GM NRB: 2015

GREEN MARK FOR NON-RESIDENTIAL BUILDINGS NRB: 2015

including Hawker Centres, Healthcare Facilities, Laboratory Buildings and Schools
Green Mark Department
Building and Construction Authority
52 Jurong Gateway Road
#11-01, Singapore 608550
(Above jem)

Green Mark Non-Residential Buildings NRB : 2015 Revision Log

<table>
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<th>Revision</th>
<th>Description</th>
<th>Date Effective</th>
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<tr>
<td>R0</td>
<td>Launch for Pilot</td>
<td>02/09/2015</td>
</tr>
<tr>
<td>R1</td>
<td>Revised Version for Implementation</td>
<td>31/08/2016</td>
</tr>
<tr>
<td>R3</td>
<td>Revised Version to include annexes for specific building types Hawker Centres, Healthcare Facilities, Laboratory Buildings and Schools. Alternate option for scoring of Energy related items and other minor changes.</td>
<td>01/08/2018</td>
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</table>
Introduction
What is BCA Green Mark?

The Building and Construction Authority (BCA) Green Mark scheme was launched in 2005 and is an internationally recognised green building rating system tailored for the tropical climate. Green Mark sets parameters and establishes indicators to guide the design, construction and operation of buildings towards increased energy effectiveness and enhanced environmental performance.

BCA Green Mark comprises a number of distinct rating tools that together holistically rate the built environment for its environmental performance. These include:

- **New Buildings**: Non-Residential, Residential, Data Centres and Landed Housing
- **Existing Buildings**: Non-Residential, Residential, Data Centres and Schools
- **User Centric**: Office Interior, Retail, Supermarket, Restaurant and Laboratories
- **Beyond Buildings**: Districts, Parks, and Infrastructure

Introducing Green Mark NRB: 2015

Green Mark for Non-Residential Buildings NRB: 2015 is the 5th edition of the Green Mark scheme for new non-residential buildings, such as commercial (office, retail and hotel), industrial and institutional buildings as well as specialised buildings Hawker Centres, Healthcare Facilities, Laboratories and Schools. This version delivers:

- A streamlined rating scheme that addresses sustainability in a more balanced and holistic manner.
- Greater emphasis on climatically contextual design, energy effectiveness, health and wellbeing of building occupants, smart buildings, and a systematic approach to addressing embodied energy and resource usage.
- Recognition of the design processes which respond to site context and facilitate sustainability considerations at the early project stages where there is the greatest opportunity for low cost, high reward options to be implemented.
- A collaborative framework with more than 130 industry members and academics involved in the setting of metrics, assessment methods and performance levels.

The Green Mark NRB: 2015 Criteria should be read in conjunction with the following accompanying handbooks and tools:

- Green Mark NRB: 2015 Technical Guide and Requirements
- BCA Carbon Calculator
- BCA Energy Performance Points Calculator
Why Green Mark NRB: 2015?

Green Mark provides a consistent method to assess and verify buildings for their overall environmental performance, assisting project teams to deliver a more sustainable built environment and encouraging best practices and market transformation. It is a design guide that can be referenced to understand the attributes of what makes buildings truly sustainable. Green Mark NRB: 2015 aims to further stretch building outcomes to substantially reduce the environmental impacts and increase the life-cycle quality of projects. Moreover, it provides a platform to recognise and make mainstream the leadership needed to drive creative, organisational & technical improvements to the overall environmental credentials of projects.

Outcomes of Green Mark NRB: 2015

The indicators within the Green Mark criteria are mapped to internationally recognised sustainability outcomes. Driving these outcomes through the Green Mark scheme can ensure buildings awarded under Green Mark will truly be high quality environmentally sustainable developments for our current and future generations.

Climate
Buildings should demonstrate emissions reduction and resilience to the effects of climate change.

Resources
As stewards of the earth’s resources, buildings should use resources in an efficient manner to reduce its environmental footprint over the building life cycle.

Wellbeing
Liveable built environments are vital for our health and well-being.

Ecology
Buildings should consider their wider impact on the biosphere through the integration of nature and protection of natural systems including flora and fauna.
Assessment Process

The BCA Green Mark Certification Process is as follows:

**Application**
- Submittal of application with relevant supporting documents for certification upon finalisation of building design.
- Upon acceptance of application and fee payable, a BCA Green Mark Assessor will be assigned for the duration of the project.

**Assessment**
- To be conducted when design and documentary evidences are ready.
- Comprises design and documentary reviews to verify if the building project meets the intents of the criteria and certification level; as well as the prerequisite requirements.
- For projects with potential BCA Green Mark GoldPLUS and Platinum rating, a presentation to BCA panel for evaluation is required.

**Verification**
- To be conducted upon project completion.
- Includes review of delivery records, updated documents on green features and building energy performance data. Site inspection and measurement will be conducted.
- For projects with BCA GoldPLUS and Platinum rating, energy savings based on the actual building operating data and parameters will be required to ascertain the energy performance of the building.

**Green Mark NRB: 2015 Ratings**

The environmental performance of a building development shall be determined by the numerical scores (i.e Green Mark points) achieved in accordance with the applicable criteria using the scoring methodology and the prerequisite requirements on the level of building performance as specified in this Green Mark scheme document. Under this assessment framework, points are awarded for incorporating sustainable design features and practices, which would add up to a final Green Mark Score. Depending on the level of building performance and Green Mark Score, the building development will be eligible for certification under one of the ratings, namely BCA Green Mark Gold, GoldPLUS or Platinum. The design of the building development shall also meet all the relevant mandatory requirements regulated under the Building Control Regulations.

The Green Mark Score of the building design is the total of all the numerical scores assigned based on the degree of compliance with the applicable criteria. The following table states the corresponding Green Mark Score to attain the respective Green Mark ratings. Buildings must also fulfil their respective prerequisite requirements to be awarded Green Mark. The total points scored include the bonus points scored under Advanced Green Efforts, as well as in the respective Annexes for buildings classified as hawker centres, healthcare, laboratories or schools.
BCA Green Mark Award Rating Scores

<table>
<thead>
<tr>
<th>Green Mark Rating</th>
<th>Green Mark Score</th>
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<tbody>
<tr>
<td>Green Mark Platinum</td>
<td>70 and above</td>
</tr>
<tr>
<td>Green Mark GoldPLUS</td>
<td>60 to &lt; 70</td>
</tr>
<tr>
<td>Green Mark Gold</td>
<td>50 to &lt; 60</td>
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</table>

Criteria Overview

To dovetail the criteria with the sustainable outcomes of Green Mark NRB: 2015, the criteria has been restructured into 5 sections, with 16 criteria and 52 sustainability indicators. Each of the 4 main sections is equally weighted in terms of points. The total point is 140 points, inclusive of 20 points from Section 5: Advanced Green Efforts as well as additional credits scored under Annexes for specialised building types: hawker centres, healthcare facilities, laboratory buildings and schools.

Within the main criteria, criteria within the grey boxes with the ‘Advanced Green Efforts’ icon are scored under 5.1 Enhanced Performance.
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**Prerequisites P.1 to P.15:** Parked under main criteria

**Minimum Points Prerequisites**

**Energy Modeling Prerequisite**

## Elective Requirements

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<tr>
<th>Requirement</th>
<th>Points</th>
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</thead>
<tbody>
<tr>
<td>P.1 Envelope and Roof Thermal Transfer</td>
<td>30</td>
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<tr>
<td>P.2 Air Tightness and Leakage</td>
<td></td>
</tr>
<tr>
<td>P.3 Bicycle Parking</td>
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#### 1.1 Leadership

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Points</th>
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<tbody>
<tr>
<td>1.1a Climatic &amp; Contextually Responsive Brief</td>
<td>1 pt</td>
</tr>
<tr>
<td>1.1b Integrative Design Process</td>
<td>4 pts</td>
</tr>
<tr>
<td>4D, 5D &amp; 6D BIM (Advanced Green Efforts)</td>
<td>2 pts</td>
</tr>
<tr>
<td>1.1c Environmental Credentials of Project Team</td>
<td>2 pts</td>
</tr>
<tr>
<td>1.1d User Engagement</td>
<td>3 pts</td>
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#### 1.2 Urban Harmony

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Points</th>
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<tbody>
<tr>
<td>1.2a Sustainable Urbanism</td>
<td>Up to 5 pts</td>
</tr>
<tr>
<td>(i) Environmental Analysis</td>
<td>2 pts</td>
</tr>
<tr>
<td>Creation of possible new ecology and natural ecosystems (Advanced Green Efforts)</td>
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</tr>
<tr>
<td>(ii) Response to Site Context</td>
<td>3 pts</td>
</tr>
<tr>
<td>(iii) Urban Heat Island (UHI) Mitigation</td>
<td>1 pt</td>
</tr>
<tr>
<td>(iv) Green Transport</td>
<td>1.5 pts</td>
</tr>
<tr>
<td>1.2b Integrated Landscape and Waterscape</td>
<td>Up to 5 pts</td>
</tr>
<tr>
<td>(i) Green Plot Ratio (GnPR)</td>
<td>3 pts</td>
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<tr>
<td>GnPR ≥ 5.0 (Advanced Green Efforts)</td>
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<tr>
<td>(ii) Tree Conservation</td>
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<tr>
<td>(iii) Sustainable Landscape Management</td>
<td>1.5 pts</td>
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<tr>
<td>(iv) Sustainable Storm Water Management</td>
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#### 1.3 Tropicality

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Points</th>
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<tbody>
<tr>
<td>1.3a Tropical Facade Performance</td>
<td>3 pts</td>
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<tr>
<td>Low heat gain façade (Advanced Green Efforts)</td>
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<tr>
<td>Greenery on the East and West Facade (Advanced Green Efforts)</td>
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<tr>
<td>Thermal Bridging (Advanced Green Efforts)</td>
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<tr>
<td>1.3b Internal Spatial Organisation</td>
<td>3 pts</td>
</tr>
<tr>
<td>1.3c Ventilation Performance</td>
<td>4 pts</td>
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<tr>
<td>Wind Driven Rain Simulation (Advanced Green Efforts)</td>
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### Part 2 – Building Energy Performance

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<tr>
<th>Section</th>
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<tr>
<td>P.4 Air Conditioning Total System and Component Efficiency</td>
<td>30 points</td>
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<tr>
<td>P.5 Lighting Efficiency and Controls</td>
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</tr>
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<td>P.6 Vertical Transportation Efficiency</td>
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#### 2.1 Energy Efficiency

<table>
<thead>
<tr>
<th>Option 1: Energy Performance Points Calculator</th>
<th>Points</th>
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<tr>
<td>2.1a Air Conditioning Total System Efficiency</td>
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<td>2.1b Lighting System Efficiency</td>
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<tr>
<td>2.1c Carpark System Efficiency</td>
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<tr>
<td>2.1d Receptacle Efficiency</td>
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<tr>
<td>2.1e Building Energy</td>
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*Further Improvement in Design Energy Consumption (Advanced Green Efforts)*  
*Option 2: Performance-Based Computation*  
<table>
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<tr>
<th>2.1f Space Conditioning Performance</th>
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<tr>
<td>Efficient space conditioning energy design (Advanced Green Efforts)</td>
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<tr>
<th>Option 2: Performance-Based Computation</th>
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<td>Efficient lighting design (Advanced Green Efforts)</td>
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<td>2.1h Building System Performance</td>
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<td>Additional Energy Efficient Practices and Features (Advanced Green Efforts)</td>
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#### 2.2 Renewable Energy

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<tr>
<td>2.2a Solar Energy Feasibility Study</td>
<td>8 points</td>
</tr>
<tr>
<td>2.2b Solar Ready Roof</td>
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<tr>
<td>2.2c Adoption of Renewable Energy</td>
<td>6 points</td>
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*Further Electricity Replacement by Renewables (Advanced Green Efforts)*  
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<tbody>
<tr>
<td>2.2a Solar Energy Feasibility Study</td>
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</tr>
<tr>
<td>2.2b Solar Ready Roof</td>
<td>1.5 points</td>
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<tr>
<td>2.2c Adoption of Renewable Energy</td>
<td>6 points</td>
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<tr>
<td>P.7 Water Efficient Fittings</td>
<td>30 points</td>
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<tr>
<td>3.1a Water Efficient Systems</td>
<td>8 points</td>
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*Better Water Efficient Fittings (Advanced Green Efforts)*  
<table>
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<tr>
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<th>Points</th>
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<tbody>
<tr>
<td>(i) Landscape irrigation</td>
<td>3 points</td>
</tr>
<tr>
<td>3.1b Water Monitoring</td>
<td>2 points</td>
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*Better Water Efficient Fittings (Advanced Green Efforts)*  
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<th>Points</th>
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<tr>
<td>(i) Water Monitoring and LeakDetection</td>
<td>1 pt</td>
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<tr>
<td>3.1c Alternative Water Sources</td>
<td>3 points</td>
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<tr>
<td>(ii) Water Usage Portal and Dashboard</td>
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<tr>
<td><strong>3.2a Sustainable Construction</strong></td>
<td>8 points</td>
</tr>
<tr>
<td>(i) Conservation and Resource Recovery</td>
<td>1 pt</td>
</tr>
<tr>
<td>(ii) Resource Efficient Building Design</td>
<td>4 pts</td>
</tr>
<tr>
<td>Use of BIM to calculate CUI (Advanced Green Efforts)</td>
<td>1 pt</td>
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<tr>
<td>(iii) Low Carbon Concrete</td>
<td>Up to 3 pts</td>
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<tr>
<td>Use of Advanced Green Materials (Advanced Green Efforts)</td>
<td>1 pt</td>
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<tr>
<td><strong>3.2b Embodied Carbon</strong></td>
<td>2 points</td>
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<tr>
<td>Provide Own Emission Factors with Source Justification (Advanced Green Efforts)</td>
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<tr>
<td>Compute the Carbon Footprint of the Entire Development (Advanced Green Efforts)</td>
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<tr>
<td><strong>3.2c Sustainable Products</strong></td>
<td>Up to 8 points</td>
</tr>
<tr>
<td>(i) Functional Systems</td>
<td>12.5 pts</td>
</tr>
<tr>
<td>(ii) Singular Sustainable Products outside of Functional Systems</td>
<td>2 pts</td>
</tr>
<tr>
<td>Sustainable Products with Higher Environmental Credentials (Advanced Green Efforts)</td>
<td>2 pts</td>
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## 3.3 Waste

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<thead>
<tr>
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<tbody>
<tr>
<td><strong>3.3a Environmental Construction Management Plan</strong></td>
<td>1 point</td>
</tr>
<tr>
<td><strong>3.3b Operational Waste Management</strong></td>
<td>3 points</td>
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<tr>
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<tr>
<td><strong>P.8 Thermal Comfort</strong></td>
<td>30 points</td>
</tr>
<tr>
<td><strong>P.9 Minimum Ventilation Rate</strong></td>
<td></td>
</tr>
<tr>
<td><strong>P.10 Filtration Media for Times of Pollution</strong></td>
<td></td>
</tr>
<tr>
<td><strong>P.11 Low Volatile Organic Compound (VOC) Paints</strong></td>
<td></td>
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<tr>
<td><strong>P.12 Refrigerants</strong></td>
<td></td>
</tr>
<tr>
<td><strong>P.13 Sound Level</strong></td>
<td></td>
</tr>
<tr>
<td><strong>P.14 Permanent Instrumentation for the Measurement and Verification of Chilled Water Air-Conditioning Systems</strong></td>
<td></td>
</tr>
<tr>
<td><strong>P.15 Electrical Sub-Metering &amp; Monitoring</strong></td>
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## 4.1 Indoor Air Quality

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<thead>
<tr>
<th>Sub-section</th>
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<tbody>
<tr>
<td><strong>4.1a Occupant Comfort</strong></td>
<td>2 points</td>
</tr>
<tr>
<td>(i) Indoor Air Quality (IAQ) Surveillance Audit</td>
<td>1 pt</td>
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<tr>
<td>(ii) Post Occupancy Evaluation</td>
<td>0.5 pt</td>
</tr>
<tr>
<td>(iii) Indoor Air Quality Display</td>
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<tr>
<td>Indoor Air Quality Trending (Advanced Green Efforts)</td>
<td>2 pts</td>
</tr>
<tr>
<td><strong>4.1b Outdoor Air</strong></td>
<td>3 points</td>
</tr>
<tr>
<td>(i) Ventilation Rates</td>
<td>1.5 pts</td>
</tr>
<tr>
<td>(ii) Enhanced Filtration Media</td>
<td>1 pt</td>
</tr>
<tr>
<td>(iii) Dedicated Outdoor Air System</td>
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<tr>
<td><strong>4.1c Indoor Contaminants</strong></td>
<td>5 points</td>
</tr>
<tr>
<td>(i) Local Exhaust and Air Purging System</td>
<td>2 pts</td>
</tr>
<tr>
<td>(ii) Ultraviolet Germicidal Irradiation (UVGI) System</td>
<td>0.5 pt</td>
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<tr>
<td>(iii) More Stringent VOC Limits for Interior Fittings and Finishes</td>
<td>2 pts</td>
</tr>
<tr>
<td>(iv) Use of Persistent Bio-cumulative and Toxic (PBT) free lighting</td>
<td>0.5 pt</td>
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<tr>
<td>Zero ODP Refrigerants with Low Global Warming Potential (Advanced Green Efforts)</td>
<td>1 pt</td>
</tr>
<tr>
<td>4.2 Spatial Quality</td>
<td>10 points</td>
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<td>---------------------</td>
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<tr>
<td><strong>4.2a Lighting</strong></td>
<td><strong>Up to 6 points</strong></td>
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<tr>
<td>(i) Effective daylighting for common areas</td>
<td>2 pts</td>
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<tr>
<td>(ii) Effective daylighting for occupied spaces</td>
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<tr>
<td>(iii) Quality of Artificial Lighting</td>
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<tr>
<td><strong>4.2b Acoustics</strong></td>
<td>2 points</td>
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<tr>
<td>(i) Sound Transmission Reduction</td>
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<tr>
<td>(ii) Acoustic Report</td>
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<tr>
<td><strong>4.2c Wellbeing</strong></td>
<td><strong>Up to 2 points</strong></td>
</tr>
<tr>
<td>(i) Biophilic Design</td>
<td>3 pts</td>
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<tr>
<td>(ii) Universal Design (UD) Mark</td>
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<thead>
<tr>
<th>4.3 Smart Building Operations</th>
<th>10 points</th>
</tr>
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<tbody>
<tr>
<td><strong>4.3a Energy Monitoring</strong></td>
<td>3 points</td>
</tr>
<tr>
<td>(i) Energy Portal and Dashboard</td>
<td>2 pts</td>
</tr>
<tr>
<td>(ii) BAS and Controllers with Open Protocol</td>
<td>1 pt</td>
</tr>
<tr>
<td>Permanent M&amp;V for VRF Systems (Advanced Green Effort)</td>
<td>2 pts</td>
</tr>
<tr>
<td>Permanent M&amp;V for Hot Water systems (Advanced Green Efforts)</td>
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<tr>
<td><strong>4.3b Demand Control</strong></td>
<td>2 points</td>
</tr>
<tr>
<td>(i) ACMV Demand Control</td>
<td>2 pts</td>
</tr>
<tr>
<td>(ii) Lighting Demand Control</td>
<td>1 pt</td>
</tr>
<tr>
<td><strong>4.3c Integration and Analytics</strong></td>
<td>3 points</td>
</tr>
<tr>
<td>(i) Basic Integration and Analytics</td>
<td>0.5 pt per feature</td>
</tr>
<tr>
<td>(ii) Advanced Integration and Analytics</td>
<td>1 pt per feature</td>
</tr>
<tr>
<td>Additional Advanced Integration and Analytical Features (Advanced Green Effort)</td>
<td>1 pt</td>
</tr>
<tr>
<td><strong>4.3d System Handover and Documentation</strong></td>
<td>1 point</td>
</tr>
<tr>
<td>Expanded Post Occupancy Performance Verification by a 3rd Party (Advanced Green Effort)</td>
<td>2 pts</td>
</tr>
<tr>
<td>Energy Performance Contracting (Advanced Green Effort)</td>
<td>1 pt</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part 5 – Advanced Green Efforts</th>
<th>20 points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5.1 Enhanced Performance</strong></td>
<td><strong>Up to 15 points</strong></td>
</tr>
<tr>
<td><strong>5.2 Demonstrating Cost Effective Design</strong></td>
<td>2 points</td>
</tr>
<tr>
<td><strong>5.3 Complementary Certifications</strong></td>
<td>1 point</td>
</tr>
<tr>
<td><strong>5.4 Social Benefits</strong></td>
<td>2 points</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Annexes for specialised buildings</th>
<th>10 to 15 points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annex 1: Energy Efficiency Features for Specialised Building [Hawker Centres]</strong></td>
<td>15 points</td>
</tr>
<tr>
<td><strong>Annex 2: Energy Efficiency Features for Specialised Building Healthcare Facilities</strong></td>
<td>10 points</td>
</tr>
<tr>
<td><strong>Annex 3: Energy Efficiency Features for Specialised Building [Laboratories]</strong></td>
<td>10 points</td>
</tr>
<tr>
<td><strong>Annex 4: Energy Efficiency Features for Specialised Building [Schools]</strong></td>
<td>10 points</td>
</tr>
</tbody>
</table>
### GM NRB:2015 Summarised Criteria

#### Part 1 – Climatic Responsive Design

<table>
<thead>
<tr>
<th>Green Mark Points</th>
<th>P.1 Envelope and Roof Thermal Transfer</th>
<th>P.2 Air Tightness and Leakage</th>
<th>P.3 Bicycle Parking</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ETTV (W/m²)</strong></td>
<td>Gold: 45</td>
<td>GoldPLUS: 40</td>
<td>Platinum: 38</td>
</tr>
<tr>
<td><strong>Prerequisite</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**P.2 Air Tightness and Leakage**

**P.3 Bicycle Parking**
Meet the minimum quantity of bicycle parking lots required for the development, in line with URA circular URA/PB/2018/03-DCG (or prevailing circular) and LTA’s Code of Practice - Street Work Proposal Relating to Development Works (or prevailing COP)

#### 1.1 Leadership

**1.1a Climatic & Contextually Responsive Brief**
Create climatic and culturally responsive brief including target setting

<table>
<thead>
<tr>
<th>(Up to 1 point for 1.1a)</th>
</tr>
</thead>
</table>

**1.1b Integrative Design Process**

(i) Demonstrate integrated design process
- Appointment of all relevant consultants early in the design phase
- Identification of responsible parties within the team to implement relevant sustainability goals and targets
- Detailing of sustainable design methodology action plans and progress
- Addressing of opportunities and challenges with integrative team strategies to achieve the targets
- Organising of design charrettes at key stages within the project design

(ii) Involve Facility Manager (FM) in the design stage and incorporating his inputs into design.

(iii) Use of BIM

<table>
<thead>
<tr>
<th>(Up to 4 points for 1.1b)</th>
</tr>
</thead>
</table>

**1.1c Environmental Credentials of Project Team**
This pertains to the appointment of environmental specialists at building design, construction and operations stages.

**Green Individuals:**
- Certified Green Mark Manager (GMM) or Green Mark Facilities Manager (GMFM) with valid Refresher Course Certification (valid for 2 years)
- Green Mark Professional (GMP) or Green Mark Facilities Professional (GMFP)

| 0.25 point with at least one GMM or GMFM |
| 0.5 point with at least one GMP or GMFP (Up to 0.5 point for Green Individuals) |

(Up to 0.5 point for Green Individuals)
### Part 1 – Climatic Responsive Design

#### Green Mark Points

<table>
<thead>
<tr>
<th>Green and Gracious Builder:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• The main builder is a BCA Certified Green and Gracious Builder.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Green Companies:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Following companies with ISO14001 certification: Architect, M&amp;E Engineer, C&amp;S Engineer, Developer and Main Contractor.</td>
<td></td>
</tr>
<tr>
<td>• SGBC Green Services Certified Firm.</td>
<td></td>
</tr>
</tbody>
</table>

| 0.25 point for Certified or Merit; or 0.5 point for Excellent or Star rating (Up to 0.5 point for Green & Gracious Builder) |  |
| 0.25 point each per consultant type ISO14001 |  |
| 0.25 point each (Up to 1.5 points for Green Companies) |  |

| 0.25 point each per consultant type ISO14001 |  |
| 0.5 point each (Up to 1 point) |  |

#### 1.1d User Engagement

Provision of relevant information and guidance to building occupants so that they can contribute positively to the reduction of the building’s environmental impact

|  • Building user guide |  |
|  • Sustainability Education Corner |  |
|  • Sustainability Awareness & Education Programme |  |
|  • Green fit out guidelines |  |
|  • Displaying Green Mark credential |  |
|  • Green lease |  |
|  • ≥ 25% of the net lettable area |  |
|  • ≥ 60% of the net lettable area |  |

| 0.5 point each |  |
| 1 point each (Up to 3 points for 1.1d) |  |

### 1.2 Urban Harmony – Part A

#### 1.2a Sustainable Urbanism

Minimise environmental impact to the surroundings through site analysis

<table>
<thead>
<tr>
<th>(i) Environmental Analysis</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Environmental Study</td>
<td>1 point</td>
</tr>
<tr>
<td>• Comprehensive Environmental Impact Assessment (EIA) by 3rd party</td>
<td>2 points (Up to 2 points)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(ii) Response to Site Context</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Level 1 site analysis and design that demonstrates sensitivity to the site condition</td>
<td>1 point</td>
</tr>
<tr>
<td>• Level 2 site analysis optimised design with at least 2 types of iterative simulations</td>
<td>3 points (Up to 3 points)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(iii) Urban Heat Island (UHI) Mitigation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• ≥ 50% site coverage (at plan view) with mitigation measures</td>
<td>0.5 point</td>
</tr>
<tr>
<td>• ≥ 80% site coverage (at plan view) with mitigation measures</td>
<td>1 point (Up to 1 point)</td>
</tr>
</tbody>
</table>
## Part 1 – Climatic Responsive Design

### Green Mark Points

<table>
<thead>
<tr>
<th>Item</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>(iv) Green Transport&lt;br&gt;• Provision of electrical vehicle charging and parking infrastructure (at least 1 lot per 100 lots (Up to 5 lots))&lt;br&gt;• Meet the prevailing lower bound requirement by of ‘Range Based Car Parking Standard (RCPS)’ based on development type and parking zone published by LTA.&lt;br&gt;• Provision of bicycle lots over and above requirements stated in URA circular URA/PB/2018/03-DCG (or prevailing circular) and LTA’s Code of Practice - Street Work Proposal Relating to Development Works (or prevailing COP) with at least 1 bicycle parking lot per 1,500m² of GFA (Up to 30 lots)&lt;br&gt;• Additional features to promote bicycle usage (at least 2 features to score) (Up to 5 points for 1.2a)</td>
<td>0.5 point each</td>
</tr>
</tbody>
</table>

### 1.2 Urban Harmony – Part B

#### 1.2b Integrated Landscape and Waterscape

Integrate a verdant landscape and waterscape into their building design, to enhance the biodiversity around the development and provide visual relief to building occupants and neighbours.

| (i) Greenery Provision<br>• Preservation of existing trees on-site<br>• Replant an equivalent number of similar or native species of equivalent LAI | 0.5 point | 0.5 point |
| (ii) Tree Conservation<br>• Adoption of native species of greenery > 50% of the flora selected | 0.5 point |
| (iii) Sustainable Landscape Management<br>• Certified under NParks Landscape Excellence Assessment Framework (LEAF) certification | 1.5 point |
| • Adoption of native species of greenery > 50% of the flora selected | 0.5 point |
| • Provision of landscape management plan | 0.5 point (Up to 1.5 point) |
| (iv) Sustainable Stormwater Management<br>• Certified under PUB Active, Beautiful and Clean Waters (ABC Waters) certification | 1 point |
| • Treatment of stormwater run-off<br>  ➢ ≥ 10% of run-off of total site area<br>  ➢ ≥ 35% of run-off of total site area | 0.5 point | 1 point (Up to 5 points under 1.2b) |

### 1.3 Tropicality

#### 1.3a Tropical Façade Performance

Holistic consideration of façade performance can reduce direct sunlight into the building and minimise thermal heat gain, enhancing indoor comfort and lowering the energy for conditioning the indoor environment.
### Part 1 – Climatic Responsive Design

#### Green Mark Points

<table>
<thead>
<tr>
<th>Simulation Method</th>
<th>Industrial Buildings</th>
<th>Other building types</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall Weighted Values</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Window U-Value</td>
<td>5.4 W/m²K</td>
<td>2.8 W/m²K</td>
</tr>
<tr>
<td>Wall U-Value</td>
<td>1.5 W/m²K</td>
<td>0.7 W/m²K</td>
</tr>
<tr>
<td>Overall Envelope U-value</td>
<td>2.4 W/m²K</td>
<td>1.6 W/m²K</td>
</tr>
<tr>
<td>Window-to-Wall Ratio (Each façade)</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Total Effective Glass Shading Coefficient (SC1 x SC2)</strong></td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Roof U-Value</td>
<td>1.1 W/m²K</td>
<td>0.8 W/m²K</td>
</tr>
<tr>
<td>Sky light/ Roof window U-Value</td>
<td>4.3 W/m²K</td>
<td>2.2 W/m²K</td>
</tr>
<tr>
<td>RTTV (where there are sky lights for AC areas)</td>
<td>50 W/m²K</td>
<td>50 W/m²K</td>
</tr>
</tbody>
</table>

#### Non-Simulation Checklist for Industrial Buildings

<table>
<thead>
<tr>
<th>Overall Weighted Values</th>
<th>Baseline</th>
<th>Points for meeting or reduction from baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Envelope U-Value (Up to 2 points)</td>
<td>2.4 W/m²K</td>
<td>0.5 points for every 0.4 W/m²K reduction</td>
</tr>
<tr>
<td>WWR (Excludes Façade openings/voids) (Up to 2 points)</td>
<td>0.2</td>
<td>0.5 pt for meeting baseline 0.5 pt for every 0.05 reduction</td>
</tr>
<tr>
<td>Glass Shading Coefficient (SC1) (Up to 2 points)</td>
<td>0.5</td>
<td>1 pt for meeting baseline 0.5 pt for every 0.05 reduction from baseline</td>
</tr>
<tr>
<td>Effective Sun Shading (Up to 2 points)</td>
<td></td>
<td>1 pt for ≥ 10% effectiveness (North and South) 1 pt for 30% effectiveness (East and West)</td>
</tr>
<tr>
<td>Roof U-Value (Up to 2 points)</td>
<td>1.0 W/m²K</td>
<td>0.5 pt for every 0.1 W/m²K reduction</td>
</tr>
<tr>
<td>Sky light/ Roof window U-Value (Up to 1 point)</td>
<td>4.0 W/m²K</td>
<td>0.5 pt for meeting baseline 1 pt for U-Value of 2 W/m²K</td>
</tr>
</tbody>
</table>

#### Non-Simulation Checklist for Other Buildings Types

<table>
<thead>
<tr>
<th>Overall Weighted Values</th>
<th>Baseline</th>
<th>Points for meeting or reduction from baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Envelope U-Value (Up to 2 points)</td>
<td>1.6 W/m²K</td>
<td>0.5 pt for meeting baseline 0.5 points for every 0.2 W/m²K reduction</td>
</tr>
<tr>
<td>WWR (Excludes Façade openings/voids) (Up to 2 points)</td>
<td>0.4 (East, West facades not to exceed 0.3)</td>
<td>1 pt for meeting baseline 0.5 pt for every 0.05 reduction</td>
</tr>
<tr>
<td>Glass Shading Coefficient (SC1) (Up to 2 points)</td>
<td>0.4</td>
<td>0.5 pt for meeting baseline 0.5 pt for every 0.05 reduction from baseline</td>
</tr>
<tr>
<td>Effective Sun Shading (Up to 2 points)</td>
<td></td>
<td>1 pt for ≥ 10% effectiveness (North and South) 1 pt for 30% effectiveness (East and West)</td>
</tr>
<tr>
<td>Roof U-Value (Up to 1 point)</td>
<td>0.8 W/m²K</td>
<td>1 pt for meeting baseline</td>
</tr>
<tr>
<td>Sky light/ Roof window U-Value (Up to 0.5 point)</td>
<td>2.2 W/m²K</td>
<td>0.5 pt for meeting baseline</td>
</tr>
</tbody>
</table>

(Up to 3 points under 1.3a)
Part 1 – Climatic Responsive Design

**1.3b Internal Spatial Organisation**
Adopting passive design strategies in the internal spatial organisation of a building provides opportunities to enhance building performance.

(i) Location of non-air-conditioned spaces, e.g. lift cores, staircases, toilets, electrical plantrooms etc that covers
- 1/3 of the east and west facades
- 2/3 of the east and west facades

(ii) Prorating the number of transient common spaces, e.g. toilets, staircases, corridors, lift lobbies and atriums by the mode of ventilation against the total number of applicable spaces

Point scored = 
\[
\text{No. of NV spaces x 2 + No. of MV spaces x 0.5 + No. of AC spaces x 0} \\
\text{Total no. of spaces}
\]

(Up to 2 points)

(Up to 3 points under 1.3b)

1.3c Ventilation Performance
Naturally ventilated functional areas should be effectively designed to be thermally comfortable and healthy for the building occupants.

(i) Ventilation Performance Checklist
- Openings towards prevailing wind directions
- Depth of room vs opening
  - Single sided ventilation: \( W \leq 2H \)
  - Cross Ventilation: \( W \leq 5H \)
  A factor of 1.5 can be applied to the \( W \)-\( H \) ratio for atria.

(ii) Full Ventilation Simulation

<table>
<thead>
<tr>
<th>Wind velocity</th>
<th>Thermal Comfort</th>
<th>Air Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Air Change Rate</td>
<td>Air Exchange Efficiency</td>
</tr>
<tr>
<td>0.2 m/s</td>
<td>( -1.0 &lt; \text{PMV} &lt; +1.0 )</td>
<td>( \geq 4 )</td>
</tr>
<tr>
<td>0.4 m/s</td>
<td>( -0.8 &lt; \text{PMV} &lt; +0.8 )</td>
<td>( \geq 4 )</td>
</tr>
<tr>
<td>0.6 m/s</td>
<td>( -1.0 &lt; \text{PMV} &lt; +1.0 )</td>
<td>( \geq 10 )</td>
</tr>
</tbody>
</table>

(Up to 4 points under 1.3c)
Part 2 – Building Energy Performance

### P.4 Air Conditioning Total System and Component Efficiency

<table>
<thead>
<tr>
<th>Green Mark Rating</th>
<th>Air Cooled Chilled-Water System/ Unitary Air-Conditioning System</th>
<th>Water Cooled Chilled Water System</th>
<th>District Cooling System (DCS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold</td>
<td>NA (0.9, N.A.)</td>
<td>NA (0.75, N.A.)</td>
<td>NA (0.68, N.A.)</td>
</tr>
<tr>
<td>GoldPLUS</td>
<td>1.10 (0.85, 0.25)</td>
<td>0.98 (0.7, 0.25)</td>
<td>0.9 (0.65, N.A.)</td>
</tr>
<tr>
<td>Platinum</td>
<td>1.03 (0.78, 0.25)</td>
<td>0.93 (0.68, 0.25)</td>
<td>0.9 (0.65, 0.25)</td>
</tr>
</tbody>
</table>

\( \eta_c, \eta_a \) shall meet their respective thresholds.

\( \eta_c \): System kW/ton excluding the air distribution equipment or DCS system kW/ton

\( \eta_a \): Air distribution equipment kW/ton

\( \eta_t = \eta_c + \eta_a \)

#### Prerequisite

\( \eta_t \) (kW/RT)

For district cooling plants under Path B scenario, where the plant is excluded from the computation, the baseline reference for the building air distribution equipment can be taken as 0.28 kW/ton for the purposes of points computation here.

#### Prerequisite

### P.5 Lighting Efficiency and Controls


#### Prerequisite

### P.6 Vertical Transportation Efficiency

Lifts and escalators shall be equipped with AC variable voltage and variable frequency (VVVF) motor drive and sleep mode features.

#### Prerequisite

### 2.1 Energy Efficiency

#### Option 1: Energy Performance Points Calculator

**Section 2.1a to 2.1e**

**2.1a Air Conditioning Total System Efficiency**

The use of energy efficient air-conditioning systems can optimise their total system performance, and reduce the energy needed to produce and distribute conditioned air into building spaces.

For district cooling plants under Path B scenario, where the plant is excluded from the computation, the baseline reference for the building air distribution equipment can be taken as 0.28 kW/ton for the purposes of points computation here.

<table>
<thead>
<tr>
<th>Peak Building Cooling Load (RT)</th>
<th>Baseline for Total Design System Efficiency (kW/RT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;500 RT</td>
<td>1.08</td>
</tr>
<tr>
<td>≥500RT</td>
<td>0.98</td>
</tr>
</tbody>
</table>

Points scored = 0.2 x % improvement from baseline

(Computed by Energy Performance Points Calculator)

(Up to 5 points for 2.1a)

**2.1b Lighting System Efficiency**

The use of energy efficient lighting can reduce the energy needed to illuminate a space.


Points scored = 0.1 x % improvement from baseline

(Computed by Energy Performance Points Calculator)

(Up to 3 points for 2.1b)

**2.1c Carpark System Efficiency**

The use of energy efficient carpark ventilation and lighting systems can reduce the energy needed for carpark operations.

Points scored = 0.05 x % improvement from baseline

(Computed by Energy Performance Points Calculator)

(Up to 2 points for 2.1c)

**2.1d Receptacle Load Efficiency**

The use of energy efficient receptacle equipment can reduce their energy consumption.

Points scored = 0.025 x % improvement from baseline

(Computed by Energy Performance Points Calculator)

(Up to 1 point for 2.1d)

**2.1e Building Energy**

Encourage effective design of building systems to reduce building’s overall energy consumption.

Points scored = \( \frac{\% \text{ improvement from baseline}}{3} \)

(Computed by Energy Performance Points Calculator)

(Up to 11 point for 2.1e)
## Part 2 – Building Energy Performance

### Option 2: Performance-Based Computation

#### 2.1f Space Conditioning Performance

Efficient use of energy to maintain a thermally acceptable indoor environment, by effective design of natural ventilation, energy efficient mechanical ventilation and air-conditioning systems.

Proration based on mode of ventilation in functional spaces

**Natural Ventilation**

As per scoring

**Mechanical Ventilation**

<table>
<thead>
<tr>
<th>Systems</th>
<th>Constant Volume &amp; Variable Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan systems with nameplate motor power</td>
<td>≥ 4kW</td>
</tr>
</tbody>
</table>

**Option 1: Fan system motor nameplate**

|  | 0.35 | No baseline |

**Option 2: Fan system input**

*Applicable pressure drop adjustments can be considered based on SS553 in accordance to GM NRB: 2015 Technical Guide and Requirements, subjected to BCA’s evaluation

|  | 0.3 | 0.17 |

**Air-conditioning**

Efficient air-conditioning system

<table>
<thead>
<tr>
<th>Peak Building Cooling Load (RT)</th>
<th>Baseline for Total Design System Efficiency (kW/RT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;500 RT</td>
<td>1.08</td>
</tr>
<tr>
<td>≥ 500RT</td>
<td>0.98</td>
</tr>
</tbody>
</table>

*TDSE refers to combined efficiency of the cooling and air distribution components

*For district cooling plants under Path B scenario, where the plant is excluded from the computation, the baseline reference for the building air distribution equipment can be taken as 0.28 kW/ton for the purposes of points computation here.

#### 2.1g Lighting System Performance

The use of energy efficient lighting can reduce the energy needed to illuminate a space.


**Points scored = 0.17 x (% improvement from baseline)**

#### 2.1h Building Systems Performance

Encourage effective design of building systems other than space conditioning systems and lighting systems to reduce building’s overall energy consumption

(i) **Receptacle Load Efficiency**

<table>
<thead>
<tr>
<th>Receptacle loads</th>
<th>Nominal Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Intensive Office</td>
<td>22W/m²</td>
</tr>
<tr>
<td>General office areas</td>
<td>16W/m²</td>
</tr>
<tr>
<td>Large conference areas</td>
<td>11W/m²</td>
</tr>
<tr>
<td>Schools (Tertiary/IHLs)</td>
<td>8W/m²</td>
</tr>
<tr>
<td>Schools (Primary/Secondary)</td>
<td>5W/m²</td>
</tr>
<tr>
<td>Server/Computer rooms</td>
<td>540W/m²</td>
</tr>
</tbody>
</table>

**Points scored = 0.05 x (% improvement from baseline) x (% of functional areas)**

(Rule 10 point for 2.1f)

(Rule 6 point for 2.1g)

(Rule 2 point for 2.1h)
## Part 2 – Building Energy Performance

### Green Mark Points

#### (ii) Car Park Ventilation Energy

<table>
<thead>
<tr>
<th>Mode of ventilation</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Ventilation</td>
<td>1.5 points</td>
</tr>
<tr>
<td>Mechanical Ventilation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Without CO sensor/without Fume Extract</td>
</tr>
<tr>
<td></td>
<td>With CO sensor / Fume Extract</td>
</tr>
</tbody>
</table>

#### (iii) Energy Use Intensity

0.5 point for meeting 25th percentile EUI as per prevailing BCA Building Energy Benchmarking Report (BEBR) (Up to 0.5 point)

#### (iv) Energy Efficient Practices and Features

Points scored = 0.5 x (% improvement from baseline total building consumption) (Up to 2 points)

(Up to 6 point for 2.1h)

### 2.2 Renewable Energy

#### 2.2a Solar Energy Feasibility Study

The evaluation of a building footprint’s potential in harnessing solar energy can raise awareness on viable solar opportunities in the development and assist building developers in their decision making to adopt photovoltaics.

0.5 point for provision of solar feasibility report (Up to 0.5 point)

(Up to 0.5 point for 2.2a)

#### 2.2b Solar Ready Roof

Designing roofs to be ready for photovoltaic installation facilitates ease of their deployment should building developers decide to do so at later stages of a project/ during building operation.

0.5 point each for achieving
- Structural readiness
- Electrical readiness
- Spatial readiness (Up to 1.5 points)

(Up to 1.5 point for 2.2b)

#### 2.2c Adoption of Renewable Energy

On-site generation of renewable energy can reduce the building development’s power consumption from the grid and carbon emissions.

<table>
<thead>
<tr>
<th>Expected Energy Use Intensity (EUI) [kWh/m²/yr]</th>
<th>% Replacement of Building Electricity Consumption by Renewable Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 220</td>
<td>1 point for every 0.5%</td>
</tr>
<tr>
<td>50 ≤ EUI &lt; 220</td>
<td>1 point for every 1.25%</td>
</tr>
<tr>
<td>&lt; 50</td>
<td>1 point for every 2.5%</td>
</tr>
</tbody>
</table>

(Up to 6 point for 2.2c)
## Part 3 – Resource Stewardship

### P.7 Water Efficient Fittings

Meet minimum requirements stated in table

<table>
<thead>
<tr>
<th>Type of Water Fittings</th>
<th>Prescribed Minimum WELS rating</th>
<th>Applicable Areas</th>
<th>Prerequisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basin Taps &amp; Mixers</td>
<td>3 Ticks WELS rating</td>
<td>Public/ staff/ school toilets</td>
<td></td>
</tr>
<tr>
<td>Sink Taps &amp; Mixers</td>
<td>2 Ticks WELS rating</td>
<td>All areas</td>
<td></td>
</tr>
<tr>
<td>Shower Taps, Mixers or</td>
<td>2 Ticks WELS rating</td>
<td>Public/ staff/ school shower</td>
<td></td>
</tr>
<tr>
<td>Showerheads</td>
<td></td>
<td>facilities</td>
<td></td>
</tr>
<tr>
<td>Dual Flush Flushing Cisterns</td>
<td>2 Ticks WELS rating</td>
<td>All areas</td>
<td></td>
</tr>
</tbody>
</table>

### 3.1 Water

#### 3.1a Water Efficient Systems

The design of water efficient mechanical systems and strategies can minimise potable water consumption in building operations.

(i) Landscape Irrigation

- Every 25% of the landscape areas that are served by water efficient irrigation systems with features such as automatic sub-soil drip irrigation system with moisture or rain sensor control.
- Every 20% of the landscape areas that comprises drought tolerant plants.

(ii) Water Consumption of Cooling Towers

- Cooling tower water treatment system with 7 or more cycles of concentration (CoC) with effective filtration system.
- Provision of devices that recovers waste heat from the condensers and helps reduce the water requirement needed to remove heat through the cooling towers.

#### 3.1b Water Monitoring

Better control and monitoring can facilitate setting of consumption reduction targets. Making the monitored information accessible to end users can facilitate user engagement programmes and promote behavioural changes with regard to water management and use.

(i) Water monitoring and leak detection

- Private meters
- Smart remote metering system

(ii) Water Usage Portal and Dashboard

- Display metered data, trending of water consumption (historical data) and relevant parameters
- Display monthly water consumption of 50th percentile line of the tenants/space within the buildings. The information could also include 25th and 75th percentile line.
### Part 3 – Resource Stewardship

#### 3.1c Alternative Water Sources

The use of alternative water sources can reduce potable water consumption for general application and use.

- AHU condensate collection where > 50% of total condensate is collected
- NEWater supply
- On-site recycled water
- Rainwater harvesting

<table>
<thead>
<tr>
<th>1 point each (Up to 4 points)</th>
</tr>
</thead>
</table>

#### 3.2 Materials

**3.2a Sustainable Construction**

To encourage the adoption of building designs, building structures and construction practices that are environmentally friendly and sustainable.

- **(i) Conservation and Resource Recovery**
  - The existing structures are conserved and not demolished.
  - The existing structures are demolished with an enhanced demolition protocol, where a recovery rate of > 35% crushed concrete waste from the demolished building is sent to approved recyclers with proper facilities.

- **(ii) Resource Efficient Building Design**
  - **Concrete Usage Index (CUI)**
  - **Adoption of sustainable building systems**

  **List of Sustainable Building Systems**
  
  - Pre-stressed Concrete Elements
  - Hollow Core or Voided Concrete Elements
  - Light Weight Concrete Elements
  - High Strength Concrete Elements (Concrete grade >60MPa)
  - Structural Steel Elements
  - Composite Structural Elements
  - Engineered Timber Elements
  - Prefabricated Prefinished Volumetric Construction units
  - Precast Concrete Elements
  - Leave-in Formwork
  - Others (to be accepted by BCA on case-by-case basis)

- **(iii) Low Carbon Concrete**
  - **Clinker Content**
  
  Use of concrete containing clinker ≤ 400 kg/m³ for grades up to C50/60 for ≥ 80% of the applicable superstructural concrete by volume

  **Replacement of coarse and fine aggregates**
  
  The usage should not fall below 1.5% x GFA for RCA and/or 0.75% x GFA for WCS for points scoring.

<table>
<thead>
<tr>
<th>Project’s CUI (m³/m³)</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 0.60</td>
<td>0.5</td>
</tr>
<tr>
<td>≤ 0.50</td>
<td>1.0</td>
</tr>
<tr>
<td>≤ 0.45</td>
<td>1.5</td>
</tr>
<tr>
<td>≤ 0.40</td>
<td>2.0</td>
</tr>
<tr>
<td>≤ 0.35</td>
<td>2.5</td>
</tr>
</tbody>
</table>

(Up to 2.5 points)

<table>
<thead>
<tr>
<th>Total coverage area</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 25% of CFA</td>
<td>0.5</td>
</tr>
<tr>
<td>≥ 50% of CFA</td>
<td>1.0</td>
</tr>
<tr>
<td>≥ 75% of CFA</td>
<td>1.5</td>
</tr>
</tbody>
</table>

(Up to 1.5 points)

<table>
<thead>
<tr>
<th>Concrete Categories*</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncertified concrete</td>
<td>0.5</td>
</tr>
<tr>
<td>SGBC-certified 1-Tick concrete</td>
<td>1.0</td>
</tr>
<tr>
<td>SGBC-certified 2-Tick concrete</td>
<td>1.5</td>
</tr>
<tr>
<td>SGBC-certified 3-Tick and 4-Tick concrete</td>
<td>2.0</td>
</tr>
</tbody>
</table>

0.5 point for every 5% replacement by mass of coarse and fine aggregates with recycled concrete aggregates (RCA) and/or washed copper slag (WCS) from approved sources for the superstructure concrete mix.

(Up to 3 points for 3.2a(iii))

(Up to 8 points for 3.2a)
### Part 3 – Resource Stewardship

#### 3.2b Embodied Carbon
This involves the computation of the carbon footprint of the development and the building life cycle analysis to better quantify the environmental impact of a building and raise awareness among key decision makers.

1 point for declaration of Concrete, Glass and Steel 0.25 point per material for Declaration of additional materials (Up to 1 point)

(Up to 2 points for 3.2b)

#### 3.2c Sustainable Products
Encourage the specification of resource efficient and environmentally friendly products for use in the fit-out of a building, taking a functional system approach to focus on greening major fit-out materials whilst allowing for flexibility in design as well as recognising designs with optimal/ minimal material use.

### (i) Functional Systems
Specification and use of green products certified by approved local certification bodies, namely the Singapore Green Building Council and the Singapore Environment Council, within the 6 main functional system categories.

<table>
<thead>
<tr>
<th>Functional System Category</th>
<th>Base Group</th>
<th>Finishes Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Wall</td>
<td>1 pt</td>
<td>2 pt</td>
</tr>
<tr>
<td>Internal Wall</td>
<td>1 pt</td>
<td>2 pt</td>
</tr>
<tr>
<td>Flooring</td>
<td>1 pt</td>
<td>2 pt</td>
</tr>
<tr>
<td>Doors</td>
<td>1 pt</td>
<td>0.5 pt</td>
</tr>
<tr>
<td>Ceiling</td>
<td>0.5 pt</td>
<td>0.5 pt</td>
</tr>
<tr>
<td>Roofing</td>
<td>0.5 pt</td>
<td>0.5 pt</td>
</tr>
</tbody>
</table>

### (ii) Singular Sustainable Products outside of Functional Systems
To encourage the use of sustainable products that do not fall into the functional systems such as:

- **Hardscape** - Includes items such as composite timber decking, outdoor equipment, pre-cast kerbs and drains, wheel stoppers in car parks, drainage cells etc.
- **Building services and M&E products** - Mechanical, electrical and plumbing equipment or products such as chillers, circuit boards, transformers, water pipes

<table>
<thead>
<tr>
<th>Singular Product Category</th>
<th>Coverage ≥ 80%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardscape, building services and M&amp;E products certified by an approved local certification body</td>
<td>0.25 point per product</td>
</tr>
</tbody>
</table>

(Up to 2 points)

(Up to 10 points for 3.2c)
### Part 3 – Resource Stewardship

#### 3.3 Waste

<table>
<thead>
<tr>
<th>Green Mark Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3.3a Environmental Construction Management Plan</strong>&lt;br&gt;An effective and holistic management plan can facilitate better environmental performance of the construction process and promote waste minimisation.</td>
</tr>
<tr>
<td><strong>3.3b Operational Waste Management</strong>&lt;br&gt;Appropriate collection and recycling provisions can facilitate the segregation of recyclable consumer waste at source. Provisions for the treatment of horticultural or wood waste for buildings with landscaping can promote their reuse and recycling as well.</td>
</tr>
<tr>
<td>1 point each&lt;br&gt;• Facilities for the collection and storage of different recyclables such as paper, glass, metal and plastic in commingled or sorted form.&lt;br&gt;• Facilities or systems for food waste to be treated and recycled, for buildings generating large volumes of food waste.&lt;br&gt;• Facilities or systems for the placement of horticultural or wood waste for recycling.</td>
</tr>
<tr>
<td>0.5 point each&lt;br&gt;• Provision of separate chute for recyclables, beyond code compliance*.&lt;br&gt;• Provision of Pneumatic Waste Conveyance System (PWCS), beyond code compliance*.</td>
</tr>
</tbody>
</table>

*NEA’s [Code of Practice on Environmental Health](#) (or prevailing code)

### Part 4 – Smart and Healthy Building

<table>
<thead>
<tr>
<th>Green Mark Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>P.8 Thermal Comfort</strong>&lt;br&gt;The normal design dry-bulb temperature for comfort air-conditioning shall be within 23°C - 25°C, and resultant relative humidity ≤ 65% in accordance with SS 553 : 2016 - Code of Practice for Air-Conditioning and Mechanical Ventilation in Buildings.</td>
</tr>
<tr>
<td><strong>P.9 Minimum Ventilation Rate</strong>&lt;br&gt;The building’s air-conditioning and mechanical ventilation systems shall be designed to provide appropriate minimum quantum of outdoor air rates as stated in Table 1 and Table 5 of SS 553 : 2016.</td>
</tr>
<tr>
<td><strong>P.10 Filtration Media for Times of Pollution</strong>&lt;br&gt;AHUs or dedicated outdoor air units in the building shall be designed to accommodate fine dust filters of at least a rating of Minimum Efficiency Reporting Value (MERV) 14 (ASHRAE 52.2: 2012) or F8 (EN779: 2012), when the outdoor pollution level is in the unhealthy range in accordance with MOH’s guidelines, as stipulated in SS 553 : 2016.</td>
</tr>
<tr>
<td><strong>P.11 Low Volatile Organic Compound (VOC) Paints</strong>&lt;br&gt;Low VOC paints certified by an approved local certification body shall be used for at least 90% of the total painted internal wall areas.</td>
</tr>
<tr>
<td>Part 4 – Smart and Healthy Building</td>
</tr>
<tr>
<td>-----------------------------------</td>
</tr>
<tr>
<td><strong>P.12 Refrigerants</strong></td>
</tr>
<tr>
<td><strong>P.13 Sound Level</strong></td>
</tr>
<tr>
<td><strong>P.14 Permanent Instrumentation for the Measurement and Verification of Chilled Water Air-Conditioning Systems</strong></td>
</tr>
</tbody>
</table>
| **P.15 Electrical Sub-Metering & Monitoring** | Subsystem measurement devices with remote capability shall be provided, linked to a monitoring system and measure and trend energy consumption data of:  
- Each of the following energy sub systems:  
  - Use (Sum of all loads)  
  - Lift & escalator  
  - Heater, including heat pump  
  - Process loads  
  - Mechanical ventilation  
  - VRF systems (CUs, FCUs)  
- Each tenancy or floor, as well as high energy load areas exceeding 50kVA such as car park, data centres, IT closets and process areas. | Prerequisite |
| **4.1 Indoor Air Quality** | The testing and evaluation of indoor air quality parameters is crucial to ensure occupant comfort. Engaging building occupants completes the feedback loop, and is essential for the management and improvement of operational practices in high-performing green buildings. |  
(i) Indoor Air Quality (IAQ) Surveillance Audit  
Committed to conduct an IAQ surveillance audit within one year after occupancy or after reasonable occupancy has been reached. The audit shall be conducted by an accredited laboratory under Singapore Accreditation Council with respect to the recommended IAQ parameters and acceptable limits stated in Table 1 of SS554: 2016, based on Indicative methods or reference methods. | 0.5 point for indicative method  
1 point for reference method |
### Part 4 – Smart and Healthy Building

<table>
<thead>
<tr>
<th>(ii) Post Occupancy Evaluation</th>
<th>Green Mark Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Committed to conduct Post Occupancy Evaluation (POE) questionnaire, with appropriate corrective actions if required, within a year after building occupancy or after reasonable occupancy has been reached.</td>
<td>0.5 point</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(iii) Indoor Air Quality Display</th>
<th>0.5 point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provision of display panels for temperature and relative humidity information at each floor/tenancy, to raise awareness among building occupants on the internal conditions of the space.</td>
<td></td>
</tr>
</tbody>
</table>

### 4.1b Outdoor Air

Provision of adequate and proper ventilation in conditioned spaces to prevent build-up in the concentration of contaminants.

<table>
<thead>
<tr>
<th>(i) Ventilation Rates</th>
<th>0.5 point for precool units (e.g. PAHUs and PFCUs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement and monitoring of outdoor airflow volume in accordance with desired ventilation rates.</td>
<td>1 point for all AHUs and FCUs</td>
</tr>
<tr>
<td>Use of demand control ventilation strategies such as carbon dioxide sensors or equivalent devices to regulate the quantity of fresh air and ventilation in accordance with the space requirements.</td>
<td>0.5 point</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(ii) Enhanced Filtration Media</th>
<th>0.5 point for all PAHUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent provision of Minimum Efficiency Rating Value (MERV 14, ASHRAE 52.2 or F8/EN779 class of filter or equivalent).</td>
<td>1 points for all PAHUs and AHUs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(iii) Dedicated Outdoor Air System</th>
<th>0.5 point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provision of a dedicated outdoor air system, such as precool units, to encourage effective treatment of outdoor air for cooling and dehumidification.</td>
<td></td>
</tr>
</tbody>
</table>

### 4.1c Indoor Contaminants

Indoor contaminant pollution control at source and air treatment strategies can safeguard the health of building occupants.

<table>
<thead>
<tr>
<th>(i) Local Exhaust and Air Purging System</th>
<th>1 point each</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local isolation and exhaust systems to remove the source of pollutants</td>
<td>(Up to 2 points)</td>
</tr>
<tr>
<td>Air purging system to replace contaminated indoor air with outdoor fresh air</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(ii) Ultraviolet Germicidal Irradiation (UVGI) System</th>
<th>0.5 point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provision of UVGI system in AHUs and FCUs to control airborne infective microorganisms.</td>
<td></td>
</tr>
</tbody>
</table>
### Part 4 – Smart and Healthy Building

#### Green Mark Points

<table>
<thead>
<tr>
<th>Functional System</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Wall</td>
<td>1 pt</td>
</tr>
<tr>
<td>Internal Wall</td>
<td>1 pt</td>
</tr>
<tr>
<td>Internal Flooring</td>
<td>1 pt</td>
</tr>
<tr>
<td>Ceiling</td>
<td>1 pt</td>
</tr>
<tr>
<td>Doors</td>
<td>0.5 pt</td>
</tr>
<tr>
<td>Other Systems:</td>
<td></td>
</tr>
<tr>
<td>Fixed furniture/</td>
<td>0.5 pt</td>
</tr>
<tr>
<td>system furniture</td>
<td></td>
</tr>
</tbody>
</table>

(Up to 2 points)

(iv) Use of Persistent Bio-cumulative and Toxic (PBT) free lighting

0.5 point for ≥ 90% of light fittings in the project.

(Up to 5 point for 4.1c)

### 4.2 Spatial Quality

#### 4.2a Lighting

Natural lighting has been linked to the positive mental wellbeing of building occupants. It connects enclosed indoor environments with the external natural environment. In the tropics, special care must be taken to maximise effective daylight while minimising visual discomfort and maintaining the façade’s thermal efficiency.

(i) Effective daylighting for common areas

Prorating the number of daylit transient common spaces with effective automatic lighting controls against the total number of applicable spaces. Note: Each toilet is counted as 0.5.

(ii) Effective daylighting for occupied spaces

Percentage of occupied spaces with access to effective daylighting. Points are computed based on the percentage of total occupied areas that can achieve the specific Daylight Autonomy (DA) requirement of DAN \( I_{x,50\%} \) (without overlighting), as outlined in the Green Mark NRB: 2015 Technical Guide and Requirements Annex B: Effective Daylighting Simulation and Pre-Simulated Daylight Availability Tables Methodology and Requirements. Effectively daylit areas shall be integrated with automated lighting controls.

Effective Mitigation of Overlit Areas

Pre-Simulation Daylight Availability Tables: Adoption of suitable mitigation strategies for overlit spaces or Daylight Simulation: mitigation measures to effectively address overlighting are included into the simulation model in accordance with Annex B.

<table>
<thead>
<tr>
<th>Pre-Simulation Daylight Availability Tables or Daylight Simulation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Percentage</strong></td>
</tr>
<tr>
<td>15 to &lt; 35 %</td>
</tr>
<tr>
<td>35 to &lt; 55 %</td>
</tr>
<tr>
<td>55 to &lt; 75 %</td>
</tr>
<tr>
<td>≥75%</td>
</tr>
</tbody>
</table>

(Up to 3 points)

Points scored = 1.5 x (% count with daylighting for toilets, staircases, corridors, lift lobbies and atriums) + 0.5 x (% areas of carpark with daylighting or having no carpark.)

(Up to 2 points for 4.2ai)

1 point

(Up to 4 points for 4.2aii)
### Part 4 – Smart and Healthy Building

#### Green Mark Points

<table>
<thead>
<tr>
<th>(iii) Quality of Artificial Lighting</th>
<th>0.5 point each for low impact item</th>
<th>1 point for high impact item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low impact item</td>
<td>• Good light-output over life with a minimum lifespan rating of L70 ≥ 50,000 life hours</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Lighting designed to avoid flicker and stroboscopic effects, by using high frequency ballasts for fluorescent luminaries and LED lighting with ≤ 30% flicker</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Meeting the minimum colour rendering index (Ra or CRI) in Clause 5 of SS 531 – 1 : 2006 (2013) – Code of Practice for Lighting of Workplaces</td>
<td></td>
</tr>
<tr>
<td>High impact item</td>
<td>• LED Luminaires certified under SGBP scheme</td>
<td>(Up to 1 point for 4.2aiii)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Up to 6 points for 4.2a)</td>
</tr>
</tbody>
</table>

**4.2b Acoustics**

An improved acoustical performance for normally occupied spaces can enhance the aural comfort of its occupants, facilitating communication, reducing unwanted sound and aiding in speech privacy.

(i) **Sound Transmission Reduction**

Projects that demonstrate that the acoustic performance of the internal partitions between adjoining spaces will be constructed to achieve the following performance levels:

<table>
<thead>
<tr>
<th>Description</th>
<th>Sound Transmission Class (STC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between general office spaces</td>
<td>40 - 50</td>
</tr>
<tr>
<td>Spaces where confidential speech are required/ Between mechanical and equipment spaces and occupied spaces:</td>
<td>50 – 60</td>
</tr>
</tbody>
</table>

(ii) **Acoustic Report**

1.5 points can be scored for an acoustic design and verification report adhering to the requirements in the GM NRB: 2015 Technical Guide and Requirements.

1.5 point (Up to 2 points for 4.2b)

**4.2c Wellbeing**

The state of being comfortable, healthy or happy. Nurturing, healing and inclusive spaces can enhance the building occupant and user’s environment, and overall wellbeing.

(i) **Biophilic Design**

- Provision of accessible sky gardens, sky terraces, internal courtyards and rooftop gardens as areas for respite.
- Building design that adopt biomimicry designs.
- The provision for at least 5% of the common areas or functional spaces to have fixed indoor planting.
- Building design that takes after any natural shapes and forms/ creates ecological attachment to the place.
- Provision of images of nature for 5% of common areas.

1 point each

0.5 point each

0.25 point each
### Part 4 – Smart and Healthy Building

#### Green Mark Points

| (ii) Universal Design (UD) Mark | Certified/Gold – 0.5 point  
GoldPLUS/Platinum – 1 point  
(Up to 2 points for 4.2c) |
|--------------------------------|-------------------------------|

### 4.3 Smart Building Operations

#### 4.3a Energy Monitoring

Tracking a building’s energy use with the data presented in a relevant manner to engage its occupants can have an effect in helping to manage building energy consumption. Related to this ideal of sharing building data openly is the need to apply open standards to future-proof the building’s management system and to facilitate data exchange between subsystems.

| (i) Energy Portal and Dashboard | 1 point each  
(Up to 2 points) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Display metered data, trending of energy consumption (historical data) and relevant parameters</td>
<td></td>
</tr>
<tr>
<td>• Display monthly energy consumption of 50th percentile line of the tenants/space within the buildings. The information could also include 25th and 75th percentile line.</td>
<td></td>
</tr>
</tbody>
</table>

| (ii) BAS and Controllers with Open Protocol | 1 point  
(Up to 3 points for 4.3a) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of BACnet, Modbus or any other non-proprietary protocol as the network backbone for the building management system, with the system being able to provide scheduled export of a set of any chosen data points to commonly used file formats.</td>
<td></td>
</tr>
</tbody>
</table>

#### 4.3b Demand Control

Using occupancy based controls to monitor the usage of spaces and vary temperature, ventilation and lighting demand while maintaining room temperature effectiveness, good indoor environmental quality and lighting quality, can significantly reduce building energy consumption. The energy savings from such controls can be taken into account under the Energy Performance Points Calculator under Part 2 Building Energy Performance.

| (i) ACMV Demand Control | 0.5 point each  
(Up to 1 point) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Binary sensing controls</td>
<td></td>
</tr>
</tbody>
</table>
| ▶ ≥ 80% of all transient areas  
▶ ≥ 80% of all occupied areas | |
| • Occupancy-based sensing controls (for VAV systems) | |
| ▶ ≥ 80% of all transient areas  
▶ ≥ 80% of all occupied areas | |

| (ii) Lighting Demand Control | 0.5 point each  
(Up to 1 point) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of occupancy/ vacancy sensors to moderate brightness of the luminaries for</td>
<td></td>
</tr>
</tbody>
</table>
| ▶ ≥ 80% of all transient areas  
▶ ≥ 80% of all occupied areas | |

| (iii) Carpark Guidance System | 0.5 point  
(Up to 3 points for 4.3b) |
|-------------------------------|-----------------|
### 4.3c Integration and Analytics

The innovative and integrative use of data can optimise workflow or attain persistence of high performance and energy efficiency in a building. Basic integration and use of sensor data can optimise and operate the building in an informed and effective manner. The use of advanced integration and analytics can provide enhanced efficacy in lowering energy use, increase asset reliability, and improve the user experience.

<table>
<thead>
<tr>
<th>Basic Features</th>
<th>Advanced Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Use adaptive control algorithms</td>
<td>• Whole system optimisation using a network of HVAC equipment</td>
</tr>
<tr>
<td>• Exception handling by identifying systems that deviates from expected performance/setting</td>
<td>• Integration of sub-systems to optimise resource use or improve user experience</td>
</tr>
<tr>
<td>• Detect equipment that run outside intended hours or settings</td>
<td>• Use of Building Information Modelling (BIM) or similar applications that provide location-based visualisation of multiple sensors</td>
</tr>
<tr>
<td>• Monitor equipment condition for preventive maintenance</td>
<td>• Participate in a Demand Response programme with electricity retailer</td>
</tr>
<tr>
<td>• Basic fault detection and diagnostics (FDD) of sensors by finding failed or improperly operating sensors or actuators</td>
<td></td>
</tr>
</tbody>
</table>

0.5 point each for Basic Features and 1 point each for Advanced Features (Features displayed via BMS, BAS, website or mobile app)

(Up to 3 points for 4.3c)

### 4.3d System Handover and Documentation

Proper system verification and handover of higher-order functional and system level performance of buildings control systems, mechanical systems and electrical systems. The project shall demonstrate a commitment to comply to verification requirements and show evidence of relevant schedules and documentation.

1 point

(Up to 1 point for 4.3d)
## Part 5 – Advanced Green Efforts

### 5.1 Enhanced Performance

Credits Advanced Green Efforts indicators that are highlighted within the Green Mark NRB: 2015 criteria, or for other outcome beyond what is specified, based on high, medium and low impact items.

Enhanced performance indicators within criteria

<table>
<thead>
<tr>
<th>Advanced Green Efforts Under Part 1 Climatic Responsive Design</th>
<th>Green Mark Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.1b Integrative Design Process</strong></td>
<td></td>
</tr>
<tr>
<td>4D, 5D &amp; 6D BIM</td>
<td></td>
</tr>
<tr>
<td>- 4D (Time) BIM</td>
<td>1 point each</td>
</tr>
<tr>
<td>- 5D (Cost) BIM</td>
<td>(Up to 3 points)</td>
</tr>
<tr>
<td>- 6D (Facilities Management) BIM</td>
<td></td>
</tr>
</tbody>
</table>

| **1.2a Sustainable Urbanism**                                 |                   |
| Creation of possible new ecology and natural ecosystems      | 1 point           |

| **1.2b Integrated Landscape and Waterscape**                  |                   |
| GnPR ≥ 5                                                     | 1 point           |

| **1.3a Tropical Façade Performance**                         |                   |
| Low heat gain façade                                         | 1 point           |
| - ETTV < 35W/m²                                               |                   |

| **Vertical Greenery on the East and West Façade**             |                   |
| For more than 30% of east and west façade areas              | 1 point           |
| For more than 15% of east and west façade areas              | 0.5 point         |

| **Thermal Bridging**                                         |                   |
| Use of thermal break /insulating profiles certified by approved local certification bodies | 1 point |

| **1.3c Ventilation Performance**                             |                   |
| Wind Driven Rain Simulation                                  | 1 point           |

| **Advanced Green Efforts under Part 2 Building Energy Performance** |                   |

| **Option 1: Energy Performance Points Calculator**            |                   |
| **2.1e Building Energy**                                     |                   |
| Further Improvement in Design Energy Consumption              |                   |
| - Additional improvement of the design energy consumption against the notional reference above maximum credit scored under 2.1e Building Energy based on the same formula. | Points scored = \( \frac{\% \text{ improvement from baseline}}{3} - 11 \) (Up to 2 points) |

<p>| <strong>Option 2: Performance-Based Computation</strong>                  |                   |
| <strong>2.1f Space Conditioning Performance</strong>                      |                   |
| Efficient Space Conditioning Energy Design                   |                   |
| Achieve highly efficient air-conditioning design            |                   |
| - Achieving 0.70kW/ton TDSE                                  | 0.5 point         |
| - Achieving 0.65kW/ton TDSE                                  | 1 point           |
|                                                            | (Up to 1 point)   |</p>
<table>
<thead>
<tr>
<th>Part 5 – Advanced Green Efforts</th>
<th>Green Mark Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.1g Lighting System Performance</strong>&lt;br&gt;<strong>Efficient Lighting Design</strong>&lt;br&gt;Achieve highly efficient air-conditioning design&lt;br&gt;- 0.5 point for 40% improvement&lt;br&gt;- 1 point for 50% improvement</td>
<td>0.5 point&lt;br&gt;- 1 point&lt;br&gt;(Up to 1 point)</td>
</tr>
</tbody>
</table>
| **2.1h Building Systems Performance**<br>**Additional Energy Efficient Practices and Features**<br>Additional improvement from baseline total building consumption above maximum credit scored under 2.1h(iv) Energy Efficient Practices and Features based on the same formula. | Points scored<br>\[ \text{Points scored} = \left( \frac{\% \text{ improvement from baseline}}{\text{total building consumption}} \right) - 4\% \]
| **2.2c Adoption of Renewable Energy**<br>**Further Electricity Replacement by Renewables**<br>Additional percentage electricity replacement by renewable energy above maximum credit scored under 2.2c Adoption of Renewable Energy based on the same formula. | Expected Energy Use Intensity (EUI) [kWh/m²/yr]<br>\[ \begin{array}{|c|c|}
\hline
\text{EUI} & \text{Replacement of Building Electricity Consumption by Renewable Energy} \\
\hline
\geq 220 & 1 \text{ point for every } 0.5\% \text{ (beyond 3\%)} \\
50 \leq \text{EUI} < 220 & 1 \text{ point for every } 1.25\% \text{ (beyond 7.5\%)} \\
< 50 & 1 \text{ point for every } 2.5\% \text{ (beyond 15\%)} \\
\text{(Up to 5 points)} \\
\hline
\end{array} \] |

**Advanced Green Efforts under Part 3 Resource Stewardship**

| **3.1a Water Efficient Systems**<br>**Better Water Efficient Fittings**<br>Demonstrate the use of better WELS rated water efficient fittings<br>- Use of better WELS rated water efficient fittings for 100% of basin taps & mixer and dual flush flushing cisterns<br>- Use of better WELS rated water efficient fittings for 100% of applicable water fittings as prescribed in P.7 whilst ensuring user requirements are not compromised. | 0.5 point<br>- 1 point<br>(up to 1 point) |
| **3.2a(ii) Resource Efficient Building Design**<br>**Use of BIM to calculate CUI**<br>BIM is used to compute CUI | 1 point |
| **3.2a(iii) Low Carbon Concrete**<br>**Use of Advanced Green Materials**<br>Use of SGBC-certified 4-Tick concrete<br>Use of SGBC-certified reinforcement bars for structural reinforced concrete elements, for more than 80% of the applicable superstructure elements by volume. | 0.5 point each<br>(Up to 1 point) |
### Part 5 – Advanced Green Efforts

#### 3.2b Embodied Carbon
- **Provide Own Emission Factors with Source Justification**
  - Provision of own material emission factors
  - Computation of the carbon footprint of the entire development and a detailed carbon footprint report based on all the materials used within the development.

- **Compute the Carbon Footprint of the Entire Development**
  - Computation of the carbon footprint of the entire development and a detailed carbon footprint report based on all the materials used within the development.

#### 3.2c Sustainable Products
- **Sustainable Products with Higher Environmental Credentials**
  - Use of products certified to higher tiers of environmental performance (per product).

<table>
<thead>
<tr>
<th>Singapore Green Building Product Certification Rating</th>
<th>Points per product (≥ 80% of the applicable use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Good (2-ticks)</td>
<td>0.25</td>
</tr>
<tr>
<td>Excellent (3-ticks)</td>
<td>0.5</td>
</tr>
<tr>
<td>Leader (4-ticks)</td>
<td>1.0</td>
</tr>
</tbody>
</table>

(Up to 2 points)

### Advanced Green Efforts under Part 4 Smart and Healthy Building

#### 4.1a Occupant Comfort
- **Indoor Air Quality Trending**
  - Provision for monitoring and trend logging of temperature and relative humidity through a centralised system.
  - Provision for monitoring and trend logging of common indoor air pollutants, such as formaldehyde, at each floor.

- **4.1c Indoor Contaminants**
  - Zero ODP Refrigerants with Low Global Warming Potential
    - Zero ODP and GWP < 750
    - Zero ODP and GWP < 10

#### 4.3a Energy Monitoring
- **Permanent M&V for VRF Systems**
  - Provision of permanent measuring instruments for monitoring of energy efficiency performance of Variable Refrigerant Flow (VRF) condensing units and air distribution subsystem.

- **Permanent M&V for Hot Water Systems**
  - Incorporation of Permanent Measurement and Verification for hot water systems, with performance requirement similar to P.14, for central hot water system.
<table>
<thead>
<tr>
<th>Part 5 – Advanced Green Efforts</th>
<th>Green Mark Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4.3c Integration and Analytics</strong>&lt;br&gt;Additional Advanced Integration and Analytical Features&lt;br&gt;Additional advanced integration and analytical features above maximum credit scored under 4.3c(ii) Advanced Integration and Analytics</td>
<td>1 point</td>
</tr>
<tr>
<td><strong>4.3d System Handover and Documentation</strong>&lt;br&gt;Expanded Post Occupancy Performance Verification by a 3rd Party&lt;br&gt;Owner engages an independent competent professional to verify the operational performance and provide recommendations on system performance enhancement, conducted within one year from the building’s TOP.</td>
<td>0.5 point can be scored per energy subsystem (Up to 2 points)</td>
</tr>
<tr>
<td><strong>Energy Performance Contracting</strong>&lt;br&gt;Engagement an Energy Performance Contracting (EPC) firm (accredited by SGBC) to implement and deliver energy efficiency, renewable energy and/or energy recovery projects with an energy performance contract wherein the EPC firm’s remuneration is based on demonstrated energy savings. Operational system efficiency should be guaranteed over a minimum of 3 years.</td>
<td>1 point</td>
</tr>
<tr>
<td><strong>Other enhanced performance indicators</strong></td>
<td>2 points for high impact items 1 point for medium impact items 0.5 point for low impact items (Up to 15 point for 5.1)</td>
</tr>
<tr>
<td><strong>5.2 Complementary Certifications</strong></td>
<td>1 point (Up to 1 point for 5.2)</td>
</tr>
<tr>
<td><strong>5.3 Demonstrating Cost Effective Design</strong>&lt;br&gt;Demonstration of cost effective or cost neutral design beyond the norm through a detailed quality surveyor’s report of the building.</td>
<td>1 point for cost effective design 2 points for cost neutral design (Up to 2 points for 5.3)</td>
</tr>
<tr>
<td><strong>5.4 Social Benefits</strong>&lt;br&gt;Projects that demonstrate their social benefits or how social sustainability has been incorporated into the project, beyond core functionality of the building. This can (but not limited to) include efforts that demonstrate enhanced considerations to further wellbeing, welfare, community integration as well as the purchase of clean energy (e.g. solar energy) through third party leasing contracts.</td>
<td>0.5 point for each distinct benefit (Up to 2 points for 5.4)</td>
</tr>
</tbody>
</table>
0. Pre-requisites

The pre-requisites for Green Mark NRB:2015 sets the minimum environmental considerations that a project shall demonstrate based on industry norms. All pre-requisites listed as follows must be fulfilled in order to be eligible to score Green Mark points in the 5 Green Mark sections.

Pre-requisites Directory for P.1 to P.15

P.1 to P.15 are parked under the criteria sections. They must be fulfilled by all projects targeting certification.

<table>
<thead>
<tr>
<th>Section</th>
<th>Pre-Requisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Climatic Responsive Design</td>
<td>P.1 – P.3</td>
</tr>
<tr>
<td>2. Building Energy Performance</td>
<td>P.4 – P.6</td>
</tr>
<tr>
<td>3. Resource Stewardship</td>
<td>P.7</td>
</tr>
<tr>
<td>4. Smart and Healthy Building</td>
<td>P.8 – P.15</td>
</tr>
</tbody>
</table>

Minimum Criteria Points Requirements

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Pre-Requisite Requirement</th>
<th>Minimum Points Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Gold</td>
</tr>
<tr>
<td>1.1a</td>
<td>Climatic &amp; Contextually Responsive Brief</td>
<td>-</td>
</tr>
<tr>
<td>1.1b</td>
<td>Integrative Design Process</td>
<td>-</td>
</tr>
<tr>
<td>1.1e</td>
<td>User Engagement</td>
<td></td>
</tr>
<tr>
<td>1.2b</td>
<td>Integrated Landscape and Waterscape</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Ventilation Performance – Ventilation Simulation</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>For GoldPLUS and Platinum projects with ≥2,000m² of naturally ventilated occupied spaces, the following wind speeds must be met via ventilation simulation</td>
<td></td>
</tr>
<tr>
<td>2.2a</td>
<td>Solar Energy Feasibility Study</td>
<td>For buildings with a footprint ≥1,000m² – 0.5 pt</td>
</tr>
<tr>
<td>3.2a</td>
<td>Sustainable Construction</td>
<td>0.5 pt</td>
</tr>
<tr>
<td>3.2b</td>
<td>Embodied Energy</td>
<td>-</td>
</tr>
<tr>
<td>3.2c</td>
<td>Sustainable Products</td>
<td>2 pts</td>
</tr>
<tr>
<td>4.1a(i)</td>
<td>Indoor Air Quality Audit</td>
<td>0.5 pt</td>
</tr>
<tr>
<td>4.1a(ii)</td>
<td>Post Occupancy Evaluation</td>
<td>-</td>
</tr>
<tr>
<td>4.1b(ii)</td>
<td>Enhanced Filtration Media</td>
<td>-</td>
</tr>
<tr>
<td>4.1c(iii)</td>
<td>Use of PBT Free Lighting</td>
<td>Healthcare – 0.5 pt</td>
</tr>
<tr>
<td>4.3d</td>
<td>System Handover and Documentation</td>
<td>-</td>
</tr>
<tr>
<td>Annex 2(d)</td>
<td>Local Energy Generation for Centralised Service Hot water Heating</td>
<td>-</td>
</tr>
<tr>
<td>Annex 2(e)</td>
<td>Onsite Airside Energy Recovery</td>
<td>-</td>
</tr>
<tr>
<td>Annex 3(c)</td>
<td>Onsite Airside Energy Recovery</td>
<td>-</td>
</tr>
<tr>
<td>Annex 4(b)</td>
<td>Raising Awareness on Environmental Sustainability</td>
<td>-</td>
</tr>
<tr>
<td>Annex 4(c)</td>
<td>Communication of Efficiency Trends</td>
<td>-</td>
</tr>
</tbody>
</table>

* Laboratory denote Laboratory Buildings, Healthcare denote Healthcare Facilities

All projects will need to compute Energy Efficiency Index (EEI) and Energy Use Intensity (EUI) in kWh/m²/yr.
Energy Savings Requirements

Intent

The quantification and setting of minimum standards for energy savings of a green building can encourage an integrated approach to building design optimisation. By determining the building’s energy usage based on different design options, developers can better understand their impact on total building performance and make cost effective design decisions that can maximise energy savings.

Scope

Applicable to all projects targeting Green Mark GoldPLUS or Platinum rating.

Assessment

The minimum energy savings to be demonstrated for the following rating tiers are as follows:

<table>
<thead>
<tr>
<th>Level of Green Mark Award</th>
<th>Minimum Energy Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>GoldPLUS</td>
<td>25%</td>
</tr>
<tr>
<td>Platinum</td>
<td>30%</td>
</tr>
</tbody>
</table>

For a building with air-conditioned area ≥ 5,000m², an energy model shall be used to demonstrate the building’s designed energy savings compared to a prescribed reference model that reflects prevailing building standards and codes of practice. The simulation shall be conducted in accordance with the Green Mark NRB: 2015 Technical Guide and Requirements - Annex C: Energy Modeling Methodology and Requirements.

For a building with air-conditioned areas < 5,000m², detailed calculations can be provided in place of energy modeling to justify the savings in energy consumption from a more efficient design.

For buildings served by existing DCS plants eligible for Path B as per the requirements outlined in the Green Mark NRB: 2015 Technical Guide and Requirements, the energy savings to be demonstrated (excluding the consumption of the DCS plant) are as follows:

<table>
<thead>
<tr>
<th>Level of Green Mark Award</th>
<th>Cooling Load Savings</th>
<th>Energy Consumption Savings (excluding DCS plant)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GoldPLUS</td>
<td>10%</td>
<td>27%</td>
</tr>
<tr>
<td>Platinum</td>
<td>15%</td>
<td>33%</td>
</tr>
</tbody>
</table>

For projects targeting Green Mark GoldPLUS or Platinum, the Energy Use Intensity should not exceed the 50th percentile value of similar building type, stated in the annual Building Energy Benchmarking Report (BEBR). In instances where the project exceeds the EUI stated, justification shall be provided and subjected to Green Mark assessment.
1. Climatic Responsive Design

Buildings serve as structures sheltering their occupants from the variable external climate. With this consideration, the built form should be considered to maximise its response to the local tropical climate, and establish a contemporary tropical vernacular. By appreciating the site context, building designers can capitalise on the physical environment and recognise opportunities for the urban built form to maximise responsive design. Consideration of the building’s human centricity and whether it is in sync with its surrounding context should also be given due account. It is paramount for such climatically contextual design to be weaved into the early thinking of building design, and this is enabled through upstream effective leadership, supported by a collaborative process of design with the partnership of relevant stakeholders.

P.1 - P.3 + POINTS PREREQUISITES

30 POINTS

1.1 Leadership (10 pts)
1.2 Urban Harmony (10 pts)
1.3 Tropicality (10 pts)

Advanced Green Efforts (9 pts)
P.1 Envelope and Roof Thermal Transfer

Intent
Minimising thermal heat gain through the building envelope and roof can enhance indoor thermal comfort and reduce the energy needed to condition the indoor environment.

Scope
Applicable to building facades and roofs.

Assessment
Where the buildings’ aggregate air-conditioned areas exceed 500 m², as determined in accordance with the formula set out in the BCA Code on Envelope Thermal Performance for Buildings, the Envelope Thermal Transfer Value (ETTV) shall not exceed the following limits:

<table>
<thead>
<tr>
<th>Level of Award</th>
<th>Maximum ETTV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold</td>
<td>45 W/m²</td>
</tr>
<tr>
<td>GoldPLUS</td>
<td>40 W/m²</td>
</tr>
<tr>
<td>Platinum</td>
<td>38 W/m²</td>
</tr>
</tbody>
</table>

The average thermal transmittance (U-value) for the gross area of the building’s roof shall not exceed the following limits:

<table>
<thead>
<tr>
<th>Roof Weight Group</th>
<th>Weight Range (kg/m²)</th>
<th>Buildings with aggregate air-conditioned area &gt; 500m²</th>
<th>Buildings with aggregate air-conditioned area ≤500m²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Maximum Thermal Transmittance for roof of air-conditioned building</td>
<td>Maximum Thermal Transmittance for roof of non air-conditioned building</td>
</tr>
<tr>
<td>Light</td>
<td>&lt; 50</td>
<td>0.5</td>
<td>0.8</td>
</tr>
<tr>
<td>Medium</td>
<td>50 to 230</td>
<td>0.8</td>
<td>1.1</td>
</tr>
<tr>
<td>Heavy</td>
<td>&gt; 230</td>
<td>1.2</td>
<td>1.5</td>
</tr>
</tbody>
</table>

The limits stipulated do not apply to roofs with skylight for buildings with aggregate air-conditioned area > 500m². However, the Roof Thermal Transfer Value (RTTV) of such roofs, computed in accordance with the Code on Envelope Thermal Performance for Buildings, shall not exceed 50W/m².

The roof limits stipulated do not apply to open sided sheds, linkways, covered walkways, store rooms, utility rooms, plant rooms and equipment rooms.
P.2 Air Tightness and Leakage

Intent
Minimising air infiltration through the building envelope can reduce the energy required for air-conditioning and enhance occupant thermal comfort.

Scope
Applicable to all windows and curtain walls on the building envelope.

Assessment

P.3 Bicycle Parking

Intent
Providing the necessary infrastructure to encourage cycling as an alternative mode of transport can reduce the energy consumption from vehicular travel.

Scope
Applicable to all building developments outlined below.

Assessment
Meet the minimum quantity of bicycle parking lots required for the development, in line with URA circular URA/PB/2018/03-DCG (or prevailing circular) and LTA’s Code of Practice - Street Work Proposal Relating to Development Works (or prevailing COP).
1.1 Leadership (10 pts)

The long-term sustainability of the built environment, economy and society depends on the collective leadership of building owners in driving sustainable buildings in partnership with the end users of the building. Effective leadership is needed to influence and drive creative, organizational and technical improvements to the overall environmental credentials of projects, from the initial stages of the project through to building occupation and operation. Upstream leadership can push the boundary of projects’ fundamental requirements and is the key towards shifting the needle towards climatic responsive design. This is supported by an integrated design process that resonates among the stakeholders, a strong design team and a shared vision of building a sustainable development and how the vision could be achieved.

- 1.1a Climatic & Contextually Responsive Brief (1 pt)
- 1.1b Integrative Design Process (4 pts)
- 1.1c Environmental Credentials of Project Team (2 pts)
- 1.1d User Engagement (3 pts)
1.1a Climatic & Contextually Responsive Brief

Intent
Considering the constraints and opportunities for environmental sustainability to set design goals approaches early at the onset of a building project can ensure a more holistic total building performance.

Scope
Applicable to all building developments.

Assessment
1 point can be scored for a climatic and culturally responsive brief detailed with:

- **Target Setting and Brief**: Setting of agreed achievable formal sustainability targets for the project. In addition to the project’s targeted Green Mark rating, such targets should involve specific sustainable outcomes and indicators. The selection, deployment and responsibilities of the project team, builders and building operators should be detailed. This includes the identification of at least one member of the team to take the lead in coordinating sustainability efforts and tracking of the targets throughout the project phase. This could also include the client’s sustainable aspirations for the project, and identification of its green potential benchmarked against similar projects.

1.1b Integrative Design Process

Intent
Addressing and negotiating between the various needs of all stakeholders involved in a building project to achieve common targets can result in a balanced and optimised sustainable design outcome. BIM can be used for coordination and design integration, enabling optimisation of resources and downstream building performance.

Scope
Applicable to all building developments.

Assessment
A maximum of 4 points can be scored for this section.

(i) **Integrative team**
2 points can be scored if the design team demonstrates an integrated design process. This encompasses the establishment of a collaborative framework for the project team during the briefing and design phases to encourage value-added contributions and constructive discussions. This process, which should be conducted in a consultative and non-hierarchical manner, includes the:

- Appointment of all relevant consultants early in the design phase
- Identification of responsible parties within the team to implement relevant sustainability goals and targets
- Detailing of sustainable design methodology action plans and progress
- Addressing of opportunities and challenges with integrative team strategies to achieve the targets
• Organising of design charrettes at key stages within the project design

(ii) **Design for operation**

1 point can be scored by involving Facility Manager (FM) in the design stage and incorporating his inputs into design.

(iii) **Use of BIM.**
1 point each can be scored for the following:

- **Collaborative BIM:** The use of a coordinated BIM modeling framework that harmonises the various disciplines’ designs in a 3D environment, to co-ordinate spatial design and reduce clashes during construction.
- **Green BIM:** The use of integrative BIM models to form the base models for at least one environmental analysis and building performance simulations, the results of which can be used to further optimise the building design.

### 4D, 5D & 6D BIM (Advanced Green Efforts)

1 point each can be scored for the 3 levels of SMART BIM under *Advanced Green Efforts*:

- **4D (Time) BIM** – This links time information to the BIM model for project scheduling and coordination. With real time construction activity on site linked to it, the 4D model can be used to review progress against the construction programme and identify methods to assess delays, make up time and evaluate extensions of time claims.

- **5D (Cost) BIM** – This consists of elemental details, finishes, fixtures and equipment within the model linked to data on performance, manufacturers and specifications. The use of integrated scheduling tools can be incorporated to assist in the preparation of cost and quantity schedules and tracking of the project budget.

- **6D (Facilities Management) BIM** – This involves the updated as built model of the building complete with the procured fixtures, finishes and equipment data.
1.1c Environmental Credentials of Project Team

**Intent**
A building project team with specialist green credentials can more competently and effectively coordinate the environmental design approach throughout the building design, construction and operation stages.

**Scope**
Applicable to all building developments.

**Assessment**
A maximum of 2 points can be scored for the project teams with the following credentials:

**Green Individuals (Up to 0.5 point)**
- Certified Green Mark Manager (GMM) or Green Mark Facilities Manager (GMFM) with valid Refresher course certificate (valid for 2 years) – 0.25 point
- Green Mark Professional (GMP) or Green Mark Facilities Professional (GMFP) – 0.5 point

**Green and Gracious Builder (Up to 0.5 point)**
- Main builder is a BCA certified Green and Gracious Builder – 0.25 point for Certified and Merit or 0.5 point for Excellent and Star rating

**Green Companies (Up to 1.5 points)**
- ISO 14001 certified: Architect, M&E engineer, C&S engineer, developer and main contractor - 0.25 point for each consultant type
- SGBC Green Services Certified firms – 0.25 point each

1.1d User Engagement

**Intent**
This refers to the provision of relevant information and guidance to building occupants/visitors to raise awareness on the building’s green features, and on how they can contribute positively to reduce the building’s environmental impact further.

**Scope**
Applicable to all building developments with occupants/visitors.

**Assessment**
A maximum of 3 points can be scored for the following:

- **Building user guide** – 0.5 point: To be disseminated to all eventual occupants in the building, the user guide should provide a detailed overview of the sustainable design strategies and green features employed in the building, on how they are operated and benefit the user.
- **Sustainability Education Corner** – 0.5 point: The Sustainability Education Corner should be dedicated to education and promotion of green building elements and environmental sustainability as well as the green
features specific to the development. It should be located at a prominent area, easily accessible and noticeable to all tenants, building occupants and/or visitors.

- **Sustainability Awareness & Education Programme** – 0.5 point: Awareness & educational programme could include regular scheduled events or tour to generate sustainability awareness.

- **Green fit out guidelines** – 1 point: To be disseminated to the relevant tenant management/ personnel, the guidelines should detail recommended minimum environmental standards to assist them in making sustainable fit-out decisions.

- **Green lease** – up to 3 points: To be incorporated into the tenancy agreement, the green lease should establish agreed levels of environmental performance between the landlord and the tenant for ≥ 60% of the net lettable area.
  
  - 3 points for ≥ 60% of the net lettable area.
  - 1 point for ≥ 25% of the net lettable area.

- **Displaying Green Mark credential** – 1 point: Can be awarded upfront when building owner commits to display the Green Mark Decal or Green Mark Plaque at prominent location (visible to public) when the project is completed. Photos evidence of installed GM credential to be submitted to BCA.
1.2 Urban Harmony
(10 pts)

With buildings forming part of a larger urban environment, it is important to identify the impact of the physical form of a building, which prefixes its sustainable performance, with respect to its immediate locale and larger context. Designing for a building’s human-centricity looks at how its presence can co-exist in harmony with its surrounding context and positively impact the movement and comfort of the people in its neighbourhood.

- 1.2a Sustainable Urbanism (5 pts)
- 1.2b Integrated Landscape and Waterscape (5 pts)
1.2a Sustainable Urbanism

Intent

Through site analysis and mitigation measures, a sustainable accessible and contextual response can be developed to ensure that the development enhances the urban realm as well as minimises its environmental impact and dis-amenity to the surrounding buildings.

Scope

Applicable to all building developments.

Assessment

A maximum of 5 points can be scored under the following sub-criteria:

(i) Environmental Analysis

Up to 2 points can be scored for either the following conducted prior to the commencement of activities on site to identify the anticipated effects on climate change, flora and fauna, soil, air and water that the development may have. It should identify and implement measures to mitigate any adverse impacts, protect valuable site ecology and/or to improve the site to its original condition.

- Environmental study – 1 point
- Comprehensive Environmental Impact Assessment (EIA) by 3rd party – 2 points

(ii) Response to Site Context

A site analysis identifies the relationships between the human and physical geography of the site. It should consider how the urban context, site topography and hydrology, site micro climate, site access and connectivity can inform the design of the urban form and site layout to respond accordingly. Up to 3 points can be scored for:

- Level 1 site analysis and design that demonstrates sensitivity to the site condition – 1 point
- Level 2 site analysis optimised design with at least 2 types of iterative simulations – 3 points

(iii) Urban Heat Island (UHI) Mitigation

Demonstrate measures to mitigate the urban heat island effect and through the material selection of the hardscape (eg. materials with high Solar Reflectance Index), softscape (eg. greenery) and building surfaces (eg. coatings such as cool paints). Areas for renewable energy generation such as photovoltaic panels are deemed to comply. Up to 1 point can be scored for:

- ≥ 50% site coverage (at plan view) with mitigation measures – 0.5 point
- ≥ 80% site coverage (at plan view) with mitigation measures – 1 point

Creation of possible new ecology and natural ecosystems (Advanced Green Efforts)

1 point can be scored if the project can detail strategies in the EIA on how the completed project ‘heals the land’. Beyond mitigation measures, it should have a net positive impact by enhancing the site ecology beyond its current state. The regenerative features should be quantified in terms of an overall net improvement versus the building not being constructed and the site remaining in the current context.
(iv) Green Transport

0.5 point each can be scored for the provision of the following:

- Electrical vehicle charging and parking infrastructure: There shall be at least 1 lot per 100 lots (Up to 5 lots)
- Meet the prevailing lower bound requirement by of ‘Range Based Car Parking Standard (RCPS)’ based on development type and parking zone published by LTA.
- Provision of bicycle lots over and above requirements stated in URA circular URA/PB/2018/03-DCC (or prevailing circular) and LTA’s Code of Practice - Street Work Proposal Relating to Development Works (or prevailing COP) with at least 1 bicycle parking lot per 1,500m² of GFA (Up to 30 lots).
- Additional features to promote bicycle usage. Examples of features (at least 2 of the features should be implemented in order to score) include:
  - Adequate shower and toilet provision above NEA requirements
  - Adequate provision of lockers
  - Bicycle maintenance facility
  - Comprehensive wayfinding signage
  - Dedicated circulation routes within development for cyclists to access bicycle parking and end-of-trip facilities safely
  - Ground level sheltered parking
  - Innovative bicycle parking designs
  - Security surveillance for bicycle parking

1.2b Integrated Landscape and Waterscape

Intent

Projects are encouraged to integrate a verdant landscape and waterscape into their building design, to enhance the biodiversity around the development and provide visual relief to building occupants and neighbours.

Scope

Applicable to all building developments.

Assessment

A maximum of 5 points can be scored under the following sub-criteria:

(i) Greenery Provision

The provision of greenery for the development can be quantified via the Green Plot Ratio (GnPR). Points can be scored as follows:

<table>
<thead>
<tr>
<th>GnPR</th>
<th>Points Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 to &lt;1.0</td>
<td>0.5</td>
</tr>
<tr>
<td>1.0 to &lt;2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>2.0 to &lt;3.0</td>
<td>2.0</td>
</tr>
<tr>
<td>3.0 to &lt;4.0</td>
<td>2.5</td>
</tr>
<tr>
<td>≥ 4.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Note: Please take note of landscape replacement requirements based on Gross Plot Ratio (GPR) and development type stated in URA circular URA/PB/2017/05-DCC (or prevailing circular).

GnPR ≥ 5 (Advanced Green Efforts)

1 more point can be scored under Advanced Green Efforts if the project has a GnPR ≥ 5.
(ii) **Tree Conservation**

0.5 point each can be scored for the following:

- Preservation of existing trees on-site to prevent disturbance to established habitats.
- Replanting of an equivalent number of similar or native species of equivalent LAI for felled trees.

(iii) **Sustainable Landscape Management**

1.5 points can be scored for projects certified under NParks Landscape Excellence Assessment Framework (LEAF) certification. For projects not certified under LEAF, 0.5 point each can be scored for the following:

- The adoption of native species of greenery > 50% of the flora selected wherever possible to maintain the local ecosystem
- Projects that scored full points under 1.2a (i) for EIA
- A landscape management plan established that covers:
  - The use of organic composts from horticultural wastes
  - The potential for onsite composting
  - General landscape maintenance and management plan during building occupation

(iv) **Sustainable Stormwater Management**

Points can be scored for either of the following:

- Projects that have obtained PUB Active, Beautiful and Clean Waters (ABC Waters) certification – 1 point
- Treatment of stormwater run-off from total area through the provision of infiltration or design features before discharge to the public drains, to reduce storm surges and to treat the water
  - ≥ 10% of run-off: 0.5 point
  - ≥ 35% of run-off: 1 point
1.3 Tropicality (10 pts)

Shaping building passive design in consideration of the climatic context, including its orientation, facades as well as interior layout can reduce the building’s heat load and energy usage and enhance effective thermal comfort for its occupants. From a performance point of view, buildings should be highly permeable in areas of natural ventilation and at the same time be shielded against heat ingress.

- 1.3a Tropical Façade Performance (3 pts)
- 1.3b Internal Spatial Organisation (3 pts)
- 1.3c Ventilation Performance (4 pts)
1.3a Tropical Façade Performance

**Intent**
The holistic consideration of façade performance can reduce direct sunlight into the building and minimise thermal heat gain, enhancing indoor comfort and lowering the energy for conditioning the indoor environment.

**Scope**
Applicable to facades and roofs bounding conditioned or non-conditioned spaces.

**Assessment**
A maximum of 3 points can be scored for the façade performance based on weighted average area, assessed through either:

**Simulation method**: Through building physics software simulation, 1 point can be scored for meeting the notional façade detailed as follows, and for every 5% heat load reduction of the envelope and solar insolation reduction of the fenestrations against the notional façade.

<table>
<thead>
<tr>
<th>Overall Weighted Values</th>
<th>Industrial Buildings</th>
<th>Other building types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Window U-Value</td>
<td>5.4 W/m²K</td>
<td>2.8 W/m²K</td>
</tr>
<tr>
<td>Wall U-Value</td>
<td>1.5 W/m²K</td>
<td>0.7 W/m²K</td>
</tr>
<tr>
<td>Overall Envelope U-value</td>
<td>2.4 W/m²K</td>
<td>1.6 W/m²K</td>
</tr>
<tr>
<td>Window-to-Wall Ratio (Each façade)</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Total Effective Glass Shading Coefficient (SC₁ x SC₂)</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Roof U-Value</td>
<td>1.1 W/m²K</td>
<td>0.8 W/m²K</td>
</tr>
<tr>
<td>Sky light/ Roof window U-Value</td>
<td>4.3 W/m²K</td>
<td>2.2 W/m²K</td>
</tr>
<tr>
<td>RTTV (where there are sky lights for AC areas)</td>
<td>50 W/m²K</td>
<td>50 W/m²K</td>
</tr>
</tbody>
</table>

**Checklist method**: Eligible for industrial buildings with a WWR ≤ 0.25, and other building types with a WWR ≤ 0.5. Points can be scored as follows:

**Non Simulation Checklist for Industrial Buildings:**

<table>
<thead>
<tr>
<th>Overall Weighted Values</th>
<th>Baseline</th>
<th>Points for Improvement</th>
<th>Point cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Envelope U-Value</td>
<td>2.4 W/m²K</td>
<td>0.5 points for every 0.4 W/m²K reduction from baseline</td>
<td>2 pts</td>
</tr>
<tr>
<td>WWR (Excludes Façade openings/ voids)</td>
<td>0.2</td>
<td>0.5 pt for meeting baseline, 0.5 pt for every 0.05 reduction from baseline</td>
<td>2 pts</td>
</tr>
<tr>
<td>Glass Shading Coefficient (SC₁)</td>
<td>0.5</td>
<td>1 pt for meeting baseline, 0.5 pt for every 0.05 reduction from baseline</td>
<td>2 pts</td>
</tr>
<tr>
<td>Effective Sun Shading</td>
<td>-</td>
<td>≥ 10% effectiveness (North and South) - 1pt, ≥ 30% effectiveness (East and West) - 1 pt</td>
<td>2 pts</td>
</tr>
<tr>
<td>Roof U-Value</td>
<td>1.0 W/m²K</td>
<td>0.5 pt for every 0.1 W/m²K reduction from baseline</td>
<td>2 pts</td>
</tr>
<tr>
<td>Sky light/ Roof window U-Value</td>
<td>4.0 W/m²K</td>
<td>0.5 pt for meeting baseline, 1 pt for U-Value of 2 W/m²K</td>
<td>1 pt</td>
</tr>
</tbody>
</table>
Non Simulation Checklist for Other Building Types:

<table>
<thead>
<tr>
<th>Overall Weighted Values</th>
<th>Baseline</th>
<th>Points for Improvement</th>
<th>Point cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Envelope U-Value</td>
<td>1.6 W/m²K</td>
<td>0.5 pt for meeting baseline 0.5 pt for every 0.2 W/m²K reduction from baseline</td>
<td>2 pts</td>
</tr>
<tr>
<td>WWR (Excludes façade openings/voids)</td>
<td>0.4 (East, West facades not to exceed 0.3)</td>
<td>1 pt for meeting WWR of 0.4 0.5 pt for every 0.05 reduction from baseline</td>
<td>2 pts</td>
</tr>
<tr>
<td>Glass Shading Coefficient (SC₁)</td>
<td>0.4</td>
<td>0.5 pt for meeting baseline 0.5 pt for every 0.05 reduction from baseline</td>
<td>2 pts</td>
</tr>
<tr>
<td>Effective Sun Shading</td>
<td>-</td>
<td>≥ 10% effectiveness (North and South) - 1 pt ≥ 30% effectiveness (East and West) - 1 pt</td>
<td>2 pts</td>
</tr>
<tr>
<td>Roof U-Value</td>
<td>0.8 W/m²K</td>
<td>1 pt for meeting 0.8 W/m²K</td>
<td>1 pt</td>
</tr>
<tr>
<td>Sky light/ Roof window U-Value</td>
<td>2.2 W/m²K</td>
<td>0.5 pt for meeting U-Value</td>
<td>0.5 pt</td>
</tr>
</tbody>
</table>

**Low heat gain façade (Advanced Green Efforts)**

1 point can be scored for achieving ETTV < 35W/m².

**Vertical Greenery on the East and West Façade (Advanced Green Efforts)**

- 1 point for more than 30% of east and west façade areas
- 0.5 point for more than 15% of east and west façade areas

**Thermal Bridging (Advanced Green Efforts)**

1 point can be scored for the use of thermal break /insulating profiles certified by approved local certification bodies, namely the Singapore Green Building Council and the Singapore Environment Council, and with a frame U-values, U₀, of < 6.0 W/m²K for ≥ 80% of external facades adjoining air-conditioned interiors.

### 1.3b Internal Spatial Organisation

**Intent**

Adopting passive design strategies in the internal spatial organisation of a building provides opportunities to enhance building performance.

**Scope**

Applicable to all building developments.

**Assessment**

Up to 3 points can be scored for the following:

- 1 point can be scored for locating non-air-conditioned spaces, e.g. lift cores, staircases, toilets, electrical plantrooms etc that covers 2/3 of the east and west facing walls to reduce thermal heat gain into occupied spaces. 0.5 point can be scored for 1/3 of the east and west façades covered by these non-air-conditioned spaces.
- Prorating the number of transient common spaces, e.g. toilets, staircases, corridors, lift lobbies and atriums by the mode of ventilation against the total number of applicable spaces – Up to 2 points

\[
\text{Points scored} = \frac{\text{Number of NV spaces} \times 2 + \text{Number of MV spaces} \times 0.5 + \text{Number of AC spaces} \times 0}{\text{Total number of spaces}}
\]

Note: Handicap toilets are excluded from count. Each toilet is counted as 0.5 each.
1.3c Ventilation Performance

Intent
Naturally ventilated functional areas should be effectively designed to be thermally comfortable and healthy for the building occupants.

Scope
Applicable for naturally ventilated occupied spaces and gathering spaces such as building atria.

Assessment
A maximum 4 points can be scored for this sub-indicator based on the following options:

Ventilation Performance Checklist

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Openings towards prevailing wind directions</td>
<td>0.1 point for every 10% of units or rooms with openings facing towards the prevailing winds (North &amp; South)</td>
<td>1</td>
</tr>
</tbody>
</table>
| Depth of room vs opening | • Single sided ventilation: \( W \leq 2H \)  
• Cross Ventilation: \( W \leq 5H \) | \( \pm 50\% \) of applicable spaces meet - 1 pt or \( \pm 70\% \) of applicable spaces meet - 2 pts |
| W: Limiting depth for effective ventilation  
H: Floor-to-ceiling height | A factor of 1.5 can be applied to the \( W/H \) ratio for atria. | |

Full Ventilation Simulation
Up to 4 points can be scored for ventilation simulations or wind tunnel testing conducted based on Green Mark NRB: 2015 Technical Guide and Requirements Annex A: Computational Fluid Dynamics Simulation Methodology and Requirements. The simulation results and recommendations derived are to be implemented to ensure optimised natural ventilation. More than 70% of applicable naturally ventilated spaces to meet the minimum weighted average wind velocity to score. Where the wind speed result cannot be met, thermal comfort or air quality modeling should be performed and the relevant criteria stated in Annex A met for all naturally ventilated spaces:

<table>
<thead>
<tr>
<th>Points</th>
<th>Minimum weighted Average Wind Velocity</th>
<th>Thermal Comfort</th>
<th>Air Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Moderate (0.2m/s)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 4      | Good (0.4m/s)                          | \(-1.0 < \text{PMV} < +1.0\) | Air Change Rate \(\geq 4\)  
Air Exchange Efficiency \(\geq 1\) |
|        | Very Good (0.6m/s)                     | \(-0.8 < \text{PMV} < +0.8\) | Air Change Rate \(\geq 10\)  
Air Exchange Efficiency \(\geq 1.2\) |

Wind Driven Rain Simulation (Advanced Green Efforts)
Up to 1 point can be scored for wind driven rain simulation in compliance with Annex A to identify the most effective building design and layout that minimises the impact of wind-driven rain into naturally-ventilated occupied spaces.
2. Building Energy Performance

The built environment is an important contributor towards reducing global carbon emissions and fossil fuel consumption. This section builds on Section 1 – Climatic Responsive Design, and focuses on how building projects can demonstrate the optimisation of building energy systems through energy efficiency, effectiveness and replacement strategies to reduce their environmental impact.

The energy performance of a building is measured through the efficiency of its active mechanical and electrical systems. In the urban tropics, this is mainly attributed to air conditioning systems, artificial lighting and hot water production in some building types. In addition, to consider the energy effectiveness of a building holistically, the extent of use of energy systems in terms of their absolute energy consumption should also be taken into account. Further tapping unto opportunities to utilise renewables in place of fossil energy sources, the energy performance of building projects can be improved significantly.

An Energy Performance Points Calculator in Excel format has been formulated to aid the design team to understand the buildings’ total energy performance, while providing options to reduce energy consumption. This calculator can be used to compute this section’s points.

P.4 - P.6 + POINTS PREREQUISITES

30 POINTS

2.1 Energy Efficiency (22 pts)
   Option 1: Energy Performance Points Calculator
   Option 2: Performance-Based Computation

2.2 Renewable Energy (8 pts)

Advanced Green Efforts (7 to 9 pts)
P.4 Air Conditioning Total System and Component Efficiency

Intent
Energy efficient air-conditioning systems with better optimised total system performance require less energy to produce and distribute conditioned air into building spaces.

Scope
Applicable to air-conditioning systems serving the building comfort cooling needs.

Assessment
Where the cooling capacity of any air-conditioning system exceeds 30 kW, the equipment (excluding air distribution) shall comply with the relevant provisions of SS 530: 2014 - Code of Practice for Energy Efficiency Standard for Building Services and Equipment.

Where the building’s aggregate air-conditioned areas exceed 500 m², the Design Total System Efficiency (DSE) and the efficiency of the cooling and air distribution components shall not exceed the limits in the tables below. For buildings with different systems, the tables will apply for the system with a larger aggregate capacity. The DSE is based on the expected part-load condition over the simulated average annual total cooling load profile for chilled-water systems, and total weighted system efficiency for unitary systems.

a) Air Cooled Chilled-Water System/ Unitary Air-Conditioning System
Relevant equipment: Air-cooled chillers, chilled-water pumps, variable refrigerant flow (VRF) systems, single-split units, multi-split units, air distribution system (e.g. AHUs, PAHUs, FCUs)

<table>
<thead>
<tr>
<th>Green Mark Rating</th>
<th>Peak Building Cooling Load (RT)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;500 RT</td>
<td>≥500RT</td>
</tr>
<tr>
<td>Minimum DSE η_t (kW/RT)</td>
<td>(η_c, η_a) shall meet their respective thresholds.</td>
<td></td>
</tr>
<tr>
<td>Gold</td>
<td>NA (0.9, N.A.)</td>
<td>NA (to be assessed on case by case basis)</td>
</tr>
<tr>
<td>GoldPLUS</td>
<td>1.10 (0.85, 0.25)</td>
<td></td>
</tr>
<tr>
<td>Platinum</td>
<td>1.03 (0.78, 0.25)</td>
<td></td>
</tr>
</tbody>
</table>

b) Water Cooled Chilled Water System
Relevant equipment: Water-cooled chillers, chilled-water pumps, condenser water pumps, cooling towers, air distribution system

<table>
<thead>
<tr>
<th>Green Mark Rating</th>
<th>Peak Building Cooling Load (RT)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;500 RT</td>
<td>≥500RT</td>
</tr>
<tr>
<td>Minimum DSE η_t (kW/RT)</td>
<td>(η_c, η_a) shall meet their respective thresholds.</td>
<td></td>
</tr>
<tr>
<td>Gold</td>
<td>NA (0.75, N.A.)</td>
<td>NA (0.68, NA)</td>
</tr>
<tr>
<td>GoldPLUS</td>
<td>0.95 (0.7, 0.25)</td>
<td>0.9 (0.65, 0.25)</td>
</tr>
<tr>
<td>Platinum</td>
<td>0.93 (0.68, 0.25)</td>
<td></td>
</tr>
</tbody>
</table>
c) **District Cooling System (DCS)** – Within or outside gazetted zones, operated by supplier of district cooling services registered under the Energy Conservation Act

Relevant equipment: *DCS plant (e.g. chillers, chilled-water pumps, condenser water pumps, cooling towers, network pumps, thermal storage, heat exchangers, renewable energy or energy recovery systems within the plant vicinity), building air-distribution system*

<table>
<thead>
<tr>
<th>Green Mark Rating</th>
<th>Minimum DSE $\eta_t$ (kW/RT)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold</td>
<td>0.9 ( (0.65, \text{N.A.}) )</td>
<td>$(\eta_c, \eta_a)$ shall meet their respective thresholds. $\eta_c$: DCS system kW/ton $\eta_a$: Building’s air distribution equipment and chilled-water pumps.</td>
</tr>
<tr>
<td>GoldPLUS</td>
<td>0.9 ( (0.65, 0.25) )</td>
<td>$\eta_t = \eta_c \eta_a$</td>
</tr>
<tr>
<td>Platinum</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*For DCS plants serving the building that were commissioned before October 2016, the supplier can meet the requirements under alternative Path B stipulated in the *GM NRB: 2015 Technical Guide and Requirements* instead.

**P.5 Lighting Efficiency and Controls**

**Intent**

Energy efficient lighting with adequate control strategies require less energy to illuminate a space.

**Scope**


**Assessment**

The maximum lighting power budget for artificial lighting and lighting controls shall comply with Clause 7 of SS 530: 2014. In hotel buildings, a control device shall be installed in every guestroom to automatically switch off the lighting when unoccupied.

**P.6 Vertical Transportation Efficiency**

**Intent**

Energy efficient vertical transportation systems require less energy to transport passengers in buildings.

**Scope**

Applicable to all lifts and escalators, except typologies where such technology is not available.

**Assessment**

Lifts and escalators shall be equipped with AC variable voltage and variable frequency (VVVF) motor drive and sleep mode features.
2.1 Energy Efficiency
(22 pts)

Air-conditioning, lighting and receptacle loads are typically the highest energy consuming building mechanical systems. Additionally, given the relatively large area of carparks in many developments, carparks also constitute a significant energy use. Using more efficient systems can reduce their contribution to the building total energy consumption.

Option 1: Energy Performance Points Calculator

- 2.1a Air Conditioning Total System Efficiency (5 pts)
- 2.1b Lighting System Efficiency (3 pts)
- 2.1c Carpark System Efficiency (2 pts)
- 2.1d Receptacle Load Efficiency (1 pt)
- 2.1e Building Energy (11 pts)

Option 2: Performance-Based Computation

- 2.1f Space Conditioning Energy (10 pts)
- 2.1g Lighting Energy (6 pts)
- 2.1h Building Energy (6 pts)
Option 1: Energy Performance Points Calculator (22 points)

2.1a Air Conditioning Total System Efficiency

**Intent**
The use of energy efficient air-conditioning systems can optimise their total system performance, and reduce the energy needed to produce and distribute conditioned air into building spaces.

**Scope**
Applicable to all the air-conditioning systems serving the building comfort cooling needs, including the air distribution equipment.

*100% non-air-conditioned building projects will score full points under this indicator.*

**Assessment**
The Energy Performance Points Calculator shall be used to calculate the percentage improvement of the weighted total design system efficiency of all the various air conditioning systems used in the project, against the code baseline. The figure should be based on the operational design load determined by the simulated average annual total cooling load profile. A maximum of 5 points can be scored as follows:

<table>
<thead>
<tr>
<th>Peak Building Cooling Load (RT)</th>
<th>&lt;500 RT</th>
<th>≥500RT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline</strong></td>
<td>1.08</td>
<td>0.98</td>
</tr>
</tbody>
</table>

Points scored = 0.2 x (% improvement from baseline)

*For district cooling plants under Path B scenario, where the plant is excluded from the computation, the baseline reference for the building air distribution equipment can be taken as 0.28 kW/ton for the purposes of points computation here.*

2.1b Lighting System Efficiency

**Intent**
The use of energy efficient lighting can reduce the energy needed to illuminate a space.

**Scope**
Applicable to building interior lighting and landscape lighting, including tenant lighting provision. Carpark and emergency lighting shall be excluded from the calculation.

**Assessment**
The Energy Performance Points Calculator shall be used to calculate the percentage improvement of the building’s weighted lighting power budget against the code baseline in SS 530: 2014 - Code of Practice for Energy Efficiency Standard for Building Services and Equipment. A maximum of 3 points can be scored as follows:

- Points scored = 0.1 x (% improvement from baseline)

The lighting should be designed to the recommended lux levels in SS 531 – 1: 2006 (2013)– Code of Practice for Lighting of Workplaces.
2.1c Carpark System Efficiency

**Intent**
The use of energy efficient carpark ventilation and lighting systems can reduce the energy needed for carpark operations.

**Scope**
Applicable to buildings with car parks. For building projects with no and open carpark, full points can be scored here.

**Assessment**
The Energy Performance Points Calculator shall be used to generate the savings of the carpark lighting and ventilation systems against code. A maximum of 2 points can be scored as follows:

- Points scored = 0.05 x (% improvement from baseline)

2.1d Receptacle Load Efficiency

**Intent**
The use of energy efficient receptacle equipment can reduce their energy consumption.

**Scope**
Applicable to non-speculative buildings.

**Assessment**
Where the procurement of energy efficient receptacle plug loads and process equipment can be committed and quantified at the design stage, their aggregate savings against BCA’s reference receptacle power budget can be generated using the Energy Performance Points Calculator. A maximum of 1 point can be scored as follows:

- Points scored = 0.025 x (% improvement from baseline) x (% of functional areas)

2.1e Building Energy

**Intent**
Encourage effective design of building systems to reduce building’s overall energy consumption.

**Scope**
Applicable to all buildings.
Assessment

The Energy Performance Points Calculator* shall be used to generate the percentage improvement of the design energy consumption of the base building against the notional reference. The consumption should exclude carpark and receptacle loads. A maximum of 11 points can be scored as follows:

- Points scored = \( \frac{\% \text{ improvement from baseline}}{3} \)

*Note: In addition to the Energy Performance Points Calculator, energy modeling (for buildings with air-conditioned areas \( \geq 5000m^2 \)) or detailed calculations (for buildings with air-conditioned area < 5000m^2) shall be performed to demonstrate that minimum energy savings for GoldPLUS and Platinum ratings are met, as per 0. Pre-requisite Requirements.

Further Improvement in Design Energy Consumption (Advanced Green Efforts)

Beyond the points cap, further points can be scored for improvement of the design energy consumption against the notional reference based on the above formula, up to a maximum of 2 points.
Option 2: Performance-Based Computation (22 points)

2.1f Space Conditioning Performance

Intent
Efficient use of energy to maintain a thermally acceptable indoor environment, by effective design of natural ventilation, energy efficient mechanical ventilation and air-conditioning systems.

Scope
Applicable to all air-conditioning and ventilation systems design to maintain thermal comfort, including the air distribution equipment and mechanical ventilation systems.

Assessment
Up to 10 points can be scored based on the systems to achieve the intended thermal comfort of the spaces, prorated by functional areas (excluding circulation, plant rooms and transit areas). Improvement is calculated based on system efficiency of conditioning systems used in the project, against the code baseline. Project can use single mode of ventilation for scoring if more than 90% of the functional space uses one mode of ventilation.

Up to 10 points based on proration of functional spaces

<table>
<thead>
<tr>
<th>Mode of ventilation</th>
<th>Scoring methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Ventilation</td>
<td>6 points for design for natural ventilation Up to 4 points based on scoring in section 1.3c</td>
</tr>
<tr>
<td>Mechanical Ventilation</td>
<td>Efficient mechanical ventilation design</td>
</tr>
<tr>
<td></td>
<td>Point scored = 0.15 x % improvement from baseline stated in SS553</td>
</tr>
<tr>
<td>Systems</td>
<td></td>
</tr>
<tr>
<td>Fan systems with nameplate motor power</td>
<td></td>
</tr>
<tr>
<td>Option 1: Fan system motor nameplate</td>
<td></td>
</tr>
<tr>
<td>Option 2: Fan system input</td>
<td></td>
</tr>
<tr>
<td>*Applicable pressure drop adjustments can be considered based on SS553 in accordance to GM NRB: 2015 Technical Guide and Requirements, subjected to BCA’s evaluation</td>
<td></td>
</tr>
<tr>
<td>Constant Volume &amp; Variable Volume</td>
<td></td>
</tr>
<tr>
<td>≥ 4kW</td>
<td>&lt; 4kW</td>
</tr>
<tr>
<td>0.35</td>
<td>No baseline</td>
</tr>
<tr>
<td>0.3</td>
<td>0.17</td>
</tr>
<tr>
<td>Air-Conditioning</td>
<td>Up to 9 points for efficient air-conditioning system</td>
</tr>
<tr>
<td>Baseline</td>
<td></td>
</tr>
<tr>
<td>Peak Building Cooling Load (RT)</td>
<td></td>
</tr>
<tr>
<td>&lt;500 RT</td>
<td>≥500RT</td>
</tr>
<tr>
<td>1.08</td>
<td>0.98</td>
</tr>
</tbody>
</table>

Points scored = 0.4 x (% improvement from baseline)

*TDSE refers to combined efficiency of the cooling and air distribution components

*For district cooling plants under Path B scenario, where the plant is excluded from the computation, the baseline reference for the building air distribution equipment can be taken as 0.28 kW/ton for the purposes of points computation here.
2.1g Lighting Performance

**Intent**
The use of energy efficient lighting can reduce the energy needed to illuminate a space.

**Scope**
Applicable to building interior lighting and landscape lighting, including tenant lighting provision and carpark lighting. Emergency lighting shall be excluded from the calculation.

**Assessment**
Up to 6 points can be scored for energy efficient lighting design (including carpark lighting) based on percentage improvement of the building's weighted lighting power budget against the code baseline in SS 530:2014 - Code of Practice for Energy Efficiency Standard for Building Services and Equipment.

- Points scored = 0.17 x (% improvement from baseline)

The lighting should be designed to the recommended lux levels in SS 531 – 1: 2006 (2013) – Code of Practice for Lighting of Workplaces.

---

2.1h Building Systems Performance

**Intent**
Encourage effective design of building systems other than space conditioning systems and lighting systems to reduce building's overall energy consumption.

**Scope**

---

**Efficient Lighting Design (Advanced Green Efforts)**

- Up to 1 point for achieving highly efficient lighting design
  - 1 point for 50% improvement
  - 0.5 point for 40% improvement

* For buildings tapping on district cooling plants under Path A scenario, it will include district cooling system efficiency as well as air and water distribution efficiency of the building.
* Not applicable to buildings tapping on district cooling plants under Path B scenario.

---

**Efficient Space Conditioning Energy Design (Advanced Green Efforts)**

- Up to 1 point for achieving highly efficient air-conditioning design
  - 1 point for achieving 0.65kW/ton TDSE
  - 0.5 point for achieving 0.70kW/ton TDSE

* For buildings tapping on district cooling plants under Path A scenario, it will include district cooling system efficiency as well as air and water distribution efficiency of the building.
* Not applicable to buildings tapping on district cooling plants under Path B scenario.
Applicable to all buildings.

**Assessment**

Up to 6 points can be scored for achieving lower building energy through lower receptacle load, more efficient carpark ventilation and energy efficient practices and features.

(i) Receptacle Load Efficiency

Where the procurement of energy efficient receptacle plug loads and process equipment can be committed and quantified at the design stage, their aggregate savings against BCA’s reference receptacle power budget, as specified under can be computed against baseline receptacle load value. A maximum of 2 point can be scored as follows:

<table>
<thead>
<tr>
<th>Receptacle loads</th>
<th>Nominal Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Intensive Office</td>
<td>22W/m²</td>
</tr>
<tr>
<td>General office areas</td>
<td>16W/m²</td>
</tr>
<tr>
<td>Large conference areas</td>
<td>11W/m²</td>
</tr>
<tr>
<td>Schools (Tertiary/IHLs)</td>
<td>8W/m²</td>
</tr>
<tr>
<td>Schools (Primary/Secondary)</td>
<td>5W/m²</td>
</tr>
<tr>
<td>Server/Computer rooms</td>
<td>540W/m²</td>
</tr>
</tbody>
</table>

- Points scored = 0.05 x (% improvement from baseline) x (% of functional areas)

(ii) Car Park Ventilation Energy

Up to 1.5 point can be scored by prorating mode of ventilation for carpark and achieving least energy consumption for carpark’s ventilation systems against code:

<table>
<thead>
<tr>
<th>Ventilation Mode</th>
<th>Mechanical Ventilation (Up to 1.25 points)</th>
<th>Natural Ventilation (1.5 points)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without CO sensor/without Fume Extract</td>
<td>With CO sensor / Fume Extract</td>
</tr>
<tr>
<td>Points</td>
<td>Point scored = 0.015 x % improvement from baseline (Up to 1 point)</td>
<td>+ 0.25 points</td>
</tr>
</tbody>
</table>

Note: For building with no carpark, full point can be scored if building occupants is more than 10 pax.

(iii) Energy Use Intensity

0.5 point can be scored for meeting 25th percentile EUI as per prevailing BCA Building Energy Benchmarking Report (BEBR). Note that all projects will need to compute Energy Efficiency Index (EEI) and Energy Use Intensity (EUI) in kWh/m²/yr as prerequisite requirement.

(iv) Energy Efficient Practices and Features

Up to 2 points can be scored for achieving lower energy consumption with more energy efficient practices and features:

Points scored = 0.5 x (% improvement from baseline total building consumption)
*Note: Hot water saving is computed based on Hot Water System Ratio (with or without heat recovery), which will consider heating energy, pumping energy and thermal losses of system.

Such items could include energy efficient hot water systems, heat recovery devices, solar thermal devices, sunpipes/light shelves to replace artificial lightings with photosensors, motion sensors/photosensors to control artificial lighting, regenerative/gearless drive lifts etc.

**Additional Energy Efficient Practices and Features (Advanced Green Efforts)**

- Up to 2 points can be scored for further improvements.
  - 1 point for every 3% improvement above 4% improvement from baseline total building consumption
2.2 Renewable Energy (8 pts)

After considering energy efficiency and effectiveness, replacement of fossil energy use with renewables should also be looked into. This indicator focuses on driving the creation of opportunities for generation and utilisation of renewable energy. It aims to spur and acknowledge efforts by buildings to work towards the vision of zero energy or net positive energy low-rise buildings and low energy high-rise buildings.

Note: Renewable energy and solar energy are used synonymously here as the context of Singapore’s tropical climate, coupled with limited natural resources, warrants solar energy as the most viable renewable energy option.

- 2.2a Solar Energy Feasibility Study (0.5 pt)
- 2.2b Solar Ready Roof (1.5 pts)
- 2.2c Adoption of Renewable Energy (6 pts)
2.2a Solar Energy Feasibility Study

Intent
The evaluation of a building footprint’s potential in harnessing solar energy can raise awareness on viable solar opportunities in the development and assist building developers in their decision making to adopt photovoltaics.

Scope
Applicable to all building developments.

Assessment
0.5 point can be scored for a solar feasibility report detailing the following aspects:

- Roof characteristics and shading considerations
- Technical solar energy generation potential
- Economics of solar installation
- Roof access and safety requirements
- Roof spatial optimisation recommendations

2.2b Solar Ready Roof

Intent
Designing roofs to be ready for photovoltaic installation facilitates ease of their deployment should building developers decide to do so at later stages of a project/ during building operation.

Scope
Applicable to projects that scored under 2.2a Solar Energy Feasibility Study. Where solar panels are installed under 2.2c Adoption of Renewable Energy, the area coverage of the feasible roof area by the panels can be counted towards compliance under this indicator.

Assessment
The project shall demonstrate its roof design for solar readiness for at least 50% of feasible roof area determined through 2.2a. 0.5 points each can be scored for the following:

- **Structural readiness**: Roof designed to accommodate optimised easy structural installation of solar panels on rooftop spaces, and included proof that the building and roof can support any additional static and wind load imposed by future PV systems
- **Electrical readiness**: Provisions to accommodate optimised easy electrical installation of solar panels on rooftop spaces
- **Spatial readiness**: Roof designed to optimise the available non-shaded rooftop area for solar panels - adoption of roof spatial optimisation recommendations outlined in 2.2a Solar Energy Feasibility Study
2.2c Adoption of Renewable Energy

**Intent**
On-site generation of renewable energy can reduce the building development’s power consumption from the grid and carbon emissions.

**Scope**
Applicable to building developments with on-site generation of renewable energy.

**Assessment**
The Energy Performance Points Calculator or manual calculation can be used to calculate savings from replacement of the building electricity consumption through the use of renewable energy.

Points can be scored up to a maximum of 6 points based on the following:

This will also include the use of solar hot water systems and renewable energy sources such as solar panels.

<table>
<thead>
<tr>
<th>Expected Energy Use Intensity (EUI) [kWh/m²/yr]</th>
<th>% Replacement of Building Electricity Consumption by Renewable Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 220</td>
<td>1 point for every 0.5%</td>
</tr>
<tr>
<td>50 ≤ EUI &lt; 220</td>
<td>1 point for every 1.25%</td>
</tr>
<tr>
<td>&lt; 50</td>
<td>1 point for every 2.5%</td>
</tr>
</tbody>
</table>

**Further Electricity Replacement by Renewables (Advanced Green Efforts)**

Up to 5 more points can be scored for further percentage electricity replacement by renewable energy.
3. Resource Stewardship

With global use of resources increasing in the backdrop of the limited carrying capacity of the Earth, it is imperative that we work towards conserving the Earth’s resources for future generations. “Resource Stewardship” in the built environment refers to the responsible use and protection of the environment through conservation and sustainable practices. This section rewards projects for the responsible use and conservation of resources from the stages of construction through to building operations and occupancy. Resources covered include water, construction materials, construction and operational waste.

P.7 + POINTS PREREQUISITES

30 POINTS

2.1 Water (8 pts)
2.2 Materials (18 pts)
2.3 Waste (4 pts)

Advanced Green Efforts (8 pts)
P.7 Water Efficient Fittings

**Intent**
The use of water efficient fittings can reduce the building's potable water consumption.

**Scope**
Applicable to all building developments with water fittings installed.

**Assessment**
The project shall demonstrate the use of water efficient fittings that meet minimum requirements as detailed in the following table:

<table>
<thead>
<tr>
<th>Type of Water Fittings</th>
<th>Prescribed Minimum WELS rating</th>
<th>Applicable Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basin Taps &amp; Mixers</td>
<td>3 Ticks WELS rating</td>
<td>Public/ staff/ school toilets</td>
</tr>
<tr>
<td></td>
<td>2 Ticks WELS rating</td>
<td>Other areas</td>
</tr>
<tr>
<td>Sink Taps &amp; Mixers</td>
<td>2 Ticks WELS rating</td>
<td>All areas</td>
</tr>
<tr>
<td>Shower Taps, Mixers or Showerheads</td>
<td>2 Ticks WELS rating</td>
<td>Public/ staff/ school shower facilities</td>
</tr>
<tr>
<td>Dual Flush Flushing Cisterns</td>
<td>2 Ticks WELS rating</td>
<td>All areas</td>
</tr>
</tbody>
</table>

Exemptions can be granted on a case-by-case basis, where there are special functional needs. As for all other water fittings such as flush valves, bib taps that are not listed in the above table shall comply with the mandatory standards stipulated in the *Singapore Standard CP 48 : 2005 – Code of Practice for Water Services.*
3.1 Water (8 pts)

With increasing occurrences of droughts and dry spells attributed to varying weather phenomenon and global warming, bouts of water shortage globally are an ever imminent threat. As Singapore has limited water catchment resources, it is crucial to implement good water management in order to ensure the long term sustainability of Singapore’s water system. Considering water efficient, monitoring and potable water replacement strategies in the building design can reduce potable water consumption and raise awareness on responsible use of water during building operation.

- 3.1a Water Efficient Systems (3 pts)
- 3.1b Water Monitoring and Leak Detection (2 pts)
- 3.1c Alternative Water Sources (3 pts)
3.1a Water Efficient Systems

Intent
The design of water efficient mechanical systems and strategies can minimise potable water consumption in building operations.

Scope
Applicable to all buildings with landscape irrigation, cooling towers or water fittings.

Assessment
(i) Landscape Irrigation
0.5 point each can be scored for the following, maximum of 1 point:
- Every 25% of the landscape areas that are served by water efficient irrigation systems with features such as automatic sub-soil drip irrigation system with moisture or rain sensor control.
- Every 20% of the landscape areas that comprises drought tolerant plants.

(ii) Water Consumption of Cooling Towers
1 point each can be scored for the following:
- Provision of cooling tower water treatment system along with effective filtration system that can help increase solubility of water and facilitate 7 or more cycles of concentration (CoC) at acceptable water quality.
- Provision of devices that recovers waste heat from the condensers and helps reduce the water requirement needed to remove heat through the cooling towers.

3.1b Water Monitoring

Intent
Better control and monitoring can facilitate setting of consumption reduction targets. Making the monitored information accessible to end users can facilitate user engagement programmes and promote behavioural changes with regard to water management and use.

Scope
Applicable to all buildings with potable water usage.
Assessment
2 points can be scored under this section.

(i) Water monitoring and leak detection
0.5 point each can be scored for the following:

- Provision of private meters for all major water uses in the development
- Provision of smart remote metering system with alert features for leak detection

(ii) Water Usage Portal and Dashboard
Up to 1 point can be scored. This requires the provision of water management portal, dashboard or other equivalent forms in the form of digital displays or web-based/mobile application. 0.5 point each can be scored for the provision of following functions in the water usage portal and dashboard:

- Display metered data, trending of water consumption (historical data) and relevant parameters which facilitate better management of water consumption during building operation.
- Enable individual tenants/space to monitor their own water usages and consumption. Information will include monthly consumption of 50th percentile line of the tenants/space, based on operating hours, within the buildings. The information could also include 25th and 75th percentile line to facilitate understanding of consumption range.

3.1c Alternative Water Sources

Intent
The use of alternative water sources can reduce potable water consumption for general application and use.

Scope
Applicable to all buildings with potable water usage.

Assessment
Where alternative water sources are used for general application, for example landscape irrigation, toilet flushing, cooling tower make-up water or washing of external areas/car park areas, up to a maximum of 3 points can be scored based on the types of water recycling systems used as well as the extent of reduction in potable water usage:

- AHU condensate collection where > 50% of total condensate is collected – 1 point
- NEWater supply – 1 point
- On-site recycled water – 1 point
- Rainwater harvesting – 1 point
3.2 Materials (18 pts)

Buildings are resource intensive in their construction and fit-out, and incur a significant carbon footprint. Adopting sustainable construction design and practices, considering embodied energy from a life cycle approach as well as giving priority to sustainable fit-out systems can reduce the environmental impact of the building.

- 3.2a Sustainable Construction (8 pts)
- 3.2b Embodied Carbon (2 pts)
- 3.2c Sustainable Products (8 pts)
3.2a Sustainable Construction

Intent
To encourage the adoption of building designs, building structures and construction practices that are environmentally friendly and sustainable.

Scope
Applicable to all structural and non-structural components constituting the building superstructure.

Assessment
(i) Conservation and Resource Recovery
For projects built on sites with existing building structures, 1 point can be scored where either:

- The existing structures are conserved and not demolished.
- The existing structures are demolished with an enhanced demolition protocol, where a recovery rate of > 35% crushed concrete waste from the demolished building is sent to approved recyclers with proper facilities.

(ii) Resource Efficient Building Design
Up to 4 points can be scored here:

Concrete Usage Index (CUI): Points scored are as follows:

<table>
<thead>
<tr>
<th>Project's CUI (m²/m³)</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 0.60</td>
<td>0.5</td>
</tr>
<tr>
<td>≤ 0.50</td>
<td>1</td>
</tr>
<tr>
<td>≤ 0.45</td>
<td>1.5</td>
</tr>
<tr>
<td>≤ 0.40</td>
<td>2</td>
</tr>
<tr>
<td>≤ 0.35</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Adoption of sustainable building systems: Points can also be scored based upon the extent of use of sustainable building systems as a percentage of the constructed floor area (CFA) as follows:

<table>
<thead>
<tr>
<th>Sustainable Building Systems</th>
<th>Points awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5 points</td>
</tr>
<tr>
<td>Pre-stressed Concrete Elements</td>
<td></td>
</tr>
<tr>
<td>Hollow Core or Voided Concrete Elements</td>
<td></td>
</tr>
<tr>
<td>Light Weight Concrete Elements</td>
<td></td>
</tr>
<tr>
<td>High Strength Concrete Elements (Concrete grade &gt;60MPa)</td>
<td></td>
</tr>
<tr>
<td>Structural Steel Elements</td>
<td>Total coverage area ≥ 25% of CFA</td>
</tr>
<tr>
<td>Composite Structural Elements</td>
<td></td>
</tr>
<tr>
<td>Engineered Timber Elements</td>
<td></td>
</tr>
<tr>
<td>Prefabricated Prefinished Volumetric Construction units</td>
<td></td>
</tr>
<tr>
<td>Precast Concrete Elements</td>
<td></td>
</tr>
<tr>
<td>Leave-in Formwork</td>
<td></td>
</tr>
<tr>
<td>Others (to be accepted by BCA on case-by-case basis)</td>
<td></td>
</tr>
</tbody>
</table>
(iii) Low Carbon Concrete

A maximum of 3 points can be scored here.

**Clinker content** – Points can be scored for the use of concrete containing clinker $\leq 400$ kg/m$^3$ for grades up to C50/60 for $\geq 80\%$ of the applicable superstructural concrete by volume as follows.

<table>
<thead>
<tr>
<th>Concrete Categories*</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncertified concrete</td>
<td>0.5</td>
</tr>
<tr>
<td>SGBC-certified 1-Tick concrete</td>
<td>1.0</td>
</tr>
<tr>
<td>SGBC-certified 2-Ticks concrete</td>
<td>1.5</td>
</tr>
<tr>
<td>SGBC-certified 3 and 4-Ticks concrete</td>
<td>2.0</td>
</tr>
</tbody>
</table>

*Note: SGBC-certified concrete is deemed to have fulfilled the requirement of clinker content $\leq 400kg/m^3$.

**Replacement of coarse and fine aggregates** – 0.5 point can be scored for every 5% replacement by mass of coarse and fine aggregates with recycled concrete aggregates (RCA) and/or washed copper slag (WCS) from approved sources for the superstructure concrete mix. The usage should not fall below 1.5% x GFA for RCA and/or 0.75% x GFA for WCS for points scoring.

---

### 3.2b Embodied Carbon

**Intent**

BCA’s Carbon Calculator is a tool to help developments identify their carbon debt and quantify their environmental impact and embodied energy, as well as allow benchmarking of projects over time.

**Assessment**

A maximum of 2 points can be scored for the use of BCA Carbon Calculator to compute the embodied carbon footprint of the development:

- Declaration of Concrete, Glass and Steel – 1 point
- Declaration of additional materials – Up to 1 point (0.25 pt per material)
<table>
<thead>
<tr>
<th><strong>Provide Own Emission Factors with Source Justification (Advanced Green Efforts)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1 point can be scored for the provision of own material emission factors (0.25 pt per material).</td>
<td></td>
</tr>
</tbody>
</table>

**Compute the Carbon Footprint of the Entire Development (Advanced Green Efforts)**

2 points can be scored for computation of the carbon footprint of the entire development and a detailed carbon footprint report based on all the materials used within the development.
3.2c Sustainable Products

**Intent**
The environmental performance of materials covered here includes their recycled content and environmental impact during production and resource extraction. The intent is to encourage the specification of resource efficient and environmentally friendly products for use in the fit-out of a building, taking a functional system approach to focus on greening major fit-out materials whilst allowing for flexibility in design as well as recognising designs with optimal/ minimal material use.

**Scope**
Applicable to non-structural building components. Structural components are excluded.

**Assessment**
A maximum of 8 points can be scored for (i) and (ii).

**(i) Functional Systems**
Points can be awarded for the specification and use of green products certified by approved local certification bodies, namely the Singapore Green Building Council and the Singapore Environment Council, within the 6 main functional system categories of the building as follows:

### Non-Speculative Buildings/ Speculative Buildings with Tenanted Areas Included

<table>
<thead>
<tr>
<th>Functional System Category</th>
<th>External Wall</th>
<th>Internal Wall</th>
<th>Flooring</th>
<th>Doors</th>
<th>Ceiling</th>
<th>Roofing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Group (Coverage: ≥ 60%)</td>
<td>1 pt</td>
<td>1 pt</td>
<td>1 pt</td>
<td>1 pt</td>
<td>0.5 pt</td>
<td>0.5 pt</td>
</tr>
<tr>
<td>Finishes Group (Coverage: ≥ 60%)</td>
<td>2 pt</td>
<td>2 pt</td>
<td>2 pt</td>
<td>0.5 pt</td>
<td>0.5 pt</td>
<td>0.5 pt</td>
</tr>
</tbody>
</table>

### Speculative Buildings with Tenanted Areas Excluded

<table>
<thead>
<tr>
<th>Functional System Category</th>
<th>External Wall</th>
<th>Internal Wall</th>
<th>Flooring</th>
<th>Doors</th>
<th>Ceiling</th>
<th>Roofing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Group (Coverage: ≥ 80%)</td>
<td>1 pt</td>
<td>0.5 pt</td>
<td>0.5 pt</td>
<td>0.5 pt</td>
<td>0.25 pt</td>
<td>0.5 pt</td>
</tr>
<tr>
<td>Finishes Group (Coverage: ≥ 80%)</td>
<td>2 pt</td>
<td>1 pt</td>
<td>1 pt</td>
<td>0.25 pt</td>
<td>0.25 pt</td>
<td>0.5 pt</td>
</tr>
</tbody>
</table>

All products (only if used) within a Group for the stipulated coverage must be green certified to score for that Group. Additionally, in order to score for a Finishes Group, projects must score for the respective Base Group first. Detailed examples may be found in the *GM NRB: 2015 Technical Guide and Requirements*.

**(ii) Singular Sustainable Products outside of Functional Systems**
Where sustainable hardscape, building services and M&E products certified by an approved local certification body are used, 0.25 point can be scored per product for ≥ 80% of the applicable use, maximum of 2 points.

### Sustainable Products with Higher Environmental Credentials (Advanced Green Effort)

Up to 2 points can be scored for the use of products certified to higher tiers of environmental performance (per product).

<table>
<thead>
<tr>
<th>Singapore Green Building Product Certification Rating</th>
<th>Points per product (≥ 80% of the applicable use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Good (2-ticks)</td>
<td>0.25</td>
</tr>
<tr>
<td>Excellent (3-ticks)</td>
<td>0.5</td>
</tr>
<tr>
<td>Leader (4-ticks)</td>
<td>1.0</td>
</tr>
</tbody>
</table>
3.3 Waste (4 pts)

It is estimated that 2.2 billion tonnes of waste will be generated globally in 2025 (Source: World Bank). Singapore’s output of solid waste has increased significantly over the years, from 1,260 tonnes per day in 1970, to a high of 8,402 tonnes per day in 2015 (Source: NEA). Waste is an indicator of excess as it means we are using more than we need and depleting precious raw materials which could be by our future generations. To minimise waste generation it is crucial to use resources (other than building materials) consumed during the construction process efficiently, as well as provide adequate facilities and systems to manage waste during building operation.

- 3.3a Environmental Construction Management Plan (1 pt)
- 3.3b Operational Waste Management (3 pts)
3.3a Environmental Construction Management Plan

Inten
An effective and holistic management plan can facilitate better environmental performance of the construction process and promote waste minimisation.

Scope
Applicable to all buildings.

Assessment
1 point can be scored for effective implementation of an environmental construction management plan on construction sites through specific target setting, monitoring of energy and water use and construction waste minimisation measures.

3.3b Operational Waste Management

Inten
Appropriate collection and recycling provisions can facilitate the segregation of recyclable consumer waste at source. Provisions for the treatment of horticultural or wood waste for buildings with landscaping can promote their reuse and recycling as well.

Scope
Applicable to all buildings.

Assessment
A maximum of 3 points can be scored for 3.3b Operational Waste Management.
1 point each can be scored for the provision of the following:
- Facilities for the collection and storage of different recyclables such as paper, glass, metal and plastic in commingled or sorted form.
- Facilities or systems for food waste to be treated and recycled, for buildings generating large volumes of food waste.
- Facilities or systems for the placement of horticultural or wood waste for recycling.

0.5 point each can be scored for the provision of the following:
- Provision of separate chute for recyclables, beyond code compliance*.
- Provision of Pneumatic Waste Conveyance System (PWCS), beyond code compliance*.
*NEA's Code of Practice on Environmental Health (or prevailing code)

The recycling facilities or systems provided should be applicable to the building type and occupancy base and located at the convenience of use for building users.
4. Smart and Healthy Building

Most of us spend a substantial proportion of our time within buildings, where we are psychologically, physiologically and emotionally affected by our surrounding environment. Aspects of a healthy indoor environment include better air quality, effective daylighting, quality artificial lighting, pleasant acoustics, inclusivity as well as biophilic design features that evokes the experience of nature. Designing for healthy buildings can be a sound economic investment that reaps healthy economic returns, with measures to improve the indoor environment leading to manifold monetary savings from improved health and well-being. A healing, positive environment nurtures healthier and happier occupants. In spaces where people work and study, this can result in increased work quality and productivity output. For social, recreational and commercial spaces, this can translate to an enhanced consumer/visitor experience and encourage more frequent patronage and human traffic.

At the same time, managing a building’s indoor environmental quality well necessitates operating the building smartly. Smart controls, direct access to building data and early fault detection allow the facility management team to gain a good understanding of the building’s health. This enables necessary intervention and optimisation measures to suit the occupants’ health and well-being.

P.8 - P.15 + POINTS PREREQUISITES
30 POINTS

2.4 Indoor Air Quality (10 pts)
2.5 Spatial Quality (10 pts)
2.6 Smart Operations (10 pts)

Advanced Green Efforts (10 pts)
P.8 Thermal Comfort

**Intent**
The air-conditioning system should be designed to serve its intended purpose of providing a thermally comfortable space for occupants.

**Scope**
Generally applicable to all air conditioning systems serving occupied spaces of building developments.

**Assessment**
The normal design dry-bulb temperature for comfort air-conditioning shall be within 23°C - 25°C, and resultant relative humidity ≤ 65% in accordance with SS 553: 2016 - *Code of Practice for Air-Conditioning and Mechanical Ventilation in Buildings*.

P.9 Minimum Ventilation Rate

**Intent**
The provision of adequate ventilation in a building is of fundamental importance to ensure the health of the occupants. Insufficient ventilation can cause a build-up in the concentration of carbon dioxide and other contaminants emitted indoors.

**Scope**
Applicable to air-conditioning or mechanical ventilation systems in regularly occupied spaces of all building developments.

**Assessment**
The building’s air-conditioning and mechanical ventilation systems shall be designed to provide appropriate minimum quantum of outdoor air rates as stated in Table 1 and Table 5 of SS 553: 2016.

P.10 Filtration Media for Times of Pollution

**Intent**
The effective removal of harmful pollutants in outdoor air from the building ventilation system through high efficiency filters can enhance indoor air quality and the health and well-being of the occupants.

**Scope**
Applicable to air handling units (AHUs) or systems for dedicated treatment of outdoor air in air-conditioned building developments.
Assessment
AHUs or dedicated outdoor air units in the building shall be designed to accommodate fine dust filters of least a rating of Minimum Efficiency Reporting Value (MERV) 14 (ASHRAE 52.2: 2012) or F8 (EN779: 2012), when the outdoor pollution level is in the unhealthy range in accordance with MOH's guidelines, as stipulated in SS 553: 2016.

P.11 Low Volatile Organic Compound (VOC) Paints

Intent
Limiting the use of high-emitting building and furnishing materials can improve the indoor environmental quality for the health and well-being of occupants.

Scope
Applicable to all indoor paints including primers, sealers, base coats and top coats.

Assessment
Low VOC paints certified by an approved local certification body shall be used for at least 90% of the total painted internal wall areas.

P.12 Refrigerants

Intent
Controlling the use and release of ozone depleting substances and greenhouse gases can reduce their potential damage to the ozone layer and curb global warming.

Scope
Applicable to all air conditioning systems within building developments.

Assessment
Air conditioning systems shall use refrigerants with ozone depleting potential (ODP) of 0 or global warming potential (GWP) of less than 100.

A refrigerant leak detection system shall also be installed in critical areas of plant rooms containing chillers and/ or other equipment using refrigerants.
P.13 Sound Level

**Intent**
Minimising noise and vibration from mechanical and electrical equipment can ensure a basic level of acoustic comfort for occupant health and wellbeing.

**Scope**
Applicable to mechanical and electrical equipment serving occupied spaces of building developments.

**Assessment**
The relevant equipment as aforementioned shall be designed to comply with the recommended ambient sound levels in Table 4 of SS 553 : 2016.

P.14 Permanent Instrumentation for the Measurement and Verification of Chilled Water Air-Conditioning Systems

**Intent**
Better energy management and monitoring of chilled water air-conditioning systems can ensure their operational efficiency can be optimised and maintained throughout the equipment lifespan.

**Scope**
Applicable to chilled-water air-conditioning systems serving the building with aggregate cooling capacity exceeding 30 kW. This applies also to district cooling systems (DCS) operated by suppliers of district cooling services registered under the Energy Conservation Act.

**Assessment**
Permanent measuring instruments for monitoring of chilled-water system (water cooled and air-cooled system) operating efficiency shall be provided. The installed instrumentation shall have the capability to calculate the resultant operating system efficiency (i.e. kW/RT) within 5% of its true value and in accordance with SS591. Each measurement system shall include the sensor(s), any signal conditioning, the data acquisition system and wiring connecting these components. The permanent instrumentation shall comply with the following:

- Location and installation of the measuring devices to meet the manufacturer’s recommendation; location of temperature sensors should be within reach to facilitate site verification
- All data logging with capability to trend at 1-minute sampling time interval, and recorded to the 3rd decimal digit
- Computation and display of air-side efficiency, water-side efficiency and total system efficiency.
- Magnetic in-line flow meter, with 1% uncertainty and capable of electronic in-situ verification to within ±2% of its original factory calibration. If installation of magnetic in-line meters is not possible, ultrasonic flow meters or other flow meters that can meet the indicated performance may be used.
• Temperature sensors are to be provided for chilled water and condenser water loop and shall have an end-to-end measurement uncertainty not exceeding ±0.05°C over the entire measurement range. Provisions shall be made for test-plugs or additional thermowells to be installed before and after each temperature sensor along the chilled water and condenser water lines for verification of measurement accuracy. All thermo-wells are recommended to be installed in a manner that ensures the sensors can be in direct contact with the fluid flow. There shall be valid justification if direct immersion of the temperature sensor(s) is/are not possible. Such projects will be assessed on a case-by-case basis.

• Dedicated power meters (of IEC Class 1 or better) and metering current transformers, where applicable, of Class 1 or better, are to be provided for each of the following groups of equipment where applicable: chillers, chilled water pumps, condenser water pumps, cooling towers, air distribution sub-system (i.e. AHUs, PAHUs, FCUs)

• A heat balance substantiating test for the water-cooled chilled-water system is to be computed in accordance to SS 591 for verification of the accuracy of the M&V instrumentation. The heat balance shall be computed over the entire normal operating hours with more than 80% of the computed heat balance within ± 5% over a 1-week period. Heat balance readings should generate automatically from BMS/BAS.

P.15 Electrical Sub-Metering & Monitoring

**Intent**
Monitoring major energy uses in the building can enable audit and continuous improvement to optimise use and avoid energy wastage.

**Scope**
Applicable to all building developments with GFA of 5,000m² or more.

**Assessment**
Subsystem measurement devices with remote capability shall be provided, linked to a monitoring system and measure and trend energy consumption data of:

- Each of the following energy sub systems:

<table>
<thead>
<tr>
<th>Use (Sum of all loads)</th>
<th>Sub-systems thresholds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lift &amp; escalator</td>
<td>Sum of all feeders &gt; 50 kVA</td>
</tr>
<tr>
<td>Heater, including heat pump</td>
<td>&gt; 50 kWth</td>
</tr>
<tr>
<td>Process loads</td>
<td>Connected loads &gt; 50 kVA</td>
</tr>
<tr>
<td></td>
<td>Connected gas or district services load &gt; 75 kW</td>
</tr>
<tr>
<td>Mechanical ventilation</td>
<td>The subsystem's load &gt; 15kW</td>
</tr>
<tr>
<td>VRF systems (CUs, FCUs)</td>
<td>No threshold</td>
</tr>
</tbody>
</table>

- Each tenancy or floor, as well as high energy load areas exceeding 50kVA such as car park, data centres, IT closets and process areas.
4.1 Indoor Air Quality  
(10 pts)

Contemporary research has shown that poor air quality is an attributing factor to sick building syndrome symptoms and respiratory illnesses, which can have detrimental effects on business productivity and performance as well as the wellbeing of the occupants. As people spend longer hours in buildings, research has also indicated that the cost of poor indoor environmental quality could well be even higher than most other costs. It is important to ensure good air quality to reduce the risk of illnesses within building occupied spaces where occupants are expected to work or remain in for an extended period of time.

- 4.1a Occupant Comfort (2 pts)
- 4.1b Outdoor Air (3 pts)
- 4.1c Indoor Contaminants (5 pts)
4.1a Occupant Comfort

**Intent**
The testing and evaluation of indoor air quality parameters is crucial to ensure occupant comfort. Engaging building occupants completes the feedback loop, and is essential for the management and improvement of operational practices in high-performing green buildings.

**Scope**
Applicable for normally occupied spaces air-conditioned for comfort purposes.

**Assessment**

(i) Indoor Air Quality (IAQ) Surveillance Audit
0.5 point can be scored for an IAQ surveillance audit conducted by an accredited laboratory under Singapore Accreditation Council with respect to the recommended IAQ parameters and acceptable limits stated in Table 1 of SS554: 2016 Code of Practice for Indoor Air Quality for Air-Conditioned Buildings, and committed to be conducted for the building within one year after occupancy or after reasonable occupancy has been reached.

1 point can be scored if the above IAQ surveillance audit is conducted based on the reference methods stated in Table 1 of SS554: 2016.

The spreadsheet of the standardised IAQ report template is available at:

(ii) Post Occupancy Evaluation
0.5 point can be scored if a Post Occupancy Evaluation (POE) questionnaire is committed to be conducted within a year after building occupancy or after reasonable occupancy has been reached to assess occupant wellbeing and interactions with their indoor environment. Appropriate corrective actions should also be committed to be taken to improve the quality of the indoor environmental conditions if required.

The spreadsheets of the standardised POE survey questionnaire and results are available at:

(iii) Indoor Air Quality Display
0.5 point can be scored for the provision of display panels for temperature and relative humidity information at each floor/ tenancy, to raise awareness among building occupants on the internal conditions of the space.

**Indoor Air Quality Trending (Advanced Green Effort)**

Up to 2 points can be scored for the provision of monitoring and trend logging for the following:

- Provision for monitoring and trend logging of temperature and relative humidity through a centralised system – 0.5 point
- Provision for monitoring and trend logging of common indoor air pollutants, such as formaldehyde, at each floor - 1.5 point
4.1b Outdoor Air

**Intent**
Provision of adequate and proper ventilation in conditioned spaces to prevent build-up in the concentration of contaminants.

**Scope**
Applicable to all building developments with air conditioning systems supplying outdoor air to occupied spaces. Full points can be scored here for buildings with no air-conditioned spaces.

**Assessment**

(i) **Ventilation Rates**
A maximum of 1.5 points can be scored for the:
- Measurement and monitoring of outdoor airflow volume in accordance with desired ventilation rates at precool units (e.g. PAHUs and PFCUs) or all AHUs and FCUs - 0.5 point or 1 point respectively
- Use of demand control ventilation strategies such as carbon dioxide sensors or equivalent devices to regulate the quantity of fresh air and ventilation in accordance with the space requirements – 0.5 point

(ii) **Enhanced Filtration Media**
0.5 point or 1 point can be scored for the permanent provision of Minimum Efficiency Rating Value (MERV 14, ASHRAE 52.2 or F8/ EN779 class of filter or equivalent) to all PAHUs or to all PAHUs and AHUs respectively.

(iii) **Dedicated Outdoor Air System**
0.5 point can be scored for the provision of a dedicated outdoor air system, such as precool units, to encourage effective treatment of outdoor air for cooling and dehumidification.

4.1c Indoor Contaminants

**Intent**
Indoor contaminant pollution control at source and air treatment strategies can safeguard the health of building occupants.

**Scope**
Applicable to buildings with relevant ventilations systems.
Assessment

(i) Local Exhaust and Air Purging System

1 point each can scored for the provision of:

- Local isolation and exhaust systems to remove the source of pollutants
- Air purging system to replace contaminated indoor air with outdoor fresh air

100% non-air-conditioned building projects will score full points under this indicator.

(ii) Ultraviolet Germicidal Irradiation (UVGI) System

0.5 point can be scored for the provision of UVGI system in AHUs and FCUs to control airborne infective microorganisms.

(iii) More Stringent VOC Limits for Interior Fittings and Finishes

A maximum of 2 points can be scored through the specification and use of products certified SGBP Very Good or above, which meet more stringent VOC emission limits. All products used in the respective Functional System with coverage of ≥ 80% of applicable areas must be SGBP Very Good or above to qualify for GM points for respective System.

- On interior fittings such as system furniture, cabinetry etc
- On wall or floor finishes as part of the functional system

<table>
<thead>
<tr>
<th>Functional System</th>
<th>Other Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Wall</td>
<td>Internal Wall</td>
</tr>
<tr>
<td>1 pt</td>
<td>1 pt</td>
</tr>
</tbody>
</table>

Note: For finishes, the combination of components that make out the finishes level of the functional system shall meet the criteria. Where bare finishes were to be used as part of the design for the operation of the building, this will apply to the final coat of treatment on the bare finish, be it protective coating or sealer or paint. If absolute no finishes are used, this criterion is not applicable unless the base finish is ascertained to meet the higher stringent standard on VOC contaminant.

(iv) Use of Persistent Bio-cumulative and Toxic (PBT) free lighting

0.5 point can be scored for the use of PBT-reduced or free luminaries for ≥ 90% of light fittings in the project.

Zero ODP Refrigerants with Low Global Warming Potential (Advanced Green Effort)

Points can be scored for the use of refrigerants with Ozone Depleting Potential (ODP) of 0 as well as low global warming potential (GWP) as follows:

- GWP < 750 - 0.5 point or
- GWP < 10 - 1 point
4.2 Spatial Quality
(10 pts)

The spatial quality of a building is assessed through the experiential value of both the physical and social qualities of the spaces within the development. Although many spatial quality indicators are qualitative, there are a number of commonly agreed upon indicators that act as a reliable proxy to determine the project’s spatial quality which can enhance the indoor environment and wellbeing of the occupants and visitors to the building. These include creating access to quality daylight and artificial lighting, ensuring spaces are acoustically comfortable and inclusive as well as incorporating design features that evoke a connection to nature.

- 4.2a Lighting (6 pts)
- 4.2b Acoustics (2 pts)
- 4.2c Wellbeing (2 pts)
4.2a Lighting

Intent
Natural lighting has been linked to the positive mental wellbeing of building occupants. It connects enclosed indoor environments with the external natural environment. In the tropics, special care must be taken to maximise effective daylight while minimising visual discomfort and maintaining the façade’s thermal efficiency. This is made possible by incorporating effective daylight design strategies at the beginning of the design process. Where daylight is not possible, adherence to minimum quality standards for artificial lighting provisions ensures well-lit and comfortable spaces for occupants.

Scope
Applicable to common spaces and occupied spaces of building developments.

Assessment
Up to 6 points can be scored for the following:

(i) Effective daylighting for common areas

Effective daylighting for common areas – 2 points
Up to 2 points can be scored by prorating the number of daylit transient common spaces with effective automatic lighting controls against the total number of applicable spaces.

Note: Each toilet is counted as 0.5.
1.5 points for % count with daylighting for toilets, staircases, corridors, lift lobbies and atriums.
0.5 point for % areas of carpark with daylighting or having no carpark.

(ii) Effective daylighting for occupied spaces

Effective daylighting for occupied spaces – 4 points

<table>
<thead>
<tr>
<th>Method</th>
<th>Percentage of occupied spaces with access to effective daylighting (3 points)</th>
<th>Effective Mitigation of Overlit Areas (1 point)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Simulated Daylight Availability Tables:</td>
<td>Points can be scored as follows based on the percentage of total occupied areas* that can achieve the specific Daylight Autonomy (DA) requirement of DAIV to 50% (without overlighting), as outlined in the Green Mark NRB: 2015 Technical Guide and Requirements Annex B: Effective Daylighting Simulation and Pre-Simulated Daylight Availability Tables Methodology and Requirements. Effectively daylit areas shall be integrated with automated lighting controls.</td>
<td>1 point can be scored for the adoption of suitable mitigation strategies for overlit spaces, such as blinds which are controlled with daylight sensors, variable opacity glazing (electrochromic glass, thermochromic glass), bi-level glazing (glazing with higher VLT for higher level glazing and glazing with lower VLT for lower level glazing) and fitted glazing.</td>
</tr>
<tr>
<td>Simplified method for standard designs to guide concept stage design in identifying design strategies for optimised daylight design.</td>
<td><strong>Percentage</strong></td>
<td><strong>Points</strong></td>
</tr>
<tr>
<td>Daylight Simulation: Performance-based method for non-standard/ complex designs.</td>
<td>15 to ≤ 35 %</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>35 to ≤ 55 %</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>55 to ≤ 75 %</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>≥ 75%</td>
<td>3</td>
</tr>
</tbody>
</table>

* Note: exclude special rooms that cannot have daylighting due to operation needs.

1 point can be scored where mitigation measures to effectively address overlighting are included into the simulation model in accordance with Annex B.
(iii) Quality of Artificial Lighting

Points can be scored for the following attributes of lighting used in occupied spaces, maximum of 1 point (90% of the applicable functional areas should be served by the relevant luminaires to score):

- Good light-output over life with a minimum lifespan rating of \( L70 \geq 50,000 \) life hours - 0.5 point
- Regular colour (temperature) uniformity. In these occupied areas where LEDs luminaires are used, they must have Standard Deviation of Colour Matching (SDCM) of \( \leq 3 \) steps based on MacAdam Ellipse - 0.5 point
- Lighting designed to avoid flicker and stroboscopic effects, by using high frequency ballasts for fluorescent luminaries and LED lighting with \( \leq 30\% \) flicker - 0.5 point
- Meeting the minimum colour rendering index (Ra or CRI) in Clause 5 of SS 531 – 1 : 2006 (2013) – Code of Practice for Lighting of Workplaces - 0.5 point
- LED Luminaires certified under SGBP scheme - 1 point

4.2b Acoustics

Intent

An improved acoustical performance for normally occupied spaces can enhance the aural comfort of its occupants, facilitating communication, reducing unwanted sound and aiding in speech privacy.

Scope

Applicable to occupied spaces of building developments.

Assessment

(i) Sound Transmission Reduction

0.5 point can be scored for projects that demonstrate that the acoustic performance of the internal partitions between adjoining spaces will be constructed to achieve the following performance levels:

<table>
<thead>
<tr>
<th>Description</th>
<th>Sound Transmission Class (STC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between general office spaces</td>
<td>40 - 50</td>
</tr>
<tr>
<td>Spaces where confidential speech are required/ Between mechanical and equipment spaces and occupied spaces:</td>
<td>50 – 60</td>
</tr>
</tbody>
</table>

Equivalent sound transmission metrics may also be used to qualify the range.

(ii) Acoustic Report

1.5 points can be scored for an acoustic design and verification report adhering to the requirements in the GM NRB: 2015 Technical Guide and Requirements.
4.2c Wellbeing

Intent
Wellbeing refers to the state of being comfortable, healthy or happy. Providing nurturing, healing and inclusive spaces can enhance the building occupant and user's environment, and overall wellbeing. This includes integrating within buildings places of respite, nature access, architecture that invoke a connection to nature as well as accessible and inclusive spaces.

Scope
Applicable to all building developments.

Assessment
A maximum of 2 points can be scored for the following:

(i) Biophilic Design
Points can be scored for architecture that reinforces the attributes and experience of nature to nurture the human-nature relationship:

- The provision of accessible sky gardens, sky terraces, internal courtyards and rooftop gardens as areas for respite – 1 point
- The provision for at least 5% of the common areas or functional spaces to have fixed indoor planting – 0.5 point
- Building design that adopt biomimicry designs – 1 point
- Building design that takes after any natural shapes and forms/ creates ecological attachment to the place – 0.25 point
- Provision of images of nature for 5% of common areas – 0.25 point

(ii) Universal Design (UD) Mark
The BCA UD Mark accords recognition to developments that adopt a user-centric philosophy in their design, operations and maintenance. Points can be scored for projects being awarded either:

- UD Mark Certified/ Gold Award – 0.5 point
- UD Mark GoldPLUS/ Platinum Award – 1 point
4.3 Smart Building Operations (10 pts)

The use of automation, data and behavioural science can enable building professionals to optimise equipment and related processes in order to maintain equipment efficiency and building comfort requirements. A three-level taxonomy is defined to classify the maturity of smartness as a framework, namely basic monitoring of data, using feedback from data to control demand, and finally advanced integration and analytics of data. Additionally, a proper handover to the facilities and operations team is of fundamental importance to ensure that the systems work as per their intended function and that sustainable design is translated into actual operational performance.

- 4.3a Energy Monitoring (3 pts)
- 4.3b Demand Control (3 pts)
- 4.3c Integration and Analytics (3 pts)
- 4.3d System Handover and Documentation (1 pt)
4.3a Energy Monitoring

Intent
Tracking a building’s energy use with the data presented in a relevant manner to engage its occupants can have an effect in helping to manage building energy consumption. Related to this ideal of sharing building data openly is the need to apply open standards to future-proof the building’s management system and to facilitate data exchange between subsystems.

Scope
Applicable to all buildings.

Assessment
(i) Energy Portal and Dashboard
Up to 2 points can be scored. This requires the provision of energy management portal, dashboard or other equivalent forms in the form of digital displays or web-based/mobile application. 1 point each can be scored for the provision of following functions in the energy portal and dashboard:
- Display metered data, trending of energy consumption (historical data) and relevant parameters which facilitate better management of energy consumption during building operation.
- Enable individual tenants/space to monitor their own energy usages and consumption. Information will include monthly consumption of 50th percentile line of the tenants/space, based on operating hours, within the buildings. The information could also include 25th and 75th percentile line to facilitate understanding of consumption range.

(ii) BAS and Controllers with Open Protocol
1 point can be scored for using BACnet, Modbus or any other non-proprietary protocol as the network backbone for the building management system, with the system being able to provide scheduled export of a set of any chosen data points to commonly used file formats.

Permanent M&V for VRF Systems (Advanced Green Effort)
An additional 2 points can be awarded for provision of permanent measuring instruments for monitoring of energy efficiency performance of Variable Refrigerant Flow (VRF) condensing units and air distribution subsystem. The installed instrumentation shall have the capability to calculate resultant system efficiency (i.e. kW/RT or COP) within 10% uncertainty. Each measurement system shall include the sensor, any signal conditioning, the data acquisition system and wiring connecting them. All data are to be logged at 5 minute sampling time interval, and recorded to at least 1 decimal place, and data shall be available for extraction for verification purposes.

Permanent M&V for Hot Water Systems (Advanced Green Effort)
1 point for incorporation of Permanent Measurement and Verification, with performance requirement similar to P.14, for central hot water system.
4.3b Demand Control

**Intent**
Using occupancy based controls to monitor the usage of spaces and vary temperature, ventilation and lighting demand while maintaining room temperature effectiveness, good indoor environmental quality and lighting quality, can significantly reduce building energy consumption. The energy savings from such controls can be taken into account under the Energy Performance Points Calculator under *Part 2 Building Energy Performance*.

**Scope**
Applicable to buildings.

**Assessment**
A maximum of 3 points can be scored under this section.

(i) ACMV Demand Control
A maximum of 2 points can be scored for the use of the following controls to regulate the temperature and/or airflow of spaces served by air-conditioning and/or mechanical ventilation systems:

- **Binary sensing controls**
  - 0.5 point for ≥ 80% of all transient areas
  - 0.5 point for ≥ 80% of all occupied areas

- **Occupancy-based sensing controls (for VAV systems)**
  - 1 point for ≥ 80% of all transient areas
  - 1 point for ≥ 80% of all occupied areas

(ii) Lighting Demand Control
0.5 point each can be scored for the use of occupancy/vacancy sensors to moderate brightness of the luminaries for ≥ 80% of transient and occupied areas respectively.

(iii) Carpark Guidance System
0.5 point for having carpark guidance system to guide car to available lot. This will include signage to state the number of lots in each segment of carpark. For building with no carpark, full point can be scored if building occupants is more than 10 pax.

4.3c Integration and Analytics

**Intent**
The innovative and integrative use of data can optimise workflow or attain persistence of high performance and energy efficiency in a building. Basic integration and use of sensor data can optimise and operate the building in an informed and effective manner. The use of advanced integration and analytics can provide enhanced efficacy in lowering energy use, increase asset reliability, and improve the user experience.
Scope
Applicable to all buildings.

Assessment
A maximum of 3 points can be scored for the following:

(i) Basic Integration and Analytics
Assessment
0.5 point each can be scored for basic integration and analytics features such as (but not limited to):

<table>
<thead>
<tr>
<th>Basic Features (Features displayed via BMS, BAS, website or mobile app)</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use adaptive control algorithms</td>
<td>• Adjust cooling tower approach based on wet bulb temperature</td>
</tr>
</tbody>
</table>
| Exception handling by identifying systems that deviates from expected performance/setting | • When efficiency of chiller plant system (in kW/RT) deviates >10%  
• When a space setpoint is set below a typical value  
• When a space operates significantly below its setpoint |
| Detect equipment that run outside intended hours or settings           | • AHUs/FCUs that run past regular office hours |
| Monitor equipment condition for preventive maintenance                 | • Use embedded sensors to predict mechanical wear and failure  
• Priorities equipment maintenance using machine condition monitoring |
| Basic fault detection and diagnostics (FDD) of sensors by finding failed or improperly operating sensors or actuators | • Compare set points to actual to find leaking valves or stuck dampers  
• Set algorithms to counter-check between sensors |

(ii) Advanced Integration and Analytics
1 point each can be scored for advanced integration and analytics features such as (but not limited to):

<table>
<thead>
<tr>
<th>Advanced Features (Features displayed via BMS, BAS, website or mobile app)</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole system optimisation using a network of HVAC equipment</td>
<td>• Drive pumps minimally to satisfy the most demanding valve</td>
</tr>
<tr>
<td>Integration of sub-systems to optimise resource use or improve user experience</td>
<td>• Integration of ID card access system to a hot-desk scheme</td>
</tr>
<tr>
<td>Use of Building Information Modelling (BIM) or similar applications that provide location-based visualisation of multiple sensors</td>
<td>• BIM for facilities and asset management such as energy and water use or temperature and relative humidity monitoring</td>
</tr>
</tbody>
</table>
| Participate in a Demand Response programme with electricity retailer      | • Reduce energy consumption of specific electrical items for short periods  
Pls refer to *Demand Response Programme by EMA* |


Additional Advanced Integration and Analytical Features (Advanced Green Effort)
An additional 1 point can be scored for additional advanced integration and analytical features beyond the points cap.
4.3d System Handover and Documentation

Intent
Design and delivery integration is essential to delivering an operationally energy efficient building. Control systems should be properly tested and verified and to ensure operational continuity from construction to building maintenance and operation. These criteria indicate the presence of a quality assurance plan to maintain the desired energy efficiency and indoor comfort.

Assessment
1 point can be scored for a proper system verification and handover of higher-order functional and system level performance of buildings control systems, mechanical systems and electrical systems. The project shall demonstrate a commitment to comply to verification requirements and show evidence of relevant schedules and documentation.

**Expanded Post Occupancy Performance Verification by a 3rd Party (Advanced Green Effort)**

0.5 point can be scored per energy subsystem (e.g. lighting controls, mechanical ventilation, hot water system, heat recovery system, renewable energy system) up to 2 points, where the owner engages an independent competent professional (either a BCA registered Energy Auditor or a Professional Engineer (PE) (Mech/Elect)) to verify the operational performance and provide recommendations on system performance enhancement. This should be conducted within one year from the building’s TOP.

**Energy Performance Contracting (Advanced Green Effort)**

1 point can be scored for engaging an Energy Performance Contracting (EPC) firm (accredited by SGBC) to implement and deliver energy efficiency, renewable energy and/or energy recovery projects with an energy performance contract wherein the EPC firm’s remuneration is based on demonstrated energy savings. Operational system efficiency should be guaranteed over a minimum of 3 years.
5. Advanced Green Efforts

The Green Mark NRB: 2015 Advanced Green Efforts section recognises the implementation of industry leading performance or innovative strategies, designs or processes that demonstrate exceptional levels of sustainability. The 20 points in this section are bonus points that can be added to the base Green Mark score to help projects demonstrate their holistic environmental performance and achieve higher levels of Green Mark award.

The enhanced performance criteria have indicators placed within the 4 main sections of Climatic Responsive Design, Building Energy Performance, Resource Stewardship and Smart and Healthy Building that we have identified as practices that are pioneering initiatives in sustainable design.

The remaining criteria within this section recognise projects that undertake sustainability with the view of market transformation, such as demonstrating cost neutrality. Other criteria recognise broader aspects of sustainability including socio-economic indicators or global sustainability benchmarking that address issues outside of green building rating tools.

20 POINTS

5.1 Enhanced Performance (15 pts)
5.2 Demonstrating Cost Effective Design (2 pts)
5.3 Complementary Certifications (1 pt)
5.4 Social Benefits (2 pts)
5.1 Enhanced Performance

**Intent**
Points can be awarded based on the Advanced Green Efforts indicators that are highlighted within the Green Mark NRB: 2015 criteria. Alternatively, where projects can demonstrate substantial performance to a specific sustainability indicator or outcome addressed within Green Mark beyond what is specified in the criteria, points can be awarded on a case by case basis.

**Assessment**
A maximum of 15 points for enhanced performance indicators can be scored for each project. Submission requirements for assessment shall follow the guidance for each enhanced performance indicator within the main Green Mark sections, or for other outcome beyond what is specified, based on 2 points for high impact items, 1 points for medium impact items and 0.5 point for low impact items.

5.2 Complementary Certifications

**Intent**
Green Mark is an assessment tool that assesses the environmental sustainability of a building. However, the consideration of sustainability indicators beyond those relevant to the built environment is also important.

**Assessment**
1 point can be scored where the project demonstrates that it is certified through a local or international complementary certification or rating tool that assesses the project beyond the environmental indicators within Green Mark NRB: 2015.

5.3 Demonstrating Cost Effective Design

**Intent**
Projects that can demonstrate that they have achieved high levels of environmental performance without an increased capital expenditure are of great interest to promote market transformation and encourage the mass market to drive towards higher levels of environmental sustainability.

**Assessment**
1 or 2 points respectively can be scored for demonstration of cost effective or cost neutral design beyond the norm through a detailed quality surveyor’s report of the building.
5.4 Social Benefits

Intent
While Green Mark focuses on environmental sustainability, this criterion rewards projects that are able to demonstrate that their project contributes to social sustainability.

Assessment
A maximum of 2 points can be scored for projects that demonstrate their social benefits or how social sustainability has been incorporated into the project beyond core functionality of the building. This can (but not limited to) include efforts that demonstrate enhanced considerations to further wellbeing, welfare, community integration as well as the purchase of clean energy (e.g. solar energy) through third party leasing contracts. 0.5 point for each distinct benefit.
Annexes

Energy Efficiency & Other Green Features for Specialised Building (up to 15 pts)

The Green Mark NRB: 2015 recognises the need for context specific criteria to enhance the sustainability value to the project. Annexes for specialised building list the additional sustainability features relevant to specific building types. The points scored under the respective Annex are bonus points that can be added to the base Green Mark score (140).

- Annex 1: Hawker Centres (15 pts)
- Annex 2: Healthcare Facilities (10 pts)
- Annex 3: Laboratory Buildings (10 pts)
- Annex 4: Schools (10 pts)
Certain criteria in GM NRB:2015 may not be applicable to specialised buildings types such as Healthcare, Laboratories, School and hawker centers. Hence, additional criteria are added to the scoring for these specialised buildings types. Additional points for different building typologies can be prorated based on size of functional spaces.

The below quick references table, highlights the various scorable, possibly scorable and unlikely-scorable credits for the different annexes:

- ✓: Scorable credits
- O: possibly scorable credits
- : unlikely-scorable credits

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### 4.2 Spatial Quality

#### 4.2a Lighting

| Effective daylighting for common areas | ✓ | ✓ | ☐ | ✓ |
| Effective daylighting for occupied spaces | ✓ | ✓ | ☐ | ✓ |
| Quality of Artificial Lighting | ✓ | ✓ | ☐ | ✓ |

#### 4.2b Acoustics

| Sound Transmission Reduction | ☐ | ✓ | ✓ | ✓ |
| Acoustic Report | ☐ | ✓ | ✓ | ✓ |

#### 4.2c Wellbeing

| Biophilic Design | ✓ | ✓ | ☐ | ✓ |
| Universal Design (UD) Mark | ✓ | ✓ | ✓ | ✓ |

### 4.3 Smart Building Operations

#### 4.3a Energy Monitoring

| Energy Portal and Dashboard | ✓ | ✓ | ✓ | ☐ |
| BAS and Controllers with Open Protocol | ✓ | ✓ | ✓ | ☐ |
| Permanent M&V for VRF Systems (Advanced Green Effort) | ✓ | ✓ | ✓ | ☐ |
| Permanent M&V for Hot Water Systems (Advanced Green Effort) | ✓ | ✓ | ✓ | ☐ |

#### 4.3b Demand Control

| ACMV Demand Control | ☐ | ✓ | ✓ | ☐ |
| Lighting Demand Control | ✓ | ✓ | ✓ | ✓ |

#### 4.3c Integration and Analytics

| Basic Integration and Analytics | ☐ | ✓ | ✓ | ☐ |
| Advanced Integration and Analytics | ☐ | ✓ | ✓ | ☐ |

#### 4.3d System Handover and Documentation

| Expanded Post Occupancy Performance Verification by a 3rd Party (Advanced Green Effort) | ✓ | ✓ | ✓ | ✓ |
| Energy Performance Contracting (Advanced Green Effort) | ✓ | ✓ | ✓ | ✓ |

### Part 5 – Advanced Green Efforts

#### 5.1 Enhanced Performance

| ✓ | ✓ | ✓ | ✓ |

#### 5.2 Demonstrating Cost Effective Design

| ✓ | ✓ | ✓ | ✓ |

#### 5.3 Complementary Certifications

| ✓ | ✓ | ✓ | ✓ |

#### 5.4 Social Benefits

| ✓ | ✓ | ✓ | ✓ |
Annex 1: Energy Efficiency & Other Green Features [Hawker Centres]

Intent
Encourage use of innovative energy efficient equipment, system or design feature.

Scope
Applicable to naturally ventilated hawker centre building.

Assessment
A maximum of 15 points can be scored for the following:

a. Implementation of Environmental-friendly procurement & purchase policy – 0.5 point
b. All kitchen exhaust to be connected to centralised exhaust system with filter to remove odour or particulates – 2 points
c. Provision of design to facilitate outflow of heated air to provide thermal comfort at seating area – 2 points
da. Provision of relevant information and guidance to facility management to main Indoor Air Quality performance in respect to cleaning, prevent migration of odors at cooking, dinning & toilets etc – 3 points
b. Provision of commitment to achieve “Happy Toilet” by Restroom Association Singapore (RAS) – 1 point
c. Provision of commitment to undertake POE every 6 months – 0.5 point
d. Provision of innovative and sustainable facilities management solutions to optimise management of Hawker Centres’ operations such as of Internet of Things (IoT), cloud computing, cashless payment – 1 point
e. Points achieved under the following credits carries double weightage:
   - 1.2a(iii) Urban Heat Island (UHI) Mitigation – 1 point
   - 3.3b Operational Waste management – 3 points
   - 4.2a Lighting – 6 points
   - 4.2c Wellbeing – 2 points
   - 4.3b(ii) Lighting Demand Control – 1 point
Annex 2: Energy Efficiency & Other Green Features [Healthcare Facilities]

Intent
Encourage use of innovative energy efficient equipment, system or design feature.

Scope
Applicable to healthcare facilities including hospitals, medical centres etc

Assessment
A maximum of 10 points can be scored for the following:

a. Use of energy efficient Uninterruptible Power Supply (UPS) systems – 1 point
b. Use of Low-loss service transformer – 1 point
c. Computation of Service Hot Water Demand – for patients’ wards, kitchen and restaurant/ café and additional service hot water demand for clinical & surgery, supply and sterilisation – 1 or 2 points respectively.
d. Provision of solar thermal hot water system or heat pumps or combines heat & power (CHP) system or Photovoltaic Thermal (PV/T) or other low and zero carbon technology hot water system to meet service hot water heating demand. The performance of service hot water system shall meet the efficiencies as described below – 1 point. Thereafter, additional point for every 10% improvement from minimum efficiency stated for each category (max 5)
   - Solar Thermal Hot water system – Solar Factor (SF) of 0.5 or Solar Energy Factor (SEF) of 2
   - Hot Water System Ratio (HWSR) of 1.60 or Heat Pump – COP of 3.5
   - Combustion turbine – based CHP – Effective electrical efficiency of 0.5
   - Reciprocating engine based CHP – effective electrical efficiency of 0.7

e. Promote airside energy recovery to all healthcare ventilation system through provision of energy – recovered device with no-recirculation (i.e. 100% of the room air to be exhausted). The energy transfers efficiency of energy – recovered device shall meet the below prescribed requirement – 1 point
   - Run Around coil – min 45% energy transfer efficiency
   - Plate heat exchanger – min 50% energy transfer efficiency
   - Thermal Wheel - 60% energy transfer efficiency
   - Other types – min 50% energy transfer efficiency
f. Provision of process water management - 1 point

g. Prevent air-borne contaminate releases and NOx emission from Fuel burning process – 1 point

h. Thermal comfort & control for each category of A/C space – 0.25 point each
   - Public areas
   - Patient and General Clinical Areas
   - Clinical areas with Specialized Ventilation Systems
   - Operating Theatre and Surgery

i. Control of indoor thermal environment by re-heating the air by provision of site – recovered energy (including condenser heat) or site solar energy – 1 point
Annex 3: Energy Efficiency & Other Green Features [Laboratories Buildings]

Intent
Encourage use of innovative energy efficient equipment, system or design feature.

Scope
Applicable to buildings with laboratories.

Assessment
A maximum of 10 points can be scored for the following:

a. Use of energy efficient Uninterruptible Power Supply (UPS) systems – 1 point
b. Design for variable ventilation and ventilation optimisation – 0.5 or 1 point per feature (up to 3 points)
c. Promote airside energy recovery to all laboratory ventilation system through provision of energy – recovered device with no-recirculation (i.e. 100% of the room air to be exhausted). The energy transfers efficiency of energy – recovered device shall meet the below prescribed requirement – 1 point
   • Run Around coil – min 45% energy transfer efficiency
   • Plate heat exchanger – min 50% energy transfer efficiency
   • Thermal Wheel - 60% energy transfer efficiency
   • Other types – min 50% energy transfer efficiency
d. Receptacle load benchmarking with existing lab to optimise cooling load design – 1 point
e. Include lab specific energy-efficient items under Green Lease – 0.5 point such as:
   • Auto Sash Closure for Fume Hood
   • Programmable timers for receptacles
   • Use of energy efficient equipment
f. Green guideline to tenants/building users include monitoring of Air Change Rate or Air Changes per hour (ACH) – 1 point
g. CFD study for exhaust air to prevent pollutants without sufficient dilution from entering neighbouring buildings – 4 points
h. (Option 1) Points achieved under 4.3 b(i) ACMV Demand Control credit carries double weightage
t. (Option 2) Setback control for Non-Occupancy Operation – 2 points
   • ACH for non-occupancy hours to be <60% of maximum operating ACH (for Biological/Chemical Laboratories)
   • Reduced ventilation/lighting operation during non-occupancy hours (for Physical Laboratories)
Annex 4: Energy Efficiency & Other Green Features [Schools]

**Intent**
Encourage integration of environmental sustainability awareness into curriculum and enrichment education in schools. To allow exposure and communication of environmental sustainability to the public in early ages.

**Scope**
Applicable to primary, secondary educational buildings.

**Assessment**
A maximum of 10 points can be scored for the following:

a. Provision, communication and dissemination of environmental policy that covers energy, waste and water management plan and green procurement – 0.5 point

b. Raising Awareness on Environmental Sustainability through creation of Sustainability Education – 2 points (0.5 point each)
   - Develop framework for Environmental Sustainability Education, such as incorporating bespoke curriculum to be taught to students of different levels,
   - Setting up of environmental club
   - Spread awareness on environmental sustainability amongst staff and students through posters, courses, competitions programmes or green corner.
   - Implement student-led programmes or activities related to environmental sustainability.

c. Communication of Energy and Water Efficiency Trends – 0.5 point
   - Regular sharing of energy and water usage (minimally on monthly basis) through platforms such as newsletter, assembly and etc, with analysis on the reasons for the consumption trend.

d. Higher ratio of functional areas with no air conditioning
   - Percentage of non-air-conditioned functional areas of total functional areas, scored according to the table below – Up to 2 points

<table>
<thead>
<tr>
<th>% Non-air-conditioned</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>60% to ≤ 70%</td>
<td>1</td>
</tr>
<tr>
<td>70% to ≤ 80%</td>
<td>1.5</td>
</tr>
<tr>
<td>≥ 80%</td>
<td>2</td>
</tr>
</tbody>
</table>

e. Minimising energy used to provide unnecessary or over-cooling – 2 points
   - Setting room temperature of air-conditioned computer and LAN rooms to 24 degrees or above – 1 point
   - Setting temperature of water in the water cooler to 15 degrees or above – 1 point

f. Points achieved under the following credits carries double weightage:
   - 1.2a(iii) Urban Heat Island (UHI) Mitigation – 1 point
   - 3.1b(ii) Water Usage Portal and Dashboard – 1 point
   - 4.2a(ii) Quality of Artificial Lighting – 1 point
   - 4.2c Biophilic Design – 2 points
   - 4.3a (i) Energy Portal and Dashboard – 1 point
References

Energy Modeling Requirements

P.1 Envelope and Roof Thermal Transfer

P.2 Air Tightness and Leakage

P.3 Bicycle Parking

1.1a Climatic & Contextually Responsive Brief

1.1b Integrative Design Process

1.1c Environmental Credentials of Project Team

1.1d User Engagement

1.2a Sustainable Urbanism

1.2b Integrated Landscape and Waterscape

1.3a Tropical Façade Performance

1.3c Ventilation Performance

1.3e Ventilation Performance
P.4 Total Air Conditioning System Efficiency/ P.5 Lighting Efficiency and Controls/ 2.1 Energy Efficiency


2.1e Building Energy


2.2 Renewable Energy


P.7 Water Efficient Fittings/ 3.1 Water


3.2a Sustainable Construction


3.2b Embodied Carbon


3.2c Sustainable Products


3.3 Waste


P.8 Thermal Comfort

4.1a Indoor Air Quality


4.2a Lighting

- BCA Singapore ‘Green Mark NRB: 2015 Technical Guide and Requirements Annex B: Effective Daylighting Simulation and Pre-Simulated Daylight Availability Tables Methodology and Requirements’

4.2b Acoustics


P.8 Thermal Comfort


P.9 Minimum Ventilation Rate


P.10 Filtration Media for Times of Pollution


P.11 Low Volatile Organic Compound (VOC) Paints


P.12 Refrigerants


P.13 Sound Level


P.14 Permanent Instrumentation for the Measurement and Verification of Air Conditioning Systems


P.15 Electrical Sub-Metering % Monitoring


4.1a Indoor Air Quality


4.2a Lighting


4.2b Acoustics

4.2b Acoustics


4.2c Wellbeing


[84] CS E09:2012 · Guidelines on Planting of Trees, Palms and Tall Shrubs on Rooftop; National Parks Board


4.3a Energy Monitoring


4.3b Demand Control


4.3d System Handover and Documentation


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BCA Working Group (Building and Construction Authority)
Management
Mr Ang Kian Seng
Mr Tan Tian Chong
Mr Jeffery Neng Kwei Sung
Ms Leong-Kok Su Ming
Mr Toh Eng Shyan

Secretariat
Mr Benjamin Henry Towell
Mr Derek Ang Wei Xiang
Ms Jacquelin Teresa Britto
Ms Michelle Tan Minxuan

Workgroup Leads
Ms Alice Goh
Mr Benjamin Henry Towell
Ms Chan Soo Cheng
Ms Chris Tay Yi Hui
Ms Denise Kwok Hui Ying
Mr Francis Tay
Ms Grace Cheok-Chan
Mr Ivan Lim You Feng
Ms June Bek
Mr Lee Jing Young
Mr Leow Yock Keng
Dr Li Ruixin
Mr Low Giau Leong
Ms Magdalene Tan
Mr Max Xu Mingfeng
Ms Ong Hui Wen
Mr Thomas Pang
Ms Tracy Liu
Mr Wee Kai Siong

Green Mark Advisory Committee (Sept 2013 – Mar 2016)
Er Lee Chuan Seng, Chair (Beca Asia Holdings Pte Ltd)
Prof Heng Chye Kiang, Deputy Chair (National University of Singapore)
Er Lam Siew Wah Deputy Chair (Building and Construction Authority)
Mr Ang Kian Seng (Building and Construction Authority)
Dr Er Johnny Wong (Housing and Development Board)
Mr Ananda Ram Bhaskar (National Environment Agency)
Mr Ahmad Sulaiman Bin Sumani (Kaer Pte Ltd)
Mr Anatoli Kolmakov (Honeywell Building Solutions)
Mr David Lau (Kruger Engineering Pte Ltd)
Mr Goh Kok Liok (National Metrology Centre)
Mdm Goh Swee Lee (Asia AMCA Pte Ltd)
Er Koh Kin Teng (SQUIRE Mech Pte Ltd)
Mr Laurance Lee (Carrier Singapore Pte Ltd)
Mr Liew Kwong Chin (ASHRAE Singapore Chapter / Trane Singapore)
Mr Lim Fatt Seng (Comfort Management Pte Ltd)
Mr Liu Xiao Feng (G-Energy Global Pte Ltd)
Dr Lu Lu (Engie Services Singapore Pte Ltd)
Ms Lydia Goh (National Environment Agency)
Ms Michelle Ang (Kele & Associates Pte Ltd)
Dr Lu Lu (Engie Services Singapore Pte Ltd)
Ms Lydia Goh (National Environment Agency)
Ms Michelle Ang (Kele & Associates Pte Ltd)
Mr Raymond Tan (Daikin Air-conditioning Singapore Pte Ltd)
Mr Steve Seah (DTZ Facilities & Engineering (S) Limited)
Mr Steven Kang (Measurement & Verification Pte Ltd)
Ms Tan Tin Tin (Asia AMCA Pte Ltd)

Green Mark Advisory Committee (Apr 2016 – Jun 2019)
Er Lee Chuan Seng, Chair (Beca Asia Holdings Pte Ltd)
Mr Ang Kian Seng, Co-Chair (Beca Asia Holdings Pte Ltd)
Dr Er Johnny Wong (Housing and Development Board)
Er Lam Siew Wah Deputy Chair (Building and Construction Authority)
Mr Neo Choon Keong, Deputy Chair (Building and Construction Authority)
Mr Ang Kian Seng (Building and Construction Authority)
Dr Er Johnny Wong (Housing and Development Board)
Mr Ang Kok Kiat (National Environment Agency)
Mr Anthony Goh (City Developments Limited)
Dr Ho Nyok Yong (samwoh Corporation Pte Ltd)
Mr Joseph Loh (G-Energy Global Pte Ltd)
Mr Koh Chwee (Jurong Town Corporation)
Er Koh Kin Teng (SQUIRE Mech Pte Ltd)
Prof Lim Fatt Seng (Comfort Management Pte Ltd)
Er Lim Ming Sing, Alfred (CapitalLand Singapore Ltd)
Mr Lim Tow Fok (Keppel Land Limited)
Prof Raymond Wong (Nanyang Technological University)
Ms Susannah West (JLL)
Mr Tan Phay Ping (Building System and Diagnostics Pte Ltd)
Mr Tan Szue Harn (Surbana Jurong Pte Ltd)
Mr Tan Tian Chong (Building and Construction Authority)
Mr Teo Orh Hai (Building and Construction Authority)
Er Tony Tay (Parsons Brinckerhoff Pte Ltd)

Taskforces
Air-Side Measurement Taskforce (GMAC)
Mr Toh Eng Shyan, Co-Chair (Building and Construction Authority)
Er Vincent Han, Co-Chair (Vincent Han & Associates)
Mr Ahmad Sulaiman Bin Sumani (Kaer Pte Ltd)
Mr Anatoli Kolmakov (Honeywell Building Solutions)
Mr David Lau (Kruger Engineering Pte Ltd)
Mr Goh Hok Liok (National Metrology Centre)
Mdm Goh Swee Lee (Asia AMCA Pte Ltd)
Er Koh Kin Teng (SQUIRE Mech Pte Ltd)
Mr Laurance Lee (Carrier Singapore Pte Ltd)
Mr Liew Kwong Chin (ASHRAE Singapore Chapter / Trane Singapore)
Mr Lim Fatt Seng (Comfort Management Pte Ltd)
Mr Liu Xiao Feng (G-Energy Global Pte Ltd)
Dr Lu Lu (Engie Services Singapore Pte Ltd)
Ms Lydia Goh (National Environment Agency)
Ms Michelle Ang (Kele & Associates Pte Ltd)
Mr Raymond Tan (Daikin Air-conditioning Singapore Pte Ltd)
Mr Steve Seah (DTZ Facilities & Engineering (S) Limited)
Mr Steven Kang (Measurement & Verification Pte Ltd)
Ms Tan Tin Tin (Asia AMCA Pte Ltd)
Air-conditioning (Water-side) Taskforce

Er Koh Kim Teng, Co-Chair (Square Mech Pte Ltd)
Mr Toh Eng Shyan, Co-Chair (Building and Construction Authority)
Ms Irene Yong (Beca Carter Hollings & Ferrer (S.E.Asia) Pte Ltd)
Mr Ero Rodijo (Ascendas Services Pte Ltd)
Mr Alfred Lim (CapitaLand Singapore Ltd)
Er Tong Kok Kwang (Nanyang Technological University)
Mr Vincent Low (G-Energy Global Pte Ltd)
Mr Yong Ping Quen (Building System and Diagnostics Pte Ltd)
Mr Steven Kang (Measurement & Verification Pte Ltd)
Mr Benjamin Lai (Kear Pte Ltd)
Mr Liew Kwong Chin (ASHRAE Singapore Chapter / Trane Singapore)
Mr Yow Kuan Yow (Trane Singapore)
Er Tan Kiat Leong (TW International Counsel Pte Ltd)
Mr Raymond Tan (Daikin Air-conditioning Singapore Pte Ltd)
Mr Laurence Lee (Carrier Singapore Pte Ltd)
Mr See Ann Seg (Johnson Controls (S) Pte Ltd)
Ms Nikita Yu (Johnson Controls (S) Pte Ltd)
Mr Ke Yam Cheong (Mitsubishi Electric Asia Pte Ltd)
Mr Sam Ringwaldt (Smardt Chillers Pte Ltd)

Architectural Taskforce

Mr Cheong Yew Kee, Chair (2B Architects)
Ms Jaye Tan, Co-Chair (Studio Green Pte Ltd)
Ms Leong-Kok Su Ming, Co-Chair (Building and Construction Authority)
Mr Siow Zhi Xiang (CPG Consultants Pte Ltd)
Ms Astee Lim (Jurong Consultants Pte Ltd)
Ms Chang Yen Lin (KPK Quantity Surveyors (Singapore) Pte Ltd)
Mr Kuan Chee Yung (CPG Consultants Pte Ltd)
Mr Sonny Chionh (RSP Architects Planners & Engineers Pte Ltd)
Mr Tan Szue Hann (Surbana Jurong Pte Ltd)
Dr To Kien (Singapore University of Technology and Design)

District Cooling Taskforce

Mr Ang Kian Seng, Co-Chair (Building and Construction Authority)
Er Lee Chuan Seng, Co-Chair (Beca Asia Holdings Pte Ltd)
Ms Leong-Kok Su Ming (Building and Construction Authority)
Mr Ler Seng Ann (Urban Redevelopment Authority)
Mr Lim Fatt Seng (Comfor Management Pte Ltd)
Mr Lim Tow Fok (Keppel Land Limited)
Prof Raymond Wong (Nanyang Technological University)
Mr Roland Tan (National Environment Agency)
Mr Toh Eng Shyan (Building and Construction Authority)
Er Tony Tay (Parsons Brinckerhoff Pte Ltd)
Mr Yee Peng Huey (JTC Corporation)

Energy Modeling Taskforce

Er Lee Chuan Seng, Co-Chair (Beca Asia Holdings Pte Ltd)
Mr Jeffery Neng, Co-Chair (Building and Construction Authority)
Ms Irene Yong (Beca Carter Hollings & Ferrer (S.E.Asia) Pte Ltd)
Mr Joseph Loh (G-Energy Global Pte Ltd)
Mr Kim Dong Kyun (Building System and Diagnostics Pte Ltd)
Prof Raymond Wong (Nanyang Technological University)
Mr Steven Kang (Measurement and Verification Pte Ltd)
Er Tay Cher Seng (Natflow Pte Ltd)
Er Vincent Han, (Vincent Han & Associates)
Mr Yong Ping Quen (Building System and Diagnostics Pte Ltd)

Envelope Taskforce

Prof Chou Siaw Kiang, Co-Chair (National University of Singapore)
Ms Leong-Kok Su Ming, Co-Chair (Building and Construction Authority)
Mr Amos Seah (Technoform Bautec Asia Pacific Pte Ltd)
Mr Gan Geok Chua (Singapore Safety Glass Pte Ltd)
Ms Maggie Low (Technoform Bautec Asia Pacific Pte Ltd)
Mr Mathieu S. Meur (Meinhardt Façade Technology International)
Prof Wong Nyuk Hien (National University of Singapore)
Dr Uma Maheswaran (Jurong Consultants Pte Ltd)

Green Products and Materials Taskforce

Ms Leong-Kok Su Ming, Co-Chair (Building and Construction Authority)
Ms Yyvonne Soh, Co-Chair (Singapore Green Building Council)
Mr Edwin Fong (SPRING Singapore)
Mr Eugene Yong (The Singapore Contractors Association Ltd)
Mr Goh Su-Liang (Singapore Green Building Council)
Ms Jennifer Yap (National Environment Agency)
Ms Joanna Shen (National Environment Agency)
Mr Kavickumar S/o Muruganathan (Singapore Environment Council)
Mr Kuan Chee Yung (CPC Consultants Pte Ltd)
Mr Lim Tow Fok (Real Estate Developers’ Association of Singapore)
Mr Ng Wee Kok (Singapore Manufacturer Federation)
Mr Pang Tong Teck (Singapore Civil Defence Force)
Dr Song Bin (Singapore Institute of Manufacturing Technology)

IEQ Taskforce

Mr Lim Fatt Seng, Chair (Comfort Management Pte Ltd)
Mr Toh Eng Shyan, Co-Chair (Building and Construction Authority)
Mr Beh Lean Hooi (CapitaLand Singapore Limited)
Mr Callan Lam (Meinhardt (Singapore) Pte Ltd)
Mr Ke Yam Cheong (Mitsubishi Electric Asia Pte Ltd)
Mr Lenz Wong (Pure Science International Pte Ltd)
Mr Leong Cheng Wei (Air-Conditioning & Refrigeration Association)
Mr Lim Sin Or (Keppel Land Limited)
Mr Lui Wing Sin (GETC Asia Pte Ltd)
Mr Steven Kang (Measurement and Verification Pte Ltd)
Ms Swen Tan (Daikin Air-conditioning (Singapore) Pte Ltd)
Mr Tan Phay Ping (Building System and Diagnostics Pte Ltd)
Mr Vincent Low (G-Energy Global Pte Ltd)

Lighting Taskforce

Er Yvonne Soh, Co-Chair (Singapore Green Building Council)
Mr Eddy Lau, Co-Chair (Singapore Green Building Council)
Ms Leong-Kok Su Ming, Co-Chair (Building and Construction Authority)
Dr Gao Chun Ping, Co-Chair (Building and Construction Authority)
Mr Adrian Ting (CapitaLand Limited)
Dr Chien Szu-Cheng (Berkeley Education Alliance for Research in Singapore)
Mr Dan Foreman (Arup Singapore Pte Ltd)
Mr Gaurav Jain (Lighting Planners Associates (S) Pte Ltd)
Ms Irene Yong (Beca Carter Hollings & Ferrer (S.E.Asia) Pte Ltd)
Mr Kevin Sturrock (iLab Pte Ltd)
Ms Ong Swee Hong (ONG&ONG Pte Ltd)
Mr Rodney Lim (Singapore Green Building Council)
Ms Toh Yah Li (Light Collab LLP)

Noise and Acoustics Taskforce

Prof Lee Siew Eang, Co-Chair (National University of Singapore)
Mr Alvin Cheong (Alfem Engineering Consultancy Pte Ltd)
Ms Emily Tan Hui Ching (Earth-In-Mind Pte Ltd)
Mr Gabriel Anthony Vincent (CGF Consultants Pte Ltd)
Dr Kenny Yap (Acoustics & Environmental Solutions Pte Ltd)
Er Koh Kin Teng (City Developments Ltd)
Er Tan Kiat Leong (Beca Carter Hollings & Ferrier (S.E.Asia) Pte Ltd)
Dr Xu Jingfong (Arup Singapore Pte Ltd)

NV Taskforce
Ms Leong-Kok Su Ming, Co-Chair (Building and Construction Authority)
Prof Wong Nyuk Hien, Co-Chair (National University of Singapore)
Mr Allen Ang (Keppel Land Limited)
Mr Chang Tze Lurn (Housing and Development Board)
Dr George Xu (Parsons Brinckerhoff Pte Ltd)
Dr Henry Feriadi (Duta Wacana Christian University)
Dr Kang Zhijian (MOH Holdings Pte Ltd)
Mr Markus Cheng (ADDP Architects LLP)
Dr Norman Wu (MOH Holdings Pte Ltd)
Mr Ong Joe Cher Shyan (Mott MacDonald Singapore Pte Ltd)
Mr Po Woei Ken (Building System and Diagnostics Pte Ltd)
Mr Wee Amir Kim Hor (CFD Research (Singapore) Pte Ltd)

SLTDC Committee
Mr Ang Kian Seng, Co-Chair (Building and Construction Authority)
Assoc Prof Tseng King Jet, Co-Chair (Singapore Green Building Council)
Mr Adrian Cheong Wah Onn (Land Transport Authority)
Mr Ananda Ram Bhaskar (National Environment Agency)
Mr Edwin Chan Yiu Wing (Nanyang Technological University)
Mr Guo Dongbin (Land Transport Authority)
Mr Lim Yong Ching (Nanyang Technological University)
Mr Ng Eng Sin (JTC Corporation)

Smart Control Taskforce
Mr Toh Eng Shyan, Co-Chair (Building and Construction Authority)
Er Tony Tay, Co-Chair (Parsons Brinckerhoff Pte Ltd)
Mr Alex Ng (Honeywell Building Solutions)
Mr Benjamin Lai (Kaer Pte Ltd)
Mr Lim Sin On (Keppel Land Limited)
Dr Lu Lu (Engie Services Asia Pacific Pte Ltd)
Mr Melvin Tan (Accenture Singapore)
Ms Michelle Ang (Kele Singapore)

Solar PV Taskforce
Mr Ang Kian Seng, Co-Chair (Building and Construction Authority)
Er Lee Chuan Seng, Co-Chair (Beca Asia Holdings Pte Ltd)
Mr Allen Ang (Keppel Land Limited)

Sustainable Construction and Carbon Taskforce
Mr Jeffery Neng, Co-Chair (Building and Construction Authority)
Er Lim Peng Hong, Co-Chair (Association of Consulting Engineers Singapore)
Er Chia Wah Karm (ARUP Singapore Pte Ltd)
Dr Ho Nyok Yong (Singapore Contractors Association Limited)
Er Joseph Goh (Institution of Engineers Singapore)
Er Lauw Su Wee (LSW Consulting Engineers Pte Ltd)
Dr Song Bin (Singapore Institute of Manufacturing Technology)
Er Tan Guan (T.Y. Lin International Group)
Er Quak Cheow Swee (Beca Carter Hollings & Ferrier (S.E.Asia) Pte Ltd)
Er Yvonne Soh (Singapore Green Building Council)

Academic Collaborations
Prof Bert Blocken (Eindhoven University of Technology)
Asst Prof J. Alstan Jakubiec (Singapore University of Technology and Design)
Assoc Prof Tham Kwok Wai (National University of Singapore)

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