Minimum Green Mark Standard for Existing Building

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BCA/GMD(EB)
Contents

1. Min GM Standards for EB
2. GM(ENRB) ver.3
3. Pilot BREEF
Four-Phased Approach to Green our Existing Building Stock

**Phase 1**
Legislation – New Bdgs (April 08)

Minimum EE Standards for New Building and Existing Buildings undergoing major retrofitting (GFA of >2000m²)

**Phase 2**
Incentive Scheme (April 09)

GMIS (Existing Buildings) scheme co-fund upgrading for energy improvement. Building owners to declare relevant energy data

**Phase 3**
Energy Data Submission

Yearly submission on energy consumption to BCA. Building owners to submit energy related building information.

**Phase 4**
Legislation – Existing Buildings

Minimum EE standards for Existing Buildings and meet GM Certified

New and retrofitted existing buildings – 3 yearly system efficiency audit
Min. GM Standard for Existing Buildings

Improvement in Energy Efficiency at Mandatory level

- New buildings in April 2008: 18%
- New buildings in December 2010: 28%
- Existing buildings 2013: 25%
A. - Any hotel, retail building or office building
- Includes mixed development with the above mix

B. GFA > 15,000m²

C. - Installing/replacing chilled-water cooling system.
- Chillers replaced with unitary systems included

Cooling system accounts for as much as 50% of the building’s total energy consumption.

(see Building Control (Environmental Sustainability Measures for Existing Buildings) Regulations 2013, s3:Prescribed Buildings)
Prescribed Cooling Systems

1. Air-cooled / water-cooled chiller

2. Unitary Air-conditioning

3. Air-cooled / water-cooled chiller

4. Unitary Air-conditioning

(see Building Control (Environmental Sustainability Measures for Existing Buildings) Regulations 2013, s4:Prescribed cooling systems)
6. This regulatory requirement was gazetted on 1st July 2013 and will take effect from 2nd January 2014. Building owners are reminded that they are not allowed to install or replace any of their chiller(s) without first obtaining the approval from BCA if their buildings fall within the category of buildings regulated under these Regulations as mentioned in paragraph 4 above.

(extract from Industry Circular dated 3 July 2013)
Planning
• Owner engages a PE(Mech).
• PE (Mech) looks into the overall building design and ensures that the building can achieve **at least Green Mark 50 points (GMEB v3)**.
• Owner / PE(Mech) to submit the Green Mark design score, retrofitting design, drawings, computations **for approval before commencement of the energy improvement works**.

Retrofitting
• Owner must complete the **energy improvement works within three years** from the date of approval of the design score by BCA.

Completion
• Owner / PE(Mech) to submit the Green Mark as-built score (**at least 50 points**) (including commissioning of the cooling system via submission of energy audit report).
## Additional Documents to Submit

### Design Stage
- Audit report on current air-conditioning system before retrofitting works (applicable to central chilled-water plant only)
- Cooling load calculations (if there is a change in cooling load or unitary air-conditioning systems installed).
- Design schematic drawing of proposed air-conditioning system (water-side)
- Chiller plant room layout drawing including position of M&V instruments using symbol and color scheme
- Chiller part-load performance data sheet from equipment supplier
- Chilled water pump, Condenser water pump and Cooling Tower selection data sheet
- Project schedule for retrofitting works
- Worksheet for chiller plant efficiency computation

### As-Built Stage
- As-built schematic drawing of air-conditioning system (water-side).
- As-built chiller plant room layout drawing indicating position of M&V instruments using symbol and color scheme
- As-built Chilled water pump, Condenser water pump and Cooling Tower selection data sheet
- Instruments’ calibration certificates from accredited laboratory and batch calibration certificates from manufacturers.
- Energy Audit report (format in accordance to Annex B of “Code on Periodic Energy Audit of Building Cooling Systems”)
Green Mark Criteria for Existing Buildings - GM(ENRB) Version 3
Main framework remains the same

### 5 Key Assessment Criteria

<table>
<thead>
<tr>
<th>Green Mark</th>
<th>Try Again</th>
<th>Certified</th>
<th>Gold</th>
<th>GoldPlus</th>
<th>Platinum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>0</td>
<td>49</td>
<td>50</td>
<td>74</td>
<td>85</td>
</tr>
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<td></td>
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<td>75</td>
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<td>89</td>
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<td>100</td>
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Estimated Energy Savings:
- 25% to 28%
- 28% to 32%
- > 32%
- > 36%
## Point Allocation

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Ver. 2.1</th>
<th>Ver. 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Points</td>
<td>Contribution</td>
</tr>
<tr>
<td>Part 1</td>
<td>63</td>
<td>49%</td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part 2</td>
<td>18</td>
<td>14%</td>
</tr>
<tr>
<td>Water Efficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part 3</td>
<td>19</td>
<td>15%</td>
</tr>
<tr>
<td>Sustainable Operation &amp; Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part 4</td>
<td>18</td>
<td>14%</td>
</tr>
<tr>
<td>Indoor Environmental Quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part 5</td>
<td>10</td>
<td>8%</td>
</tr>
<tr>
<td>Other Green Features</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total points</strong></td>
<td><strong>128</strong></td>
<td></td>
</tr>
</tbody>
</table>
Objective of changes to GMEB version 3

- To raise the energy standard for existing non-residential building stock
- Reference to 2005 energy standard/code as baseline
No more Cap on Minimum scores

No more cap of 50 points in
Part 1 & Part 2 to 5

Pre-requisite Requirement
All relevant pre-requisite requirements for the specific Green Mark Rating are to be complied with

Energy Related Requirements
Minimum 30 points

Other Green Requirements
Minimum 20 points

Part 1 - Energy Efficiency
1-1 Thermal Performance of Building Envelope
1-2 Air Conditioning System
1-3 Artificial Lighting

Part 2 - Water Efficiency
2-1 Water Monitoring
2-2 Water Efficient Fittings
2-3 Alternative Water Sources
Pre-requisite Requirements

Minimum score for GM Ratings
Air-Conditioning System Efficiency
Accurate Permanent Measurement and Verification instrumentation
Conduct IAQ Audit
<table>
<thead>
<tr>
<th>Green Mark Rating</th>
<th>Min. points required from Part 1 – Energy Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Mark Certified</td>
<td>30 pts</td>
</tr>
<tr>
<td>Green Mark Gold</td>
<td>35 pts</td>
</tr>
<tr>
<td>Green Mark Gold(^{\text{PLUS}})</td>
<td>40 pts</td>
</tr>
<tr>
<td>Green Mark Platinum</td>
<td>45 pts</td>
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</tbody>
</table>
## Pre-requisite Requirements

### Air Conditioning System Efficiency

<table>
<thead>
<tr>
<th>Green Mark Rating</th>
<th>Building Cooling Load (RT)</th>
<th>Efficiency (kW/RT)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 500</td>
<td>≥ 500</td>
</tr>
<tr>
<td>Certified</td>
<td>0.85</td>
<td>0.75</td>
</tr>
<tr>
<td>Gold</td>
<td>0.80</td>
<td>0.70</td>
</tr>
<tr>
<td>Gold&lt;sup&gt;Plus&lt;/sup&gt;</td>
<td>0.75</td>
<td>0.68</td>
</tr>
<tr>
<td>Platinum</td>
<td>0.70</td>
<td>0.65</td>
</tr>
</tbody>
</table>

For buildings using **Water-Cooled Chilled-Water Plant**

<table>
<thead>
<tr>
<th>Green Mark Rating</th>
<th>Building Cooling Load (RT)</th>
<th>Efficiency (kW/RT)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;500</td>
<td>≥ 500</td>
</tr>
<tr>
<td>Certified</td>
<td>1.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Gold</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Gold&lt;sup&gt;Plus&lt;/sup&gt;</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>Platinum</td>
<td>0.78</td>
<td></td>
</tr>
</tbody>
</table>

For buildings using **Air Cooled Chilled-water Plant or Unitary Air-Conditioner**

<table>
<thead>
<tr>
<th>Green Mark Rating</th>
<th>Building Cooling Load (RT)</th>
<th>Efficiency (kW/RT)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;500</td>
<td>≥ 500</td>
</tr>
<tr>
<td>Certified</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Gold</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Gold&lt;sup&gt;Plus&lt;/sup&gt;</td>
<td>0.85</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Platinum</td>
<td>0.78</td>
<td></td>
</tr>
</tbody>
</table>
Pre-requisite Requirements

Accurate Permanent M&V instrumentation

- **Chilled-water side:**
  - $T_S + T_R + \text{Flow Meter} = \text{Cooling load}$
  - $+/- \ 0.05 \, ^\circ \text{C end-to-end}$
  - Up to 2%

- **Condenser-water side:**
  - $T_S + T_R + \text{Flow Meter} = \text{Heat Rejection}$

- **Main Control Board:**
  - Power Meters
  - (Chillers, Pumps and Cooling Towers)

- **Provision of permanent measuring instruments for monitoring the performance of the System Efficiency ($+/- \ 5\%$ error)**

- **Heat Balance test for verification of the accuracy of M&V instrumentation ($+/- \ 5\%$ error for 80% of data points collected)**
Pre-requisite Requirements

Indoor Air Quality Audit

- To conduct full IAQ audit
- IAQ audit to be performed by an accredited laboratory under Singapore Accreditation Council
- IAQ audit to comply with NEA’s Guidelines for Good Indoor Air Quality in Office Premises or SS554:2009 Code of Practice for ‘Indoor air quality for air-conditioned buildings’
Main Changes

Energy Related Criterions

ETTV
Air-side system
Permanent M&V
VSD for plant equipments

Ventilation in Car park
Ventilation in Common areas
Lifts & Escalators
Main Changes

Non-Energy Related Criterions

- Irrigation & landscaping
- Waste storage Area
- Recycling Programme
- Roof top & Vertical Greenery
- Sheltered bicycle Lots with Showering facilities
- IAQ Management Plan
- Room temperature Sensor
- CO₂ Sensor
- Indoor air Pollutants
### Case Study of GM Certified Criteria

#### Energy Efficiency

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Energy Efficiency Features</th>
<th>Point Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part 1-2 System Energy Efficiency</td>
<td>System Efficiency = 0.75 kW/ton</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>30% improvement in AHU/FCU</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>VSD control for Air-con plant</td>
<td>1</td>
</tr>
<tr>
<td>Part 1-3 Artificial Lighting</td>
<td>30% improvement in Lighting System</td>
<td>9</td>
</tr>
<tr>
<td>Part 1-4 Ventilation in Carparks</td>
<td>Efficient MV System in Carparks</td>
<td>2</td>
</tr>
<tr>
<td>Part 1-6 Lifts and Escalators</td>
<td>Efficiency Lift system (VVVF/Sleep Mode)</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total Points in Part 1</strong></td>
<td></td>
<td><strong>31</strong></td>
</tr>
</tbody>
</table>
## Case Study of GM Certified

### Part 2 to Part 5  
Other Green Requirements

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Green Features</th>
<th>Point Score</th>
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</thead>
<tbody>
<tr>
<td>Part 2-1 Water Monitoring</td>
<td>Monitor water consumption monthly</td>
<td>1</td>
</tr>
<tr>
<td>Part 2-2 Water Efficiency Fittings</td>
<td>“Good” WELS or equivalent for water fittings</td>
<td>9</td>
</tr>
<tr>
<td>Part 3-2 Post Occupancy Evaluation</td>
<td>Post occupancy survey &amp; corrective action</td>
<td>3</td>
</tr>
<tr>
<td>Part 3-3 Waste Management</td>
<td>Provision of recycling facilities &amp; promotional programme on recycling</td>
<td>4</td>
</tr>
<tr>
<td>Part 4-1 IAQ Performance</td>
<td>Conduct IAQ Audit</td>
<td>4</td>
</tr>
<tr>
<td>Part 4-3 Lighting Quality</td>
<td>Lighting level compliance (Lux)</td>
<td>1</td>
</tr>
<tr>
<td>Part 4-4 Thermal Comfort</td>
<td>Temperature &amp; RH</td>
<td>1</td>
</tr>
</tbody>
</table>

Total Points in Part 2 to 5: 23
Pilot Building Retrofit Energy Efficiency Financing Scheme (BREEF)
To help building owners with the upfront capital required for EE retrofits.

Eligible Applicants

- MCSTs, building owners and accredited ESCOs & SPV

Loan Condition

- An EPC between the MCST/building owner and an accredited ESCO.
- Existing commercial (office, retail or hotel) buildings and commit to achieve minimum GM Certified rating (GMNREB V3).
- Maintain GM certified rating for period of loan tenure.
BREEF Scheme Details

- **Max Loan Tenure**: 8 years
- **Max Loan Quantum**: S$ 5 million
- **Interest Rate**: Set by PFI.
- **Participating FI**: Standard Chartered, ORIX, UOB, IFS Capital Limited
- **Contact Person**: Email: zhang_xiuting@bca.gov.sg
Thank You!