Singapore’s Green Building Energy Efficiency Standards
Evolution of BCA Green Mark Standard

- **2005**: Version 1.0
- **2007**: Version 2.0
- **2008**: Version 3.0
- **2010**: Version 4.0
- **2012**: Version 4.1
- **2015**: GM NRB: 2015
- **2017**: GM ENRB: 2017
- **2018**: GM SLE

**BCA Green Mark V4.1 (2012)**
- **Energy Efficiency**: 61%
- **Water Efficiency**: 9%
- **Environmental Protection**: 22%
- **IEQ**: 4%
- **Other Green Features**: 4%

**BCA Green Mark GM NRB: 2015**
- **Advanced Green Efforts**: 15%
- **Climatic Responsive Design**: 22%
- **Building Energy Performance**: 21%
- **Resource Stewardship**: 21%
- **Smart & Healthy Building**: 21%

**GM ENRB: 2017**
- **GM SLE**
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

Singapore’s context:
High Rise High Density Urban Tropics

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
Best-in-class Energy Defined

- Percentage Improvement
- SLE Buildings: 60.0%
- Platinum – GM 2015: 50.0%
- Platinum – GM V4.1: 43.7%
- Platinum – GM V3.0: 38%

Baseline as at 2005: 0%

- Intro of GM
- Launch of SS530: 2006
- GM Legislation (Apr 08)
- SS553: 2009
- GM SLE Launch

Year

- 2005
- 2007
- 2008
- 2010
- 2015
- 2018

- 30%
- 8%
- 8%
- 5.7%
- 7.7%
- 4.3%

- 12.5% (10-15%)
- 40%
- 50.0% improvement

Platinum – GM V4.1
Platinum – GM V3.0
GM 2015
GM 2015
GM SLE
SLE Buildings --
Platinum – GM 2015
Platinum – GM V4.1
Platinum – GM V3.0
Baseline as at 2005
0%
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
- SJI Jurong

Institutes of Higher Learning
- Nanyang Technological University Singapore
- NUS
- SIT Singapore Institute of Technology
- SINGAPORE MANAGEMENT UNIVERSITY

Public Sector Agencies
- Building and Construction Authority
- DSTA
- Sport Singapore

BCA Green Mark for Super Low Energy

GM ENR: 2017

GM NR: 2015

SLE Technology Roadmap

Not Zero

Passive Strategies
- Solar shading
- Natural ventilation
- Facade and daylighting

Active Strategies
- State of the Art HVAC
- Mechanical Ventilation
- Artificial Lighting

Energy Management
- Building Automation
- Smart Control
- Plug Load Management

Renewable Energy
- Roof and Solar Farming
- Photovolitic Technologies
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 m²

NUS School of Design and Environment (SDE 4)
New Non-Residential Building
BCA Green Mark Platinum Award
Zero Energy

Project Information
Total GFA: 8,525.63 m²
No. of Storeys: 6
Estimated energy savings: 292,900 kWh a year
Estimated water savings: 6,607 m³
New Green Mark for SLE Buildings

GM ENRB: 2017
Green Mark for Existing Non-Residential Buildings

GM NRB: 2015
Green Mark for Non-Residential Buildings

GM SLE
Green Mark for Super Low Energy Buildings

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Good LCC for 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)

**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

**Super Low Energy (ENRB)**

a. Minimum Green Mark Gold Award
b. Benchmark EUI requirements
c. OR Demonstration of Energy Savings

**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.

GM Gold
100% Energy Replacement On-Site

CERTIFIED GREEN MARK ZERO ENERGY

EUI to be achieved first
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
End of Presentation

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