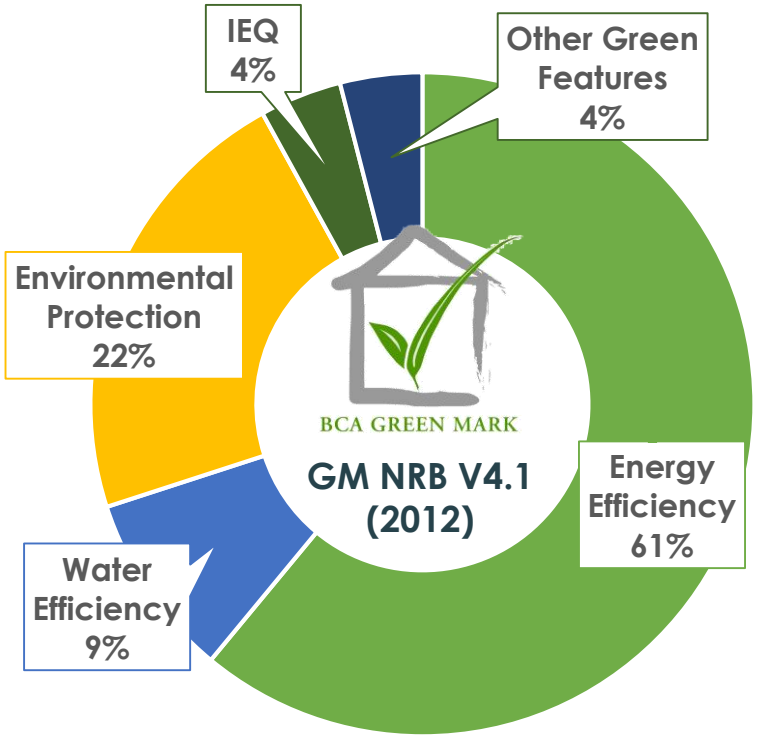
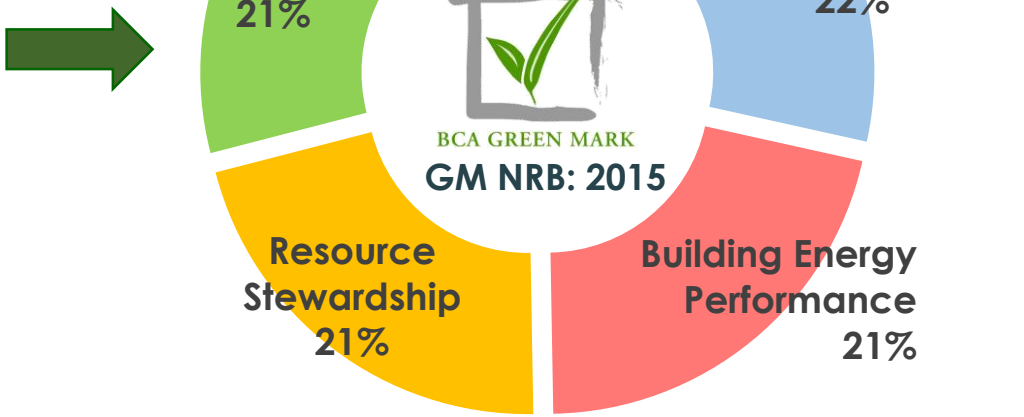
Building and Construction Authority

Singapore's Green Building Energy Efficiency Standards

Evolution of BCA Green Mark Standard





Launch of GM ENRB: 2017 at International Green Building Conference (Sep 2018)

- **Energy monitoring**
  - Sub-metering
  - Energy dashboard/ portal
- **Demand Control**
- **Integration & Analytics**
  - System integration & optimisation
  - Demand response
  - Preventive maintenance

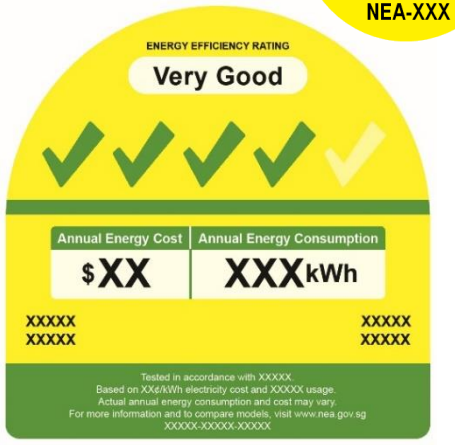
- **Occupant Comfort**
  - Post Occupancy Evaluation
  - Thermal comfort with elevated air speed
  - IAQ audit
- **Indoor Air Quality**
  - IAQ trending & monitoring
  - IAQ display
  - Demand control ventilation
  - Local exhaust & air purging system
  - Outdoor airflow monitoring system
  - MERV 14 filters for outdoor air filtration

Mandatory Energy Labelling Scheme (MELS) & Minimum Energy Performance Standards (MEPS)

Mandatory Energy Labelling Scheme (MELS)

- Air-conditioners
- Refrigerators
- Clothes dryers
- Lamps
- Motors
- Televisions

Minimum Energy Performance Standards (MEPS)



Local Building Landscape

Climate : **Hot & Humid**

Land area: **Scarce**

Renewable Energy Options: **Limited**

Physical : **High-rise & Dense**

Roof Space: **Small**

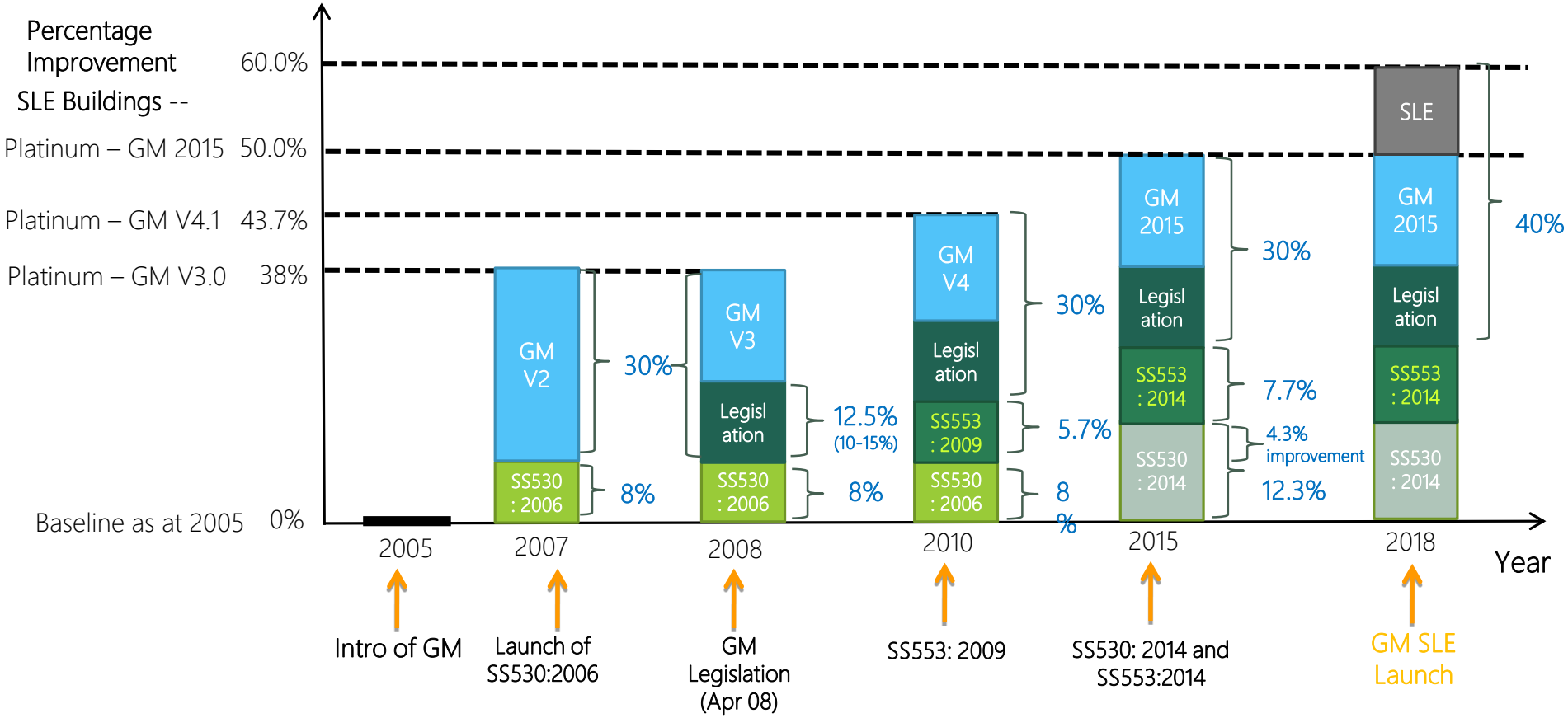
Behaviour: **Reliance on air-conditioners**

Energy consumption: **High**

Singapore's context:

High Rise High Density Urban Tropics

Best-in-class Energy Defined



Super Low Energy (SLE) Programme

To encourage cost-effective and energy-efficient building designs

SLE Challenge

Private Sector Companies

City Developments Limited

Keppel Land

SAMWOH

SURBANA JURONG

Institutes of Higher Learning

Nanyang Technological University Singapore

NUS National University of Singapore

SIT Singapore Institute of Technology

Singapore Management University

Public Sector Agencies

Building and Construction Authority

DSTA

jtc

National Parks

Sport Singapore

BCA Green Mark for Super Low Energy

GREEN MARK FOR SLE
- Best in class energy efficiency (>60% Energy Savings over 2005 building codes)
- Onsite and Offsite RE

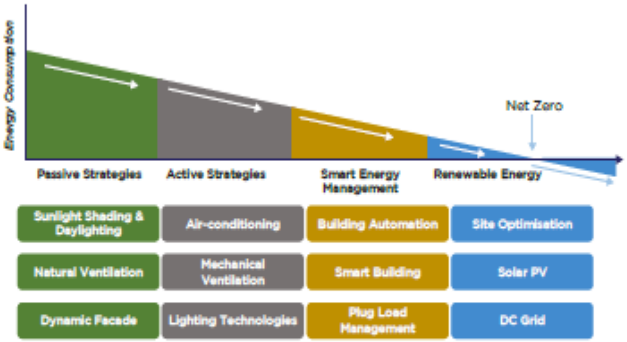
PASSIVE STRATEGIES
- Solar shading
- Natural Ventilation
- Facade and daylighting

ENERGY MANAGEMENT
- Building Automation
- Smart Control
- Plug Load Management

ACTIVE STRATEGIES
- State of the Art ACMV
- Mechanical Ventilation
- Artificial Lighting

RENEWABLE ENERGY
- Roof and Site optimisation
- Photovoltaic Technologies

SLE Technology Roadmap



Upcoming SLE Projects

KRANJI CAMP

New Non-Residential Building

BCA Green Mark Platinum Award
Zero Energy

Project Information

Estimated energy savings:
156,553 kWh/yr

Estimated water savings:
4,496.54 m³

SMU -X

New Non-Residential Building

Targeting BCA Green Mark Platinum Award
Super Low Energy & Zero Energy

Project Information

No. of Storeys: 5

No. of Blocks: 2

Total GFA:
20,206 m³

NUS SCHOOL OF DESIGN AND ENVIRONMENT (SDE 4)

New Non-Residential Building

BCA Green Mark Platinum Award
Zero Energy

Project Information

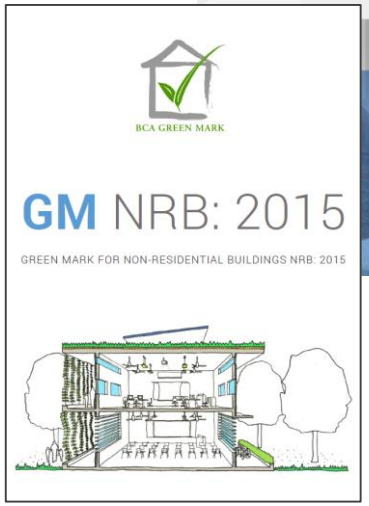
Total GFA: 8525.63 m2

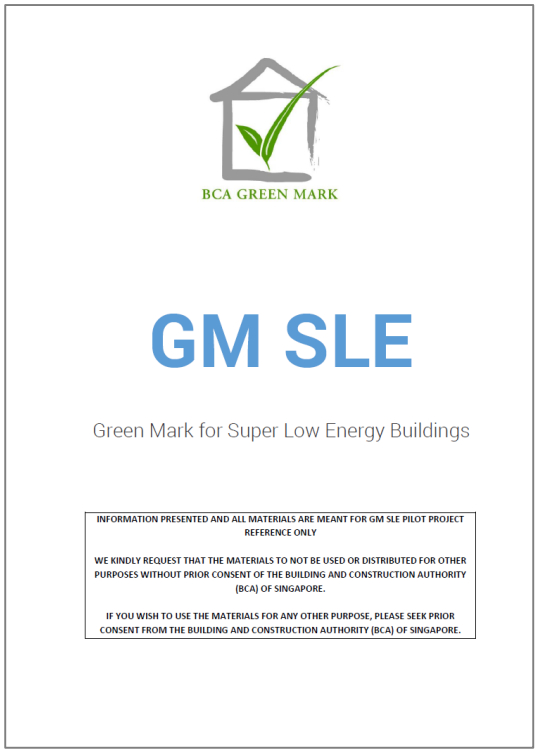
No. of Storeys: 6

Estimated energy savings:
292,900kWh a year

Estimated water savings:
6,607 m³

New Green Mark for SLE Buildings





Good LCC fro SLE and ZE Projects

Green Mark for SLE Criteria

Super Low Energy (NRB)

a. Minimum Green Mark Gold Award

b. 60% Energy Savings (10% above Platinum)

c. OR Benchmark EUI requirements for Buildings <5,000m2 AC FA &<500RT)

Super Low Energy (ENRB)

a. Minimum Green Mark Gold Award

b. Benchmark EUI requirements

c. OR Demonstration of Energy Savings

Zero Energy (ALL)

a. Minimum Green Mark Gold Award

b. RE ≥ Energy Consumption*

**Note on-site RE shall be optimised prior to use of off-site RE . Use of off-site has SLE conditions*

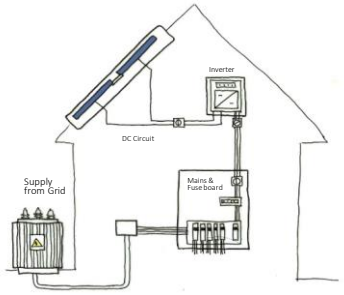
Building Type	EUI
Schools	25
Office	100
Hotel/ Retail/ Mixed Commercial	160

Zero Energy Pathways

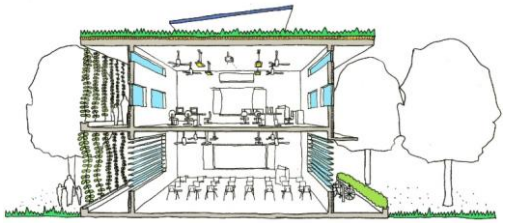
Zero Energy Direct Route:
- 100% Net replacement through **on-site renewables**

Off-Site Route
- Where a % of **off-site renewables** are used.

CERTIFIED GREEN MARK ZERO ENERGY



GM Gold
100% Energy Replacement On-Site



EUI to be achieved first

NUS SDE4 : Net Zero Energy Building

1. Passive Strategies

Massing to promote comfortable NV spaces
Large roof for shading and to aid with ventilation

EUI: 58.4kWh/m²/yr
Cost Premium 5%

2. Active Strategies

Hybrid cooling system using ceiling fans and air-conditioning set at a higher temperature (27°C)

3. Smart Energy Management

- Extensive sensors for lighting and cooling systems

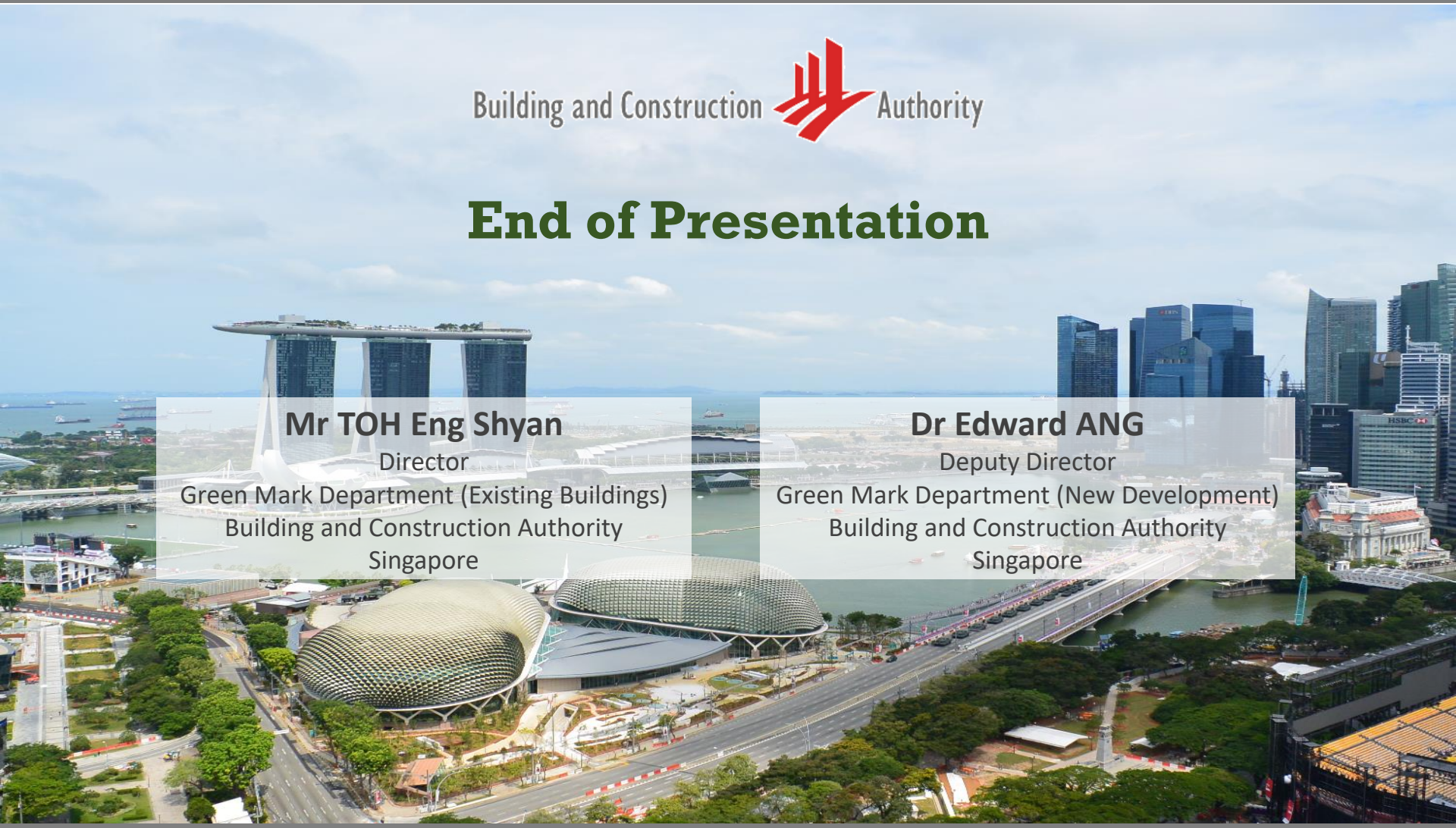
4. Renewable Energy

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

Project Team:
Client: NUS
Designer: Serie + Multiply Consultants
Architect/MEP/ESD: Surbana Jurong
Specialist: Transsolar Energietechnik

Building and Construction Authority

End of Presentation



Mr TOH Eng Shyan
Director
Green Mark Department (Existing Buildings)
Building and Construction Authority
Singapore

Dr Edward ANG
Deputy Director
Green Mark Department (New Development)
Building and Construction Authority
Singapore