

BCA Green Mark for Existing Non-Residential Buildings

GM ENRB: 2017 (DRAFT)

Framework – BCA Green Mark for Existing Non-Residential Buildings 2017 (GM ENRB:2017)

To achieve Green Mark Award

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

Section 1 – SUSTAINABLE MANAGEMENT

1.1 Environmental Credentials of Facility Managers and Professionals
1.2 Sustainable Policy and Action Plan
1.3 Green Building Committee
1.4 Green Education
1.5 Green Fit-out Guidelines
1.6 Green Lease
1.7 Green-related Activities for Building Occupants
1.8 Greenery
1.9 Refrigerant
1.10 Green Transport
1.11 Sustainable Operation

Section 2 – BUILDING ENERGY PERFORMANCE

2.1 Façade Performance
2.2 Air Conditioning System Efficiency
2.3 Natural / Mechanical ventilation
2.4 Lighting Efficiency
2.5 Vertical Transportation System
2.6 Ventilation in Car Park
2.7 Ventilation in Common Areas
2.8 Energy Efficient Practices and Features
2.9 Renewable Energy

Section 3 – RESOURCE STEWARDSHIP

3.1 Water Efficient Fittings
3.2 Landscape Irrigation
3.3 Reduction of Water Consumption of Cooling Towers
3.4 Water Monitoring and Leak Detection
3.5 Water Usage Portal and Dashboard
3.6 Use of Alternative Water Sources
3.7 Green Materials / Products
3.8 Recycling Facilities
3.9 Storage Area for Recyclable Waste
3.10 Promotion of Waste Reduction
3.11 Waste Monitoring

Section 4 – SMART AND HEALTHY BUILDINGS

4.1 Occupant Comfort
4.2 Outdoor Air Control
4.3 Enhanced Filtration Media
4.4 Indoor Contaminants
4.5 Lighting Quality
4.6 Acoustics
4.7 Biophilic features
4.8 Level I – Energy Monitoring
4.9 Level II – Demand Control
4.10 Level III – Integration and Analytics

Section 5 – ADVANCED GREEN EFFORTS

POINT ALLOCATION – BCA Green Mark for Existing Non-Residential Buildings 2017 (GM ENRB: 2017)

GM Criteria		Point Allocations
Section 1 – SUSTAINABLE MANAGEMENT		
1.1	Environmental Credentials of Facility Managers and Professionals	1
1.2	Sustainable Policy and Action Plan	4
1.3	Green Building Committee	2
1.4	Green Education	2
1.5	Green Fit-out Guidelines	1
1.6	Green Lease	2
1.7	Green-related Activities for Building Occupants	3
1.8	Greenery	6.0
1.9	Refrigerant	4
1.10	Green Transport	4
1.11	Sustainable Operation	6
	Score for Section 1 – Sustainable Management	**35**
Section 2 – BUILDING ENERGY PERFORMANCE		
2.1	Façade Performance	2
2.2	Air Conditioning System Efficiency	16 for AC;
2.3	Natural / Mechanical Ventilation	17 for NV
2.4	Lighting Efficiency	6
2.5	Vertical Transportation System	1.5
2.6	Ventilation in Car Park	2
2.7	Ventilation in Common Areas	3
2.8	Energy Efficient Practices and Features	2
2.9	Renewable Energy	6.5
	Score for Section 2 – Building Energy Performance	**40**
Section 3 – RESOURCE STEWARDSHIP		
3.1	Water Efficient Fittings	7
3.2	Landscape Irrigation	1
3.3	Reduction of Water Consumption of Cooling Towers	2.5
3.4	Water Monitoring and Leak Detection	1
3.5	Water Usage Portal and Dashboard	1
3.6	Use of Alternative Water Sources	2
3.7	Green Materials / Products	7
3.8	Recycling Facilities	3.5
3.9	Storage Area for Recyclable Waste	1
3.10	Promotion of Waste Reduction	2
3.11	Waste Monitoring	2
	Score for Section 3 – Resource Stewardship	**30**

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POINT ALLOCATION – BCA Green Mark for Existing Non-Residential Buildings 2017 (GM ENRB: 2017)

GM Criteria		Point Allocations
Section 4 – SMART AND HEALTHY BUILDINGS		
4.1	Occupant Comfort	5.5
4.2	Outdoor Air Control	1.5
4.3	Enhanced Filtration Media	2.5
4.4	Indoor Contaminants	2.5
4.5	Lighting Quality	4
4.6	Acoustics	1
4.7	Biophilic features	2
4.8	Level I – Energy Monitoring	11
4.9	Level II – Demand Control	5
4.10	Level III – Integration and Analytics	5
	Score for Section 4 Smart and Healthy Buildings	**40**
Section 5 – ADVANCED GREEN FEATURES		
	Advanced Green Features	20
	Score for Section 5 – Advanced Green Features	**20**
	Total Green Mark Score available	**165**

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Green Mark Award Rating

BCA Green Mark Award Rating and Pre-requisite Requirements

Green Mark Rating	Green Mark Score
Green Mark Platinum	70 and above
Green Mark Gold^{PLUS}	60 to < 70
Green Mark Gold	>50 to < 60
Green Mark Certified	Compliance with all pre-requirement requirement

Pre-requisite Requirements for Existing Non-residential Building Criteria

1. ENERGY CONSUMPTION OF THE DEVELOPMENT — All Rating

To compute and monitor the Energy Use Intensity (EUI) for past 3 years and review EE improvement plans

2. MINIMUM SYSTEMS' EFFICIENCY — All Rating

(i) For buildings using Water-Cooled Chilled-Water Plant

Green Mark Rating	Building Cooling Load (RT)	
	< 500	≥ 500
	Minimum Efficiency (kW/RT)	
Certified	0.85	0.75
Gold	0.75	0.70
Gold^{PLUS}	0.7	0.68
Platinum	0.68	0.65

(ii) For Buildings using Air Cooled Chilled-water Plant or Unitary Air-Conditioner

Green Mark Rating	Building Cooling Load (RT)	
	< 500	≥ 500
	Minimum Efficiency (kW/RT)	
Certified	1.1	1.0
Gold	1.0	*Case-by-case basis
Gold^{Plus}	0.85	
Platinum	0.78	

*For building with cooling load of more than 500 RT, air cooled chilled-water plant or other unitary air-conditioners will be assessed on a case-by-case basis. It will only be considered when it meets the same efficiency requirement as stipulated in 2(i).

Note: The performance of the overall air-conditioning system for the building is based on the Operating System Efficiency (OSE) of the system during the normal building operating hours as defined below:

Office Building: Monday to Friday: 9am to 6pm Retail Mall: Monday to Sunday: 10am to 10pm	Hotel and Hospital: 24-hour Industrial and Other Building Types: To be determined based on the operating hours

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3. ENERGY IMPROVEMENT ON LIGHTING SYSTEM To demonstrate at least 20% improvement in lighting power budget for common areas over the baseline stated in annex A	All Rating
4. WATER CONSUMPTION MONITORING To compute and monitor the yearly water consumption (m^3/m^2) for past 3 years and review water improvement plan	All Rating
5. CHILLER PLANT MEASUREMENT AND VERIFICATION (M&V) INSTRUMENTATION Provision of permanent measuring instruments for monitoring of water-cooled chilled-water system and air-cooled chilled water system operating system efficiency. The installed instrumentation shall have the capability to calculate resultant plant operating system efficiency (i.e. kW/RT) within 5% of its true value and in accordance with ASHRAE Guide 22 and AHRI 550/590. Heat balance test for water-cooled chilled-water system is required for verification of the accuracy of the M&V instrumentation	All Rating
6. INDOOR TEMPERATURE To maintain indoor dry bulb temperature of 23 °C and above to prevent overcooling	All Rating
9. IAQ SURVEILLANCE AUDIT To conduct a three yearly IAQ audit according to NEA's Guidelines for Good Indoor Air Quality in Office Premises or SS554:2016 Code of Practice for `Indoor air quality for air-conditioned buildings'	All Rating
10. TENANT / OCCUPANT ENGAGEMENT To conduct at least one green related activities in a year involving building occupants	Gold^{PLUS} and Platinum Rating
11. RECYCLING FACILITIES To provide recycling facilities for collection and storage of common recyclables such as paper, glass, metal and plastic in commingled or sorted form	Gold^{PLUS} and Platinum Rating
12. POST OCCUPANCY EVALUATION To conduct a post occupancy evaluation and take corrective actions accordingly.	Gold^{PLUS} and Platinum Rating

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Section 1 – SUSTAINABLE MANAGEMENT	Green Mark Points (35 Points)
1.1 Environmental Credential of Facility Managers and Professionals To recognise facility managers, consultants and EPC firms with specialist green credentials who contribute towards sustainable management of the building Applicable to in-house building management and facility management team or external consultants with the following credentials: a) Certified Green Mark Facility Manager (GMFM) b) Certified Green Mark Facility Professional (GMFP) c) Singapore Certified Energy Manager (SCEM)	0.5 point for Certified GMFM 1 point for Certified GMFP or SCEM (Up to 1 point)
1.2 Sustainable Policy and Action Plan To recognise management commitment and leadership towards a sustainable operation of the building. To establish the following policies and documents which contain sustainable targets, implementation strategies and improvement plans to achieve the target set over the next three years; and endorsement by top management :- a) Energy Policy and Improvement Plan b) Water Policy and Improvement Plan c) Waste Management Policy and Recycling Plan d) ISO 14001 or ISO 50001 certifications	1 point for each item (Up to 4 points)
1.3 Green Building Committee To encourage environmentally conscious owners and tenants to come together to promote sustainability related initiatives within the building. a) Set up Green Building Committee b) Members in this Committee includes tenants	1 point 1 point
1.4 Green Education To create awareness among building occupants on the green features of the buildings and how they can contribute towards sustainability. a) Green building user guide b) Green corner	1 point 1 point
1.5 Green Fit-out Guidelines To educate tenants on how to renovate their spaces sustainably by providing fit-out guidelines with details recommending minimum environmental standards to assist tenants in making their fit-out decisions.	1 point

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<table>
<tr><td></td><td></td></tr>
<tr><td><u>1.6 Green Lease</u>

To encourage building owners and tenants to go an extra mile towards sustainability by implementing Green Lease. To be incorporated into the tenancy agreement, the green lease shall establish agreed levels of environmental performance between landlord and the tenant.

Points can be scored based on the percentage of the net lettable area (NLA) having the green lease</td><td>0.5 point for provision of Green Lease
or
1 point if ≥10% of NLA are on Green lease
or
2 points if ≥40% of NLA are on Green lease</td></tr>
<tr><td><u>1.7 Green-related Activities for Building Occupants</u>

To encourage tenant/occupant engagement through green related activities. Points can be scored based on the number of green activities held in a year.</td><td>1 point for each green activity
(up to 3 points)</td></tr>
<tr><td><u>1.8 Greenery</u>

This refers to the provision of greenery within the development to mitigate the urban heat island effect.

a) Greenery Provision (GnP)

To encourage greater use of greenery within the development. Greenery Provision (GnP) is calculated by considering the 3D volume covered by plants using the Green Area Index (GAI)

b) Rooftop Greenery

To encourage rooftop greenery to reduce the temperature underneath, which in turn saving air-conditioning energy.

c) Vertical Greenery

To encourage vertical greenery on façade to reduce heat gain into building. Points can be scored based on the vertical greenery areas.

d) Sustainable Landscape Management

To encourage greenery with proper landscape management within the development. Points can be scored for the following:-

(i) The landscape within the development has achieved NParks Landscape Excellence Assessment Framework (LEAF) certification;

OR

(ii) Adoption of a landscape management plan that covers
• the use of organic composts from horticultural wastes,
• onsite compost production
• general landscape maintenance plan</td><td>
<table>
<tr><th>Description</th><th>GAI</th></tr>
<tr><td>Trees</td><td>6</td></tr>
<tr><td>Palms</td><td>4</td></tr>
<tr><td>Shrubs</td><td>3</td></tr>
<tr><td>Landscape & grass</td><td>1</td></tr>
</table>

<table>
<tr><th>GnP</th><th>Points</th></tr>
<tr><td>0.5 to < 1.0</td><td>1 point</td></tr>
<tr><td>1.0 to < 2.0</td><td>1.5 points</td></tr>
<tr><td>2.0 to < 3.0</td><td>2 points</td></tr>
<tr><td>≥ 3.0</td><td>2.5 points</td></tr>
</table>
(Up to 2.5 points)

<table>
<tr><th>Useable roof area (%)</th><th>Point</th></tr>
<tr><td>≥ 20% to < 50%</td><td>0.5</td></tr>
<tr><td>≥ 50%</td><td>1.0</td></tr>
</table>
(Up to 1 point)

<table>
<tr><th>Greenery area (m2)</th><th>Point</th></tr>
<tr><td>≥ 10 to < 50</td><td>0.5</td></tr>
<tr><td>≥ 50</td><td>1.0</td></tr>
</table>
(Up to 1 point)

1.5 points

OR
0.5 point
0.5 point
0.5 point each
(Up to 1.5 points)</td></tr>
</table>

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1.9 Refrigerant

To encourage the use of environment-friendly refrigerants which can reduce the potential damage to the ozone layer and reduce global warming.

a) Green Refrigerant

To use of refrigerants which can reduce ozone depletion and minimising direct contributions to climate change.

Points can be scored based on the Ozone Depleting Potential (ODP) and/or Global Warming Potential (GWP).

ODP and GWP of Refrigerant	Points
ODP=0 **or** GWP<100	0.5
ODP=0 **and** GWP<750	1
ODP=0 **and** GWP<10	1.5

(Up to 1.5 points)

b) Refrigerant Leak Detection System

An automated refrigerant leak detection system shall be installed in the plant rooms containing the chillers and/or other equipment using refrigerants.

1 point

c) Refrigerant Management System

A refrigerant management procedure is in place on proper handling of refrigerant during the storage and top-up, maintaining the log sheets, tracking, reducing the refrigerant consumption and avoiding leakages.

1.5 points

1.10 Green Transport

The choice of transportation modes for commuting has a significant environmental impact in terms of emissions and pollution.

a) The building has good access (< 500m walking distance) to public transport networks such as MRT/LRT stations and bus stops. — 0.5 point

b) Provision of covered walkway to facilitate connectivity and use of public transport. — 0.5 point

c) Priority parking lots for hybrid/electric vehicle

- provision of adequate priority parking lots (1 lot of hybrid/electric vehicle lot per 100 car parking lots or at least 10 hybrid/electric vehicle lot) — 1 point
- provision of at least 1 no. of electric vehicle charging points — 0.5 point

d) Provision of sheltered bicycle parking lots with adequate shower and changing facilities.

- Provision of at least 1 bicycle parking lot per 1,500 m^2 GFA. — 0.5 point
- Provision of at least 2 bicycle parking lots per 1,500m^2 GFA — 1 point
- Provision of at least 3 bicycle parking lots per 1,500m^2 GFA — 1.5 points

(Up to 1.5 points)

Note: 1.5 points can be scored for the provision of at least 50 bicycle parking lots

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1.11 Sustainable Operation This refers to the implementation of various policies and measures to promote sustainable operation within the building	
a) Green Procurement Policy Adoption of environmental preferable procurement policy in the operation and maintenance of the building. The objective of this policy is to reduce the adverse environmental impact of building owners' purchasing decisions by buying goods and services from environmentally responsible product/service providers	1 point
b) Performance Based Procurement for Retrofitting Adoption of Energy Performance Contract (EPC) by EPC firms accredited by Singapore Green Building Council (SGBC) for the replacement of the following systems:- (i) Centralised chilled water system (ii) Air distribution system	1 point 1 point
c) Performance Based Procurement for Maintenance Adoption of performance based maintenance contract for at least 3 years for the following air-conditioning system:- (i) Centralised chilled water system (ii) Air distribution system	1 point 1 point
d) System Handover and Documents When a building system (e.g. Air-conditioning system, Building Automation System) is retrofitted, it shall be properly tested and verified to ensure compliance with the desired efficiency and performance levels. Maintain a proper and updated system handover documents, which shall include description of systems operation and controls, testing and commissioning reports, as-built drawings, technical and training manuals and user guides.	1 point

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<table>
<tr><th>Section 2 – BUILDING ENERGY PERFORMANCE</th><th>Green Mark Points (40 Points)</th></tr>
<tr><td><u>2.1 Façade Performance</u>

Enhance the overall thermal performance of building envelope to minimise heat gain thus reducing the overall heat gain into the building.</td><td><table><tr><th>ETTV (W/m2)</th><th>Points</th></tr><tr><td>45 to <50</td><td>1</td></tr><tr><td>40 to <45</td><td>2</td></tr></table></td></tr>
<tr><td><u>2.2 Air Conditioning System Efficiency</u>

The use of energy efficient and appropriately sized air-conditioning system can optimise its performance and reduce its environment impact.

a) Water-Cooled Chilled-Water Plant:
▪ Water-Cooled Chiller
▪ Chilled water pump
▪ Condenser water pump
▪ Cooling tower

<table><tr><th rowspan="2">Baseline</th><th colspan="2">Building Cooling Load</th></tr><tr><th>< 500 RT</th><th>≥500 RT</th></tr><tr><td><u>Pre-requisite Requirements</u>
Minimum system efficiency of central chilled-water plant</td><td>0.85 kW/RT</td><td>0.75 kW/RT</td></tr></table>
OR

b) Air Cooled Chilled-Water Plant / Unitary Air-Conditioners:

Air cooled Chilled-Water Plant:
▪ Air-Cooled Chiller
▪ Chilled Water Pump

Unitary Air-Conditioners:
▪ Variable Refrigerant Flow (VRF) System
▪ Water-Cooled Package Unit
▪ Single-Spilt Unit
▪ Multi-Spilt Unit

<table><tr><th rowspan="2">Baseline</th><th colspan="2">Building Cooling Load</th></tr><tr><th>< 500 RT</th><th>≥500 RT</th></tr><tr><td><u>Pre-requisite Requirements</u>
Minimum system efficiency of air cooled chilled water plant or unitary conditioners</td><td>1.1 kW/RT</td><td>1.0 kW/RT</td></tr></table>
Note 1: For building with different air-conditioning systems, the point scored will be pro-rated based on the cooling load of each system.

Note 2: For buildings using district cooling system, the points scored for chiller plant system will be based on the weighted percentage of the point scored in air distribution system efficiency.</td><td>Point scored = 0.6 x (% improvement)
(Up to 12 points)

Point scored = 0.4 x (% improvement)
(Up to 12 points)</td></tr>
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c) Air Distribution System • Air Handling Units (AHUs) • Fan Coil Units (FCUs) Baseline: 0.28 kW/RT *Note 3: For Building score for air distribution system, Building's air-con EUI shall be submitted.* *The below Energy Use Intensity (EUI) of air-conditioning system for the past one year shall be calculated and submitted. It shall be calculated based on the following formulae:* *(i) EUI_{AC} = Annual Building Energy Consumption of air-conditioning system (kWh) / GFA(m2).* *(ii) $EUI_{AC\#}$= Annual Building Energy Consumption of air-conditioning system (kWh) within standard operating hour / GFA(m2).*	Point scored = 0.14 x (% improvement) (Up to 4 points)
2.3 Natural / Mechanical Ventilation Applicable to Non Air-Conditioned Building Areas (with an aggregate non air-conditioned areas > 10% of total floor area excluding car parks and common areas) a) **Natural Ventilation** ***(only applicable to occupied areas, excluding circulation, plant rooms and transit areas)*** Encourage building that facilities good natural ventilation. Naturally ventilated areas should be properly designed to utilise prevailing wind condition to achieve adequate cross ventilation, and effectively designed to be thermally comfortable and healthy for the building occupants. **b) Mechanical Ventilation** Encourage energy efficient mechanical ventilation system as the preferred ventilation mode to air-conditioning in buildings. Baseline: Allowable nameplate motor power Constant volume: 0.47 W/CMH Variable volume: 0.74 W/CMH *Note : Where there is a combination of naturally ventilated and mechanical ventilated spaces, the points scored will only be based on the predominant ventilation modes of normally occupied spaces.*	10 based points will be awarded for use of natural ventilation 1 points for every 10% of NV areas with window openings facing north and south directions and cross ventilation (Up to 17 points) 0.3 point for every percentage improvement from the baseline (Up to16 points)
2.4 Lighting Efficiency Encourage the use of energy efficient lighting to minimise energy consumption from lighting usage while maintaining proper lighting level. Please refer to Annex A for the baseline of lighting power budget.	Point scored = 0.12 x (% improvement) (Up to 6 points) Excluding tenant lighting provision – Up to 3 points

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2.5 Vertical Transportation System The use of energy efficient vertical Vertifical transportation systems can reduce the energy consumption required for ease of travel around the building. a) Lifts, escalators and travelators with AC variable voltage and variable frequency (VVVF) motor drive and sleep mode features. b) Lift with sleep mode, VVVF motor and regenerative drive.	1 point OR 1.5 points
2.6 Ventilation in Car Park Encourage the use of energy efficient design and control of ventilation systems in carparks. a) Mechanically ventilated car park with CO sensor control b) Naturally ventilated car park *Note: Where there is a combination of different ventilation mode adopted for carpark design, the points obtained will be prorated accordingly*	1.5 points 2 points (Up to 2 points)
2.7 Ventilation in Common Areas Encourage the use of energy efficient of ventilation systems in the following common areas: • Toilets • Staircases • Corridors • Lift lobbies • Atrium	Extent of Coverage: At least 90% of each applicable area Point scored based on the mode of ventilation provided in the applicable areas Natural ventilation –1 point for each area Mechanical ventilation – 0.5 point for each area (Up to 3 points)
2.8 Energy Efficiency Practices And Features Encourage the use of energy efficient practices and features which are innovative and/or have positive environmental impact.	1 points for every 1% energy saving over the total building energy consumption (Up to2 points)
2.9 Renewable Energy This indicator focuses on driving the creation of opportunities for generation and utilisation of renewable energy. **a) Solar Energy Feasibility Study** The evaluation of a building footprint's potential in harnessing solar energy can raise awareness on viable solar opportunities within the development and assist building owners in their decision making to adopt photovoltaic.	1 point

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Solar feasibility report should consists the following details:

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

b) Solar Ready Roof

To encourage existing buildings to be ready for photovoltaic installation and facilitate their deployment should building owners decide to do so in the near future.

The building development shall demonstrate solar readiness for at least 50% of feasible roof area determined through the feasibility study. Point can be scored for the following:

- **Structural readiness**: Provisions to accommodate optimised structural installation of solar panels on rooftop spaces — 0.5 point
- **Electrical readiness**: Provisions to accommodate optimised electrical installation of solar panels on rooftop spaces — 0.5 point
- **Spatial readiness**: Provisions to optimise the available non-shaded rooftop area for photovoltaic; and/or adoption of roof spatial optimisation recommendations outlined in the feasibility study. — 0.5 point

c) Adoption of Renewable Energy

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

Point scored based on energy use intensity (EUI) and % replacement of electricity by renewable energy source

Energy Use Intensity (EUI) [kWh/m^2/yr]	% Replacement of Building Electricity Consumption by Renewable Energy
≥ 120	1 point for every 0.5%
80 ≤ EUI < 120	1 point for every 1.0%
50 ≤ EUI < 80	1 point for every 1.5%
< 50	1 point for every 2.5%

(Up to 4 points)

Section 2
ENERGY BUILDING PERFORMANCE SCORE:

$$\frac{\text{(2.2 score) X Air-conditioned Building Floor Area}}{\text{Total Floor Area}} + \frac{\text{(2.3 score) X Non Air-Conditioned Building Floor Area}}{\text{Total Floor Area}} + \text{(2.1, 2.4 to 2.9 scores)}$$

Where
2.2 score = Total Green Mark score obtained under part 2.2
2.3 score = Total Green Mark score obtained under part 2.3
2.1, 2.4 to 2.9 scores = Total Green Mark scores obtained under part 2.1, 2.4 to 2.9

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<table>
<tr><th>Section 3 – RESOURCE STEWARDSHIP</th><th>Green Mark Points (30 Points)</th></tr>
<tr><td><u>3.1 Water Efficient Fittings</u>

a) Encourage the use of water efficient fittings under Water Efficiency Labelling Scheme (WELS) or adopt equivalent water efficient flow-rate/flush volume for water fittings:-
• Basin taps and mixers
• Showers
• Sink/Bib taps and mixers
• Urinals and Urinal Flush Valves
• Dual flushing cistern for WC

Or

b) To have PUB Water-Efficient Building Certificate</td><td><table><tr><th colspan="2">Rating based on Water Efficiency Labelling Scheme (WELS)</th><th rowspan="3">Points scored based on the number and water efficiency rating of the fitting type used

(Up to 7 points)</th></tr><tr><th>Very Good</th><th>Excellent</th></tr><tr><th colspan="2">Weightage</th></tr><tr><td>5</td><td>7</td><td></td></tr></table>
Or

5 points</td></tr>
<tr><td><u>3.2 Landscape Irrigation</u>

a) At least 50% of the landscape areas that are served by water efficient irrigation systems with features such as automatic drip irrigation system with moisture or rain sensor control

b) At least 50% of the landscape areas that comprises drought tolerant plants</td><td>0.5 point

0.5 point</td></tr>
<tr><td><u>3.3 Reduction of Water Consumption of Cooling Towers</u>

a) Use of cooling tower water treatment system which can achieve 7 or better cycles of concentration at acceptable water quality

b) Use of NEWater or on-site recycled water from approved sources

c) Provision of heat recovery system or equivalent device that help to reduce heat rejection required through the cooling towers</td><td>1 point

1 point

0.5 point</td></tr>
<tr><td><u>3.4 Water Monitoring and Leak Detection</u>

a) Provision of private meters for all major water uses in the buildings

b) Provision of smart remote metering system with alert features for leak detections and monitoring purposes</td><td>0.5 point

0.5 point</td></tr>
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3.5 Water Usage Portal and Dashboard

a) Provision of water usage portal, dashboard or other equivalent forms that display metered data, trending of water consumption and relevant parameters which facilitate better management of water consumption during building operation — 0.5 point

b) Provision of water usage portal, dashboard or other equivalent forms for individual tenants to monitor their own water usages and consumption — 0.5 point

3.6 Use of Alternative Water Sources

Use of suitable systems that utilise alternative water sources for non-potable uses: irrigation, washing, water features, toilet flushing, etc (excluding cooling tower make up water) to reduce use of potable water.

Points awarded based on % reduction in total potable water usage of the applicable uses

% reduction	Points
< 10 %	1
≥10 % to 50 %	1.5
> 50 %	2

3.7 Green Materials / Products

a) Green certified building services products

Points will be awarded for building services and M&E products by an approved local certification body.

Examples of products include:
- Chillers
- Auto-tube cleansing system
- Pumps
- transformers

Point per product			
Good	Very Good	Excellent	Leader
0.4	0.6	0.8	1.0

(Up to 2 points)

b) Sustainable Products

Points will be awarded for environmentally friendly products that are certified by approved local certification body. Points scored based on the weightage and the extent of coverage & impact. I point for high impact item and 0.5 point for low impact item, up to maximum 6 points.

Weightage based on the extent of environmental friendliness of products			
Good	Very Good	Excellent	Leader
0.4	0.6	0.8	1.0

(Up to 5 points)

3.8 Recycling Facilities

a) Provision of facilities for the collection and storage of common recyclables such as paper, glass, metal and plastic in commingled or sorted form. — 1 point

b) Provision of facilities for the recycling of specialised waste stream such as E-waste, light bulb/fluorescent tubes, and food waste. — 1 point each (Up to 2 points)

c) Provision of facilities or systems to consolidate horticultural waste for recycling — 0.5 point

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3.9 Storage Area for Recyclable Waste Provision of proper dedicated storage area at a central location for recyclable waste	1 point
3.10 Promotion of Waste Minimization Promote and encourage waste minimization and recycling among occupants, tenants and visitors	1 point per avenue (Up to 2 points)
3.11 Waste Monitoring Quantifying and monitoring the waste collection and recycling programme for continuous improvement a) Tonnage of waste disposed b) Tonnage of recycled waste	 1 point 1 point

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Section 4 – SMART AND HEALTHY BUILDING	Green Mark Points (40 Points)
4.1 Occupant Comfort	
a) Thermal Comfort Ensure the consistent indoor conditions for thermal comfort: Indoor dry-bulb temperature within 23°C to 25 °C and relative humidity <70%	1 point
b) Temperature Control Occupants are able to control the indoor temperature by zones according to their preference. The thermostat set point should not go below 23ºC.	0.5 point
c) Post Occupancy Evaluation (POE) A POE is conducted and corrective actions are taken accordingly to promote occupant satisfaction. The POE sample size should be at least 10% of the occupant population or at least 100 occupants to be surveyed. Please refer to Annex B for POE template.	2 points
d) IAQ Management To implement IAQ management practices according to *Workplace Safety and Health Guidelines – Management of Indoor Air Quality in Air-Conditioned Workplaces*.	2 points
4.2 Outdoor Air Control	
a) Dedicated Outdoor Air System To provide a dedicated outdoor air system, such as precool units, to encourage effective treatment of outdoor air for cooling and dehumidification.	1 point
b) Demand Control Ventilation Use of demand control ventilation strategies such as carbon dioxide sensors or equivalent devices to regulate the quantity of fresh air	0.5 point
4.3 Enhanced Filtration Media	
a) At least Minimum Efficiency Rating Value (MERV) 6 or equivalent filters are used for outdoor air filtration all the time, and at least MERV 14 or equivalent filters are used for outdoor air filtration when outdoor pollution level is in the unhealthy range in accordance with Ministry of Health's guidelines.	0.5 point OR
b) Permanent provision of MERV 14 or equivalent filters to all precool units	1 point
c) Permanent provision of MERV 14 or equivalent filters to all AHUs (90% coverage)	1.5 points (Up to 2.5 points)

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4.4 Indoor Contaminants	
a) Ultraviolet Germicidal Irradiation System or Equivalent Airborne Disinfection Technologies To provide UVGI system or equivalent in AHUs to control airborne infective microorganisms.	30% to 50% 0.5 point >50% 1 point
b) IAQ Display To provide display panels for temperature, relative humidity and CO2 information at each floor/ tenancy, to raise awareness among building occupants on the indoor air conditions	0.5 point for each parameter (Up to 1.5 points)
4.5 Lighting Quality	Extent of coverage: at least 90% of the occupied areas
a) Lighting Level The measured indoor lighting levels comply with the recommended illuminance (average lux level) in SS 531 : 2006 Part 1 or CP 38 : 1999	1 point
b) Task Light Task lighting provided for workstations	1 point
c) Flicker-Free Fittings Provide high frequency ballasts with frequency >20kHz and equivalent performance characteristics from LED drivers	1 point
d) Colour Rendering Index (CRI) lightings meet the minimum colour rendering index (Ra or CRI) in Clause 5 of SS 531 : 2006	1 point
4.6 Acoustics The measured indoor sound levels comply with the recommended ambient sound levels in SS 553 : 2009 or CP 13 : 1999	1 point
4.7 Biophilic features Biophilia is the inherent human inclination to associate with nature to improve our physical and mental wellbeing. Biophilic design features include:	
a) Direct experience of nature (access to plants, light, air, water, aquarium etc)	1 point
b) Indirect experience of nature (images, natural materials, texture, geometry)	1 point

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4.8 Level I - Energy Monitoring	
a) Electrical Sub-metering Provide private sub-meter (linked to BMS) to monitor major energy use system in the building: • Airside HVAC (AHUs and/or FCUs) to be displayed in kW/RT • Lighting for common areas • Lighting for non-common areas • Lift and escalators • Carpark MV system	2 points for Air Distribution System 1 point each per systems (Up to 4 points)
b) Energy Portal and Dashboard • The provision of an energy portal or dashboard in the form of digital display or web-based and mobile applications for internal facilities management team	1 point
• The provision of an energy portal or dashboard in the form of digital displays in common areas	1 point
• Provision of energy portal or dashboard made available to tenants, showing the energy consumption of the building and the individual tenant consumption	1 point
c) BAS and Controller with Open Protocol BACnet, Modbus or any other non-proprietary protocol is used as the network backbone for the building management system (BMS), with the system being able to provide scheduled export of a set of any chosen data points with time stamp to commonly used file formats such as .csv or .xls.	1 point
c) Connection to BCA Smart Chiller Portal To connect the building chiller plant performance data to BCA Smart Chiller Portal. The sampled data shall be grouped and transmitted automatically, at least once a day, to the portal using the REST API interface defined in Annex C.	1 point
4.9 Level II - Demand Control Using occupancy based controls to monitor the usage of spaces and vary indoor conditions can significantly reduce building energy consumption while maintaining good indoor environmental quality.	Extent of coverage: at least 50% of each applicable area
a) Common areas such as • Toilets • Staircase • Corridor • Lift lobby • Atrium	0.5 point for each common area type (Up to 2 points)
b) Occupied / Tenanted areas	1 point for every 25% coverage of occupied area, such as offices, retail shops or hotel guest room (Up to 3 points)

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4.10 Level III - 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. **a) Basic Integration and Analytics** • Basic fault detection and diagnostics (FDD) of energy related equipment sensors, e.g. faulty, stuck or miss-calibrated sensors. • Provision of adaptive control algorithms based on outdoor weather conditions. • Equipment exceptions monitoring, e.g. abnormal set point, detecting equipment that run beyond intended operating hours. • Others basic integration and analytics features **b) Advanced Integration and Analytics** • Whole system optimisation using a network of HVAC equipment. • Prioritise equipment maintenance using machine condition monitoring. • Integrate building subsystems to optimise resource use or improve the user experience. • Demand response control for load shedding to curtail energy use subject to equipment constraints and occupants' comfort. • Use of BIM or similar applications that provide location-based visualisation of the building's state. • Other advanced integration and analytics features	0.5 point each for basic integration and analytics 1 point each for advanced integration and analytics (Up to 5 points)

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Section 5 – ADVANCED GREEN EFFORTS	Green Mark Points (20 Points)
5.1 ETTV <40W/m2	1 point
5.2 Air Distribution System Efficiency Air distribution system efficiency <0.2 kW/RT Baseline = 0.28 kW/RT	0.14 point for every percentage improvement in the air distribution efficiency better than the baseline Point scored = 0.14 x (% improvement) - 4 (Up to 2 points)
5.3 Hot Water System a) Permanent Instrumentation for M&V of Hot Water System b) The use of energy efficient hot water system can reduce the energy consumption. Baseline: COP = xxx	 1 point 2 points
5.4 Renewable Energy a) Replacement of electricity by on-site renewable energy b) Purchase of renewable energy from licenced electricity retailers c) Roof leasing for PV installation	 A max 5 more points beyond the point cap under part 2.9c for further percentage electricity replacement by renewable energy can be scored 1 point 1.5 point
~~5~~.5 PUB (WEB) Gold/Silver Certificate a) Water Efficient Building (WEB) Silver Certificate, or b) Water Efficient Building (WEB) Gold Certificate	 1 point 2 points
5.6 Thermal Comfort Use of innovative solutions to achieve thermal comfort while reducing energy consumption such as high temperature cooling with increased air speed.	 2 points
5.7 Indoor Air Quality Trending and Monitoring To provide monitoring and trend logging for the following parameters, linked to a centralised system a) temperature and relative humidity b) At least one common indoor air pollutant such as formaldehyde, Total Volatile Organic Compounds (TVOC) or particulate matters	 1 point 1 point for each parameter

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5.8 IAQ Surveillance Audit IAQ surveillance audit is conducted based on the reference methods described in SS 554: 2016 by an accredited laboratory under Singapore Accreditation Council.	2 points
5.9 Outdoor Airflow Monitoring System To monitor outdoor airflow volume by permanent devices at	1 point
a) All precool units (e.g. PAHUs)	1 point
b) All AHUs	
5.10 Local Exhaust and Air Purging System	
a) Local isolation and exhaust systems to remove the pollutants at source such as photocopier room with exhaust system	0.5 point
b) Air purging system to replace contaminated indoor air with outdoor fresh air	0.5 point
5.11 M&V for VRF system	
a) Power meters installed for VRF system at least for all Condenser Units	1 point
b) Provision of permanent measuring instruments for monitoring of energy efficiency performance of Variable Refrigerant Flow (VRF) condensing units. 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 point, and data shall be available for extraction for verification purposes.	2 points
5.12 Accredited Green Facility Management Companies Engagement of green facility management (FM) companies accredited by Singapore Green Building Council (SGBC), in operation and maintenance of the building.	1 point
5.13 Complementary Certifications Encourage tenants to take up Green Mark Occupant Centric Schemes	
a) at least 1 tenant certified under Green Mark Occupant-Centric Schemes	0.5 point
b) achieving Green Mark Pearl Award	1 point
c) achieving Green Mark Pearl Prestige Award	2 points

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5.14 Display Plaque To display the Green Mark Display Plaque at a prominent location such as foyer or main lobby.	0.5 points
5.15 Other Advanced Green Efforts Project can demonstrate substantial performance to a specific sustainability indicator or outcome addressed within Green Mark beyond what is specified in the criteria.	2 points each for high impact item 1 point each for medium impact item 0.5 point each for low impact item

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Annex A: Maximum lighting power budget (including ballast loss)

Type of usage	Maximum lighting power budget (W/m2)
Offices	15
Classrooms	15
Hotel guest room	15
Lecture theatres	15
Auditoriums / Concert halls	10
Shops / Supermarkets / Departmental stores (including general, accent & display lighting)	25
Restaurants	15
Lobbies / Atriums / Concourse	10
Stairs	6
Corridors	10
Toilets	15
Car parks	5
Electronic manufacturing and fine detail / Assembly industries	20
Medium and heavy industries	15
Warehouses / Storage areas	10

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Annex B: QUESTIONAIRE FOR INDOOR ENVIRONMENT SURVEY

A. General Information and Environmental Conditions

1. Company: _____ Unit No: #_____

2. What is your gender?

( ) Male ( ) Female

3. What is your age group?

( ) Under 21 Years ( ) 21-30 Years ( ) 31-40 Years ( ) 41-50 Years ( ) 51-60 Years ( ) 61 and above

4. What is your job category?

( ) Managerial ( ) Professional ( ) Admin ( ) Others

(if others, please specify: _____)

5. On average, what is the total number of hours per week you spend at your workplace?

( ) Less Than 10 Hours ( ) 11-15 Hours ( ) 16-20 Hours ( ) 21-25 Hours

( ) 26-30 Hours ( ) Over 30 Hours

6. What is the type of your workspace?

( ) Enclosed room ( ) Open/shared space

7. Do you work near one of the following?

( ) Photocopier/Printer ( ) Server rack/room ( ) Pantry ( ) Entrance

( ) Not applicable ( ) Others (if others, please specify: _____)

8. Which of the following do you often use to attain thermal comfort?

( ) Fans ( ) Extra clothes ( ) Less clothes ( ) Not applicable ( ) Others

(if others, please specify: _____)

9. Do you experience an unpleasant odour?

( ) Regularly ( ) Sometimes ( ) Never

10. Do you have any of the following medical conditions?

- Asthma: ( ) Yes, on medication ( ) Yes, not on medication ( ) No
- Allergy: ( ) Yes, on medication ( ) Yes, not on medication ( ) No
- Sinus: ( ) Yes, on medication ( ) Yes, not on medication ( ) No
- Migraine: ( ) Yes, on medication ( ) Yes, not on medication ( ) No

B. Satisfaction towards Indoor Environment

Please circle your satisfaction levels towards the following parameters

Symptoms	**Level of satisfaction**
1. Thermal comfort	Excellent / Good / Average / Poor / Very poor

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2. Air quality	Excellent / Good / Average / Poor / Very poor
3. Lighting level	Excellent / Good / Average / Poor / Very poor
4. Daylight level	Excellent / Good / Average / Poor / Very poor
5. Window view to outside	Excellent / Good / Average / Poor / Very poor
6. Noise level	Excellent / Good / Average / Poor / Very poor
7. Overall cleanliness	Excellent / Good / Average / Poor / Very poor
8. Overall indoor environment	Excellent / Good / Average / Poor / Very poor

C. Health Symptoms

Please circle your experience on the following health symptoms at work accordingly.

Symptoms	**Frequency**	**Feel better or relief after leaving the building?**
1. Stuffy nose	Daily / 2-3 times weekly / No	Yes / No
2. Dry throat	Daily / 2-3 times weekly / No	Yes / No
3. Cough	Daily / 2-3 times weekly / No	Yes / No
4. Skin rash/itchiness	Daily / 2-3 times weekly / No	Yes / No
5. Eye irritation	Daily / 2-3 times weekly / No	Yes / No
6. Headache	Daily / 2-3 times weekly / No	Yes / No
7. Lethargy	Daily / 2-3 times weekly / No	Yes / No
8. Drowsiness	Daily / 2-3 times weekly / No	Yes / No
9. Dizziness	Daily / 2-3 times weekly / No	Yes / No
10. Nausea/vomiting	Daily / 2-3 times weekly / No	Yes / No
11. Shortness of breath	Daily / 2-3 times weekly / No	Yes / No

D. Comments and/or Suggestions

_____

_____

_____

_____

Thank you for your participation.

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Annex C: REST API to Import Chiller Data (DRAFT)

Title	*REST API to insert chiller plant raw data*
URL	*e.g. http://bca_cesp.portal.com/api/ImportRawData*
Method	*The request type* **POST**
URL Params	*Not Required*
Data Params	*[* *{* *"BuildingId": "buildinga",* *"ObjectId": "CH",* *"ObjectNo": "1",* *"DataFieldId": "KW",* *"Value": "110",* *"Timestamp": "2016-01-16 02:15:01",* *"Key": "secretkey"* *},* *{* *"BuildingId": "uwctamp",* *"ObjectId": "* CHWP*",* *"ObjectNo": "1",* *"DataFieldId": "* CWST*",* *"Value": "11.40",* *"Timestamp": "2016-01-16 02:15:01",* *"Key": "secretkey* *"},* *]*
Success Response	**Example:** **Code:** 200
Error Response	***Code:*** *400, if buildingId not valid* ***Code:*** *402, if building object datafield mapping not valid* ***Code:*** *403, if secrectkey for that building is not correct* ***Code:*** *404, Other problem*
Notes	

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Building Object Naming Dictionary (DRAFT)

Item	Type	Input	Remarks	Constraints
BuildingId	String	BuildingA	Building ID	1 to 50 character
ObjectId	string	CH	Chiller	1 to 50 character
		CHWP	Chiller Water Pump	1 to 50 character
		CWP	Condenser Water Pump	1 to 50 character
		CHWH	Chilled Water Header	
		CWH	Condenser Water Header	
		CT	Cooling Tower	1 to 50 character
ObjectNo	numeric	1..10	Instance number	1 to 10
DataFieldId	String	CHWST	Chilled Water Supply Temperature	1 to 50 character
		CHWRT	Chilled Water Return Temperature	1 to 50 character
		CWST	Condenser Water Supply Temperature	
		CWRT	Condenser Water Return Temperature	
		CWF	Condenser Water Flow	
		CHWF	Chilled Water Flow	1 to 50 character
		KW	Power	1 to 50 character
Value	numeric	1..999999	Value of that point	decimal value
Timestamp	Cal + time	2016-01-16 02:15:01	Datetime format	yyyy-mm-dd hh:mm:ss
Unit	String			
Remarks	String			
Key	String	Secret key	Building secret key provided by Vendor	1 to 10 character

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