Singapore’s Green Building Journey

Toh Eng Shyan
Director, Green Mark Department – Existing Buildings
Presentation Outline

1. Introduction to BCA Green Mark Scheme
2. Green Building Policies in Singapore
3. Going Forward – Super Low Energy (SLE)
A Suite of BCA Green Mark Schemes

New Buildings
- BCA Green Mark for New Non-Residential Buildings
- BCA Green Mark for New Residential Buildings
- BCA Green Mark for Landed Houses
- BCA-IMDA Green Mark for New Data Centres

Existing Buildings
- BCA Green Mark for Existing Non-Residential Buildings
- BCA Green Mark for Existing Residential Buildings
- BCA Green Mark for Existing Schools
- BCA-IMDA Green Mark for Existing Data Centres

Beyond Buildings
- BCA-NParks Green Mark for Existing Parks
- BCA-NParks Green Mark for New Parks
- BCA Green Mark for Infrastructures
- BCA Green Mark for Districts
- BCA-LTA Green Mark for Rapid Transit Systems

User-Centric
- BCA Green Mark for Healthier Workplaces
- BCA Green Mark for Restaurants
- BCA Green Mark for Supermarkets
- BCA Green Mark for Retail
- BCA Green Mark for Laboratories
2) System Efficiency Approach

1) Permanent M&V Standards

Publication in ASHRAE Journal (Nov 2016)

Singapore’s Green Mark System

Improving Commercial Building Energy Performance

BY LEE ENG LOCK, TAN ENG SHYAN; THOMAS MARTMAN, P.E., LIFE MEMBER ASHRAE

For several decades, the building industry has been struggling with the issue of improving energy performance in commercial buildings. A number of initiatives promoted by industry organizations and government agencies have established very ambitious near-term goals for commercial building performance. But despite some recent encouraging trends, over the last several decades the energy use intensity for U.S. commercial buildings has remained largely unchanged. This trend must be dramatically changed if the industry is to meet its ambitious upcoming building energy use goals.

So the question is, what has gone wrong in our industry’s effort to improve building operating efficiency, and what can be done to correct it? A decade ago, a number

The Singapore Approach

Situated within the equatorial belt and tropics.
Singapore experiences hot and humid weather year-
**BCA Green Mark – 3 Key Attributes**

- Strong focus on verification and outcome-based performance
- Periodic Energy Audit (Continual Commissioning)
- Strong Business Case of Green Buildings

**Retrofitting Existing Chiller Plants**

- **Before retrofit**: 1.1 kW/RT
- **After retrofit**: 0.63 kW/RT

![Graph showing efficiency improvements](chart.png)
Performance Verification – Building Level

Study on 147 Retrofitted Existing Buildings

308 GWh
Absolute Annual Electricity Savings

Average Percentage Saving of 18%

Based on projects up to 2017
Based on BCA Building Energy Benchmarking Report 2018

From 2008 to 2017, overall EUI for commercial buildings improved by 11%

Retail Buildings improved by 8%

Office Buildings improved by 19%

Hotels improved by 12%
## Business Case for New Building Developments

### Green Cost Premium and Payback Periods

<table>
<thead>
<tr>
<th>Green Mark Award</th>
<th>Green Cost Premium (% of construction cost)</th>
<th>Payback period (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platinum</td>
<td>0.8% to 3.4%</td>
<td></td>
</tr>
<tr>
<td>GoldPLUS</td>
<td>0.7% to 2.6%</td>
<td>1.9 to 5.7</td>
</tr>
<tr>
<td>Gold</td>
<td>0.2% to 2.2%</td>
<td></td>
</tr>
</tbody>
</table>

- **Payback Periods**
  - Platinum: 1.9 to 5.7 years
  - GoldPLUS: 1 year
  - Gold: 5 years

- **Green Cost Premium**
  - Platinum: 1.9%
  - GoldPLUS: 1.9%
  - Gold: 3.1%

### Examples of New Green Buildings

- **OUR TAMNINES HUB**
  - **People Association**
  - **Public**
  - **GM PLATINUM**
  - **Payback Period:** 5 years
  - **Green Cost Premium:** 3.1%

- **SURBANA JURONG CAMPUS**
  - **Private**
  - **GM PLATINUM (SLE)**
  - **Payback Period:** 1 year
  - **Green Cost Premium:** 1.9%

---

*Computed based on data submitted to BCA for Green Mark assessments, for projects awarded in FY16 and FY17*
Study on 147 Retrofitted Existing Buildings

Average Savings of **18%**

308,000,000 kWh/year absolute electricity savings

**Office**
18% Energy Improvement
Average Payback: 6 - 7.4

**Retail**
15% Energy Improvement
Average Payback: 4.9 – 6.1

**Mixed Dev.**
15% Energy Improvement
Average Payback: 6.5 – 8.1

**Hotel**
22% Energy Improvement
Average Payback: 4.6-5.8

Examples of Green Buildings that have reaped energy savings from retrofitting projects:

- **LUCKY PLAZA**
  - Payback: 6.6 years
  - Energy Savings: 3,819,725 kWh/yr or $763,945/yr

- **RETAIL MALL PLATINUM**
Singapore’s Green Building Journey since 2005

**Focus**
- New Buildings
- Existing Buildings
  (early focus on commercial/institutional buildings due to higher energy footprint)
- Occupants and Tenants
- Super Low Energy Buildings

**Outcomes**
- Reduce Singapore’s emissions intensity by 36% in 2030
- Green >80% GFA by 2030

**Legislation**
- 2005: Legislation on Environmental Sustainability for New Buildings
- 2007: Legislation on Environmental Sustainability for Existing Buildings
- 2017: Mid-Term Review of 3rd Green Building Masterplan

**Launch of Schemes**
- 2006: 1st Green Building Masterplan
- 2008: 2nd Green Building Masterplan
- 2009: Launch of BCA Green Mark Scheme
- 2012: 3rd Green Building Masterplan

**Timeline**
- 2005: <0.1% Green Buildings
- 2010: >13% Green Buildings
- March 2019: ~40% Green Buildings
- 2020: >50% Green Buildings
- 2030: >80% Green Buildings
Public Sector Taking the Lead in Environmental Sustainability
Leading the Way as Building Owners

GM Platinum
New Buildings
Air-con area > 5,000 m²

GM GoldPLUS
Existing Buildings
Air-con area > 10,000 m²

GM Gold
Existing Buildings
Air-con area <10,000 m², GFA>5,000 m²

GM HW Gold
Healthier Workplaces
For new lease or office spaces that had undergone major renovation

*All public sector buildings need to meet PSTLES Green Mark (GM) targets by FY2020
Public Sector Taking the Lead in Environmental Sustainability

Creating Lead Demand as an End-User

**Tenancy**
Lease from a GM GoldPLUS/Platinum building

**Green Event Venues**
To host events only at GM certified venues

Almost 150 GM Certified Venues

Only Green Venues listed in DA Contract w.e.f 25 Feb'19

EDB and MCCY at Raffles City [GM GoldPLUS]

CPF at Novena Square [GM GoldPLUS]
For both New Developments and Existing Buildings

Bonus GFA Incentive Scheme (GM GFA)

Platinum – Up to 2% Additional GFA
GoldPLUS – Up to 1% Additional GFA

For Existing Buildings

Building Retrofit Energy Efficiency Financing (BREEF)
Co-share risk with Private Financial Institutions

GMIS-Existing Building (Health Check)

S$50m Green Mark Incentive Scheme for Existing Building and Premises (GMIS-EBP)

Encouraging the Private Sector
Building Up Industry Eco System

- Zero Capital Partnership Scheme
- Standard EPC Templates
- EPC for EE Retrofits
- EPC for Chiller Maintenance
- Greening existing building Eco-system
- Green FM Accreditation

EPC for EE Retrofits

EPC for Chiller Maintenance

Greening existing building Eco-system

Green FM Accreditation

Zero Capital Partnership Scheme

Standard EPC Templates
Building Industry Capability

Structured training & accreditation programmes for greater professionalism

Executive Programmes

Executive Development Programme
Leadership in Environmental Sustainability
Carnegie Mellon University

Innovations in Sustainable Design & Technology
Stuttgart University of Applied Sciences / Technical University of Braunschweig

Seminars and Conferences
BCA-REMAS-SGBC Green Building Seminar
BCA-ASHRAE Distinguished Lecture Programme
Green & Gracious Construction Practices Seminar
World Workplace Asia Conference & Exhibition
BCA-IFMA FM Conference

Academic Programmes

Postgraduate Degree
MSc in Sustainable Building Design
University of Nottingham

MSc in Facility & Environment Management
University College London

Degree
BSc (Hons) in Facilities & Events Management
UniSIM, BCA & Singapore Polytechnic

Specialist Certification Programmes

Specialist Certificates
Green Mark Manager (GMM)
Green Mark Facilities Manager (GMFM)
Green Mark Professional (GMP)
Green Mark Facilities Professional (GMFP)
Measurement & Verification of Central Chilled Water Plant Efficiency

Structured Training & Accreditation Programmes

Associate Professional Level
Specialist Diploma
Facility & Energy Management
M & E Coordination

Bachelor of Technology (Mechanical Engineering - Green Building Technology)

Strategic Facilities Management
Electrical Engineering & Clean Energy

Professional Level

Diploma
Mechanical Engineering (Green Building Technology)

BCA Academy

25,000 Green Specialists by 2025

>19,000 trained
Niche competency - Well sought after
Minimum Standards to Establish the Green Building Ecosystem – Setting the baseline

Building Control (Environmental Sustainability) Regulations 2008

Minimum environmental sustainability standard for new buildings

Environmental Sustainability Measures for Existing Building Regulations (2012)

Minimum environmental sustainability standard for existing buildings

Three-yearly energy audit on cooling system and compliance to design system efficiency

Annual mandatory submission of building information & energy consumption data
Periodic Audit of Central Chilled Water System

Continuous commissioning benefits (illustrative)

Periodic Audit

3 years

Optimization
Continuous Commissioning Effect

Efficiency (%)

Building Constructed

Time
Next Phase….. Zero Energy Building (ZEB)?

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
Furthe ring Development of Green Buildings - SLE Journey

- Workshop #1 (Aug 2016) • Focus on PES
- Workshop #2 (Dec 2016) • Focus on Mid-rise ZEB & High-rise SLEB
- Workshop #3 ZEB Roundtable (14 Sept 2017)
- Start of project journey (Jul 2016)
- SLE Programme & Criteria Development (Jan 2018)
- International Panel of Experts Review (6-8 Sept 2017)
- Advisory Committee meeting (May 2018)
- Results of 3GBMP Review
- Industry Engagement & Piloting
- SLE Technology Roadmap
- SLE projects awarded at BCA Awards 2019
- IGBC 2018 SLE Challenge & GM SLE
- Furthering Development of Green Buildings - SLE Journey
SUPER LOW ENERGY BUILDINGS
ADVANCING NET ZERO IN SINGAPORE

Passive Strategies
- Solar Shading
- Natural Ventilation
- Façade and Daylighting

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

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

Renewable Energy
- Roof and Site Optimisation
- PV Technologies

On-site
Off-site
### GM (SLE) Criteria

#### Super Low Energy (New bdg)
- a. Minimum Green Mark Gold Award
- b. 60% Energy Savings compared to 2005 code (10% above Platinum)
- c. OR Benchmark EUI requirements for Buildings

#### Super Low Energy (Extg bdg)
- 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 (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.
Green Mark Super Low Energy (SLE) Programme

To encourage cost-effective and energy-efficient building designs that can achieve energy savings of at least 60% energy savings over the 2005 building codes

SLE Programme was officially launched on 5 September 2018
**Green Mark Super Low Energy (SLE) Programme**

*Highlights of Exemplary Projects*

**DSTA Kranji Camp**
- BCA Green Mark Platinum (Zero Energy)
- **Project Information**
  - Total GFA: 6,866.55m²
  - No. of storeys: 4
  - Estimated Energy Savings: 156,553 kWh/yr

**Home Team Academy**
- BCA Green Mark Platinum (Super Low Energy)
- **Project Information**
  - Total GFA: 138,813.57m²
  - Estimated Energy Savings: 3,179,300 kWh/yr

**NUS SDE4**
- BCA Green Mark Platinum (Zero Energy)
- **Project Information**
  - Total GFA: 8,525.63 m²
  - No. of storeys: 6
  - Estimated Energy Savings: 292,900 kWh/year

**SMU Tahir Foundation Connexion**
- BCA Green Mark Platinum (Zero Energy)
- **Project Information**
  - Total GFA: 8,775m²
  - No. of storeys: 5
  - Estimated Energy Savings: 458,400 kWh/yr
Aspiration

To accelerate cost effective super low energy buildings and kick start the next wave of our green building movement towards advancing net zero in the tropics.
Join us at International Built Environment Week (IBEW) 2019

See you at International Built Environment Week (IBEW) 2019

Join us, as an advocate, on this Journey of Transformation!

Actively Participate in IBEW
to learn from among the best and enjoy the many networking opportunities

Raise the profile of your firms through sponsorship, to enhance business opportunities and attract new talents

3 – 6 September 2019
Sands Expo and Convention Centre

Do spread the word and join us!

Register at: www.ibew.sg
Thank You