Innovation Cluster Programme

GBIC



Super Low Energy



S\$ 52 Million
Programme

Catalysing technology development

Funding innovation piloting for SLE buildings

Sharing of latest technology with industry

GBIC Innovation Challenge Calls Advancing Super Low Energy

Smart Building Technologies

1) Industry-led

2) Client-driven (Strong commitment from building owners/ developers)

3) Demonstration in an operational environment in actual buildings

4) Integrated smart solutions to improve 20% energy savings

Alternative Cooling Technologies Partnership with CoolestSG Consortium

1) Review of Existing ACT solutions

2) Develop/enhance ACT solutions

3) Solutions close-to-market

4) Effectiveness on IAQ and Thermal comfort



Advanced “real-world” test facility for green building technologies in the tropics



Demonstration in real world settings



To promote and bring innovations closer to market adoption



To aid policy formulation



To gain performance data and set new benchmarks for energy efficiency improvement in buildings

Demonstration in real world settings

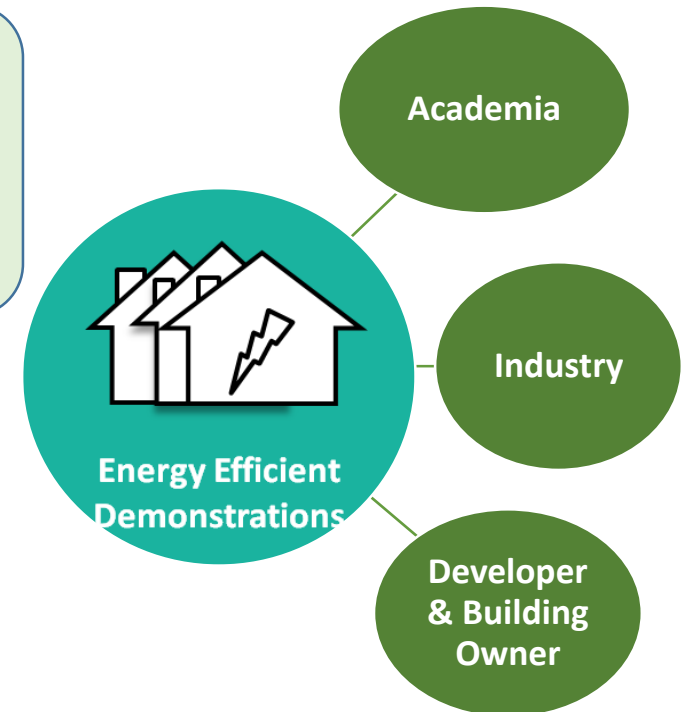
Supports large-scale demonstration of promising energy-efficient technologies integrated to achieve greater energy savings for the building.

Target: 20% energy savings from GM Platinum, or EUI to top 10%

Encourage building owners and developers to demonstrate innovative energy efficient technologies:

- i) Developed from R&D and/or
- ii) Proven technologies not widely adopted.

- Validated performance through stringent M&V protocols
- Co-funding (up to 70% or \$3m whichever is lower)



ZERO ENERGY BUILDING@BCA



> 30 technologies test-bedded



SEA's first retrofitted Zero Energy Building

- Operational since 2009
- A fully functional building for office and institutional use
- Demonstration and educational platform for Green Building Technologies
- >35,000 visitorships

ZEB PLUS – TOWARD POSITIVE ENERGY BUILDING

4 Key Focus



Cooling



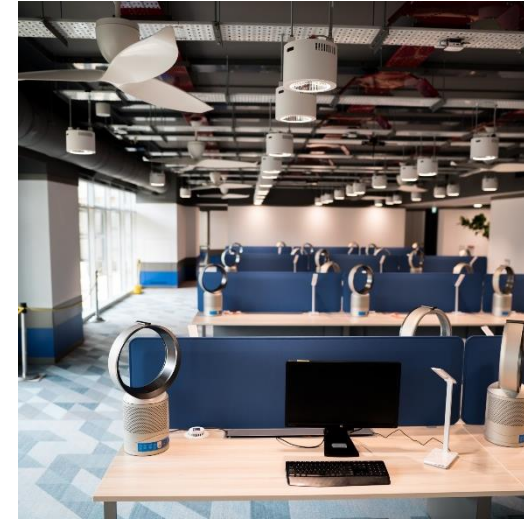
Ventilation



Lighting



Plug load



	New PV System
Generation (MWh/yr)	249*
Efficiency (%)	22.3
Installed Capacity (kWp)	195
Capacity/Panel (Wp)	395
Generation Surplus (%)	40 (Target)

Target to achieve Positive Energy with 40% Energy Surplus production

A Mid-rise ZEB in the city centre SMU-Connexion



- Passive Displacement Cooling (PDC)
- Dimmable LED system based on data analytics and machine learning
- Smart building control with open platform

**Overall energy savings 45%
better than current Green Mark
Platinum standard**

SMU-Connexion (SMU-C)
[Photo courtesy of SMU]

Start-up to provide
professional services
for PDC design



Super Low Energy (SLE) for Existing Commercial Buildings Keppel Bay Towers

BCA-Keppel Land Joint Challenge Call

To achieve **overall energy savings** of at least **20%** better than the best-in-class Green Mark Platinum buildings



5 Technologies Selected
out of
53 Submissions

- Integrated sensors for fresh air control
- Autonomous lighting system
- Physics based intelligent building control
- Super efficient air-handling unit fan system
- Cooling tower water management system

Overall energy savings 20% better than current Green Mark Platinum standard

Keppel Bay Tower



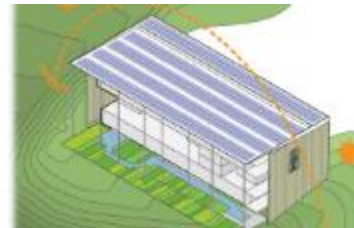
NUS SDE4 : Net Zero Energy Building



1. Passive Strategies



Over-sailing roof



2. Active Strategies

Hybrid cooling system using ceiling fans and air-conditioning set at a higher temperature



3. Smart Energy Management

- Extensive sensors for lighting and cooling systems



4. Renewable Energy

- Latest high efficiency photovoltaic (PV) panels to offset 100% of its energy consumption



EUI: 58.4kWh/m²/yr

Project Team:

Client: NUS

Designer: Serie + Multiply Consultants

Architect/MEP/ESD: Surbana Jurong

Specialist: Transsolar Energietechnik



- What is SLEB Smart Hub
- A digital platform to help building owners to source for green building technologies and services to achieve the SLEB targets.



- Who are the users
 - ✓ Building owners
 - ✓ Technology providers
 - ✓ Service providers
 - ✓ General public



- How it helps
 - ✓ Data and knowledge
 - ✓ AI-enabled analytics
 - ✓ Value added services
 - ✓ Enable collaborations

Super Low Energy Smart Hub

GREEN-TECH DIRECTORY



BUILDING ENERGY-EFFICIENT DATA



Technology Directory

- ✓ Comprehensive library of new and existing green technologies
- ✓ List updated as new products are registered



Smart Advisor

- ✓ Propose customized upgrades for building
- ✓ All-in-one glance of energy performance
- ✓ In-depth analysis for optimized energy efficiency



Building Dashboard

- ✓ 2000 building's data
- ✓ Benchmark against similar buildings
- ✓ Identify potential areas for improvement

THANK YOU