Scope of Presentation

• Background

• Minimum Green Mark Standard for Existing Buildings

• Three-Yearly Energy Audit on Building Cooling Systems

• Annual Submission of Building Info & Energy Consumption Data
BCA Green Mark Scheme

- 2005

<table>
<thead>
<tr>
<th>Green Mark</th>
<th>Try Again</th>
<th>Certified</th>
<th>Gold</th>
<th>Gold Plus</th>
<th>Platinum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>0</td>
<td>49</td>
<td>50</td>
<td>74</td>
<td>75</td>
</tr>
</tbody>
</table>
Improved in Building Energy Efficiency at Mandatory Level

- 2008

Mandated minimum environmental sustainability standard for new buildings

Equivalent to BCA GREEN MARK

Apr 2008
Improved in Building
Energy Efficiency at Mandatory Level

- **2010**
  - 28% more energy efficient
  - **2010**
  - 10% more energy efficient

- **2005**
  - Mandated minimum environmental sustainability standard for new buildings

- **Apr 2008**
  - Enhanced minimum environmental sustainability standard for new buildings

- **Dec 2010**
More than 80% of building stocks are built before 2008.
3-Pronged Legislative Approach

- **2012**

**Amendments to Building Control Act**

- **Improve**
  - Minimum GM standard for existing buildings

- **Maintain**
  - Three-yearly audit on building cooling system

- **Verify**
  - Submission of energy consumption data
3-Pronged Legislative Approach

- **2012**

Amendments to Building Control Act

- **Improve**
  - Minimum GM standard for existing buildings

- **Maintain**
  - Three-yearly audit on building cooling system

- **Verify**
  - Submission of energy consumption data
Minimum GM Standard for Existing Buildings

PHASE 1 applies to hotels, retail and office buildings with gross floor area (GFA) of 15,000m² or more when any chiller is installed or replaced.

Building has to comply with minimum environmental sustainability standard for existing buildings.

Next phase: institutions, hospitals, convention centre, schools etc.
Minimum GM Standard for Existing Buildings

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**.
- Owner to submit the Green Mark design score, retrofitted 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
- **PE (Mech)** to submit the Green Mark as-built score (**at least 50 points**) within 1 month after completion (including commissioning of the cooling system).
## Plan Fee for Minimum Green Mark Standard

### Subsidised Fee:

<table>
<thead>
<tr>
<th>Year 2014</th>
<th>25% Subsidy</th>
<th>$6,675 for the first 15,000m(^2) (or part thereof), and $0.12 for every subsequent m(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 2015</td>
<td>15% Subsidy</td>
<td>$7,565 for the first 15,000m(^2) (or part thereof), and $0.13 for every subsequent m(^2)</td>
</tr>
<tr>
<td>Year 2016</td>
<td>Full fee</td>
<td>$8,900 for the first 15,000m(^2) (or part thereof), and $0.15 for every subsequent m(^2)</td>
</tr>
</tbody>
</table>

**Note - from 2014 onwards:**

1. Projects complying with the Min GM Std and applying for voluntary GM Certification (min GM Gold Rating) will pay only one fee.
Minimum GM Standard for Existing Buildings

Penalties

Building Owner

Fine not exceeding $100,000

Continuing offence:
A further fine not exceeding $1,000 for every day after conviction

PE(Mech)

Fine not exceeding $10,000
3-pronged Legislative Approach

- 2012

Amendments to Building Control Act

- Improve
  - Minimum GM standard for existing buildings

- Maintain
  - Three-yearly audit on building cooling system

- Verify
  - Submission of energy consumption data
Three-Yearly Energy Audit on Building Cooling Systems

Buildings Involved

Existing buildings which have undergone retrofitting and are required to meet min. GM standard for existing buildings.

New buildings with centralised chilled-water building cooling system which are required to comply with the enhanced minimum environmental sustainability standard for new buildings implemented on 1 December 2010

Owners of these buildings must carry out three-yearly audits on cooling systems to ensure operating efficiency is maintained to function at an acceptable level.
Three-Yearly Energy Audit on Building Cooling Systems

BUILDING OWNER serves notice for 3 yearly audit

ensure system is maintained to perform up to minimum design requirement

appoints professional PE(MECH)/ENERGY AUDITOR

Submit report to BCA by Deadline stipulated in Notice

carry out audit and comply with requirements

Three-Yearly Energy Audit on Building Cooling Systems
Penalties

Building owner
[for failing to comply with Notice]
Fine not exceeding $20,000.
For continuing offence, a further fine not exceeding $500 for every day after conviction.

Auditor
[for failing to conduct audit in accordance with Code]
Fine not exceeding $10,000.
3-pronged Legislative Approach

2012

Amendments to Building Control Act

- **Improve**
  - Minimum GM standard for existing buildings

- **Maintain**
  - Three-yearly audit on building cooling system

- **Verify**
  - Submission of energy consumption data
Annual Submission of Building Info and Energy Consumption Data

Purpose

- Basis of the national energy benchmarks
- Sharing of data with building owners for pro-active improvement to the energy performance of buildings
- Measure effectiveness of energy efficiency initiatives
Annual Submission of Building Info and Energy Consumption Data

**PHASE 1**

- Applies to hotels, retail and office buildings (about 1000 buildings)

**UTILITIES SUPPLIER**

- Building annual energy consumption data

**BCA**

- Basic building information (gross floor area, types of cooling and lighting systems, tenant profile)

**BUILDING OWNER**
Submit to BCA through **Building Energy Submission System** (BESS)

**BESS URL:** [https://www.bca-bess.gov.sg](https://www.bca-bess.gov.sg)

**Useful links**
- user submission manual
- technical guide
- demo-video

Annual Submission of Building Info and Energy Consumption Data
Annual Submission of Building Info and Energy Consumption Data

BCA serve Notice to building owner to provide information

Submit to BCA through Building Energy Submission System (BESS) by deadline specified in Notice

Penalty
Fine not exceeding $10,000
Thank you
Three-Yearly Energy Audit on Building Cooling Systems

Persons who can conduct energy audit

- Mechanical PE
- Registered energy auditor
### Minimum GM Standard for Existing Buildings

#### Chiller Plant Efficiency Benchmarks *(Source: ASHRAE)*

<table>
<thead>
<tr>
<th>Chiller Plant Type</th>
<th>Average Annual Efficiency in kW/ton</th>
<th>COP</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Technology All-Variable Speed Chiller Plants</td>
<td>0.5</td>
<td>(7.0)</td>
</tr>
<tr>
<td>High-efficiency Optimized Chiller Plants</td>
<td>0.6</td>
<td>(5.9)</td>
</tr>
<tr>
<td>Conventional Code Based Chiller Plants</td>
<td>0.7</td>
<td>(5.0)</td>
</tr>
<tr>
<td>Older Chiller Plants</td>
<td>0.8</td>
<td>(4.4)</td>
</tr>
<tr>
<td>Chiller Plants with Correctable Design or Operational Problems</td>
<td>0.9</td>
<td>(3.9)</td>
</tr>
<tr>
<td></td>
<td>1.0</td>
<td>(3.5)</td>
</tr>
<tr>
<td></td>
<td>1.1</td>
<td>(3.2)</td>
</tr>
<tr>
<td></td>
<td>1.2</td>
<td>(2.9)</td>
</tr>
</tbody>
</table>

**NEEDS IMPROVEMENT**

**FAIR**

**GOOD**

**EXCELLENT**

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**AVGARE ANNUAL CHILLER PLANT EFFICIENCY IN KW/TON (C.O.P.)**

*(Input energy includes chillers, condenser pumps, tower fans and chilled water pumping)*

Based on electrically driven centrifugal chiller plants in comfort conditioning applications with 42°F (5.6°C) nominal chilled water supply temperature and open cooling towers sized for 85°F (29.4°C) maximum entering condenser water temperature and 20% excess capacity.

*Local Climate adjustment for North American climates is +/- 0.05 kW/ton*
Three-Yearly Energy Audit on Building Cooling Systems

Registered energy auditor

- No design or engineering work involved
- Verification of system performance
- ESCOs are conducting energy audits today
- Bigger pool -> cost competitiveness
- Other countries, like US, also do not require energy auditors to be PEs
- Consulted ACES and IES
## Summary of Key Legislative Requirements

<table>
<thead>
<tr>
<th>1) Minimum Green Mark Standards for Buildings installing/replacing Cooling Systems</th>
<th>2) Three-Yearly Audit on Cooling Systems</th>
<th>3) Annual Submission of Building Info &amp; Energy Consumption Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Role of building owner</strong></td>
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</tr>
<tr>
<td>• Engage PE(Mech) to assess Green Mark scores.</td>
<td>• Appoint PE(Mech)/energy auditor to audit on the energy efficiency of the building cooling systems on receipt of Notice from BCA at three-yearly interval.</td>
<td>• Submission of electricity consumption data by utilities suppliers.</td>
</tr>
<tr>
<td>• Submit plans and Green Mark scores.</td>
<td>• Submit audit report demonstrating that the energy efficiency of the cooling system meets the minimum design efficiency standard.</td>
<td>• Submission of building info by building owners.</td>
</tr>
<tr>
<td>• Ensure that retrofitting works are completed within 3 years.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Role of PE(Mech)</strong></th>
<th><strong>Role of Auditor</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Assess and prepare design score (at least 50 points) before retrofitting works.</td>
<td>• Conduct audit on energy efficiency of building cooling system in accordance with Code.</td>
</tr>
<tr>
<td>• Assess and prepare the as-built score (at least 50 points) after completion of retrofitting works.</td>
<td>• Prepare audit report.</td>
</tr>
</tbody>
</table>