

BCA Green Mark for New Non-Residential Buildings
Version NRB/4.1

Framework - BCA Green Mark for New Non-Residential Buildings (Version NRB/4.1)

To achieve Green Mark Award

Pre-requisite Requirement

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

Energy Related Requirements
Minimum 30 points

Other Green Requirements
Minimum 20 points

Elective Requirement for Energy Improvement
(Combination of the following items to meet 30 points)

Part 1 - Energy Efficiency

Air-con
- 1-1 Thermal Performance of Building Envelope - ETTV
- 1-2 Air-Conditioning System

Non Air-con
- 1-3 Building Envelope – Design/Thermal Parameter
- 1-4 Natural Ventilation / Mechanical Ventilation

General
- 1-5 Daylighting
- 1-6 Artificial Lighting
- 1-7 Ventilation in Carparks
- 1-8 Ventilation in Common Areas
- 1-9 Lifts and Escalators
- 1-10 Energy Efficient Practices & Features
- 1-11 Renewable Energy

Elective Requirement from Other Areas
(Combination of the following items to meet 20 points)

Part 2 - Water Efficiency
- 2-1 Water Efficient Fittings
- 2-2 Water Usage and Leak Detection
- 2-3 Irrigation System and Landscaping
- 2-4 Water Consumption of Cooling Towers

Part 3 – Environmental Protection
- 3-1 Sustainable Construction
- 3-2 Sustainable Products
- 3-3 Greenery Provision
- 3-4 Environmental Management Practice
- 3-5 Green Transport
- 3-6 Refrigerants
- 3-7 Stormwater Management

Part 4 - Indoor Environmental Quality
- 4-1 Thermal Comfort
- 4-2 Noise Level
- 4-3 Indoor Air Pollutants
- 4-4 Indoor Air Quality (IAQ) Management
- 4-5 High Frequency Ballasts

Part 5 – Other Green Features
- 5-1 Green Features and Innovations

Point Allocations - BCA Green Mark for New Non-Residential Buildings (Version NRB/4.1)

	Category		Point Allocations
(I)	**Energy Related Requirements**		
Minimum 30 points	**Part 1 : Energy Efficiency**		
	NRB 1-1 Thermal Performance of Building Envelope - ETTV	Section (A) Applicable to air-con areas	12
	NRB 1-2 Air-Conditioning System		30
	Sub-Total (A) – NRB 1-1 to 1-2		42
	NRB 1-3 Building Envelope – Design/Thermal Parameter	Section (B) Applicable to non air-con areas excluding carparks and common areas	35
	NRB 1-4 Natural Ventilation / Mechanical Ventilation		20
	Sub-Total (B) – NRB 1-3 to 1-4		55
	NRB 1-5 Daylighting	Section (C) Generally applicable to all areas	6
	NRB 1-6 Artificial Lighting		12
	NRB 1-7 Ventilation in Carparks		4
	NRB 1-8 Ventilation in Common Areas		5
	NRB 1-9 Lifts and Escalators		2
	NRB 1-10 Energy Efficient Practices & Features		12
	NRB 1-11 Renewable Energy		20
	Sub-Total (C) – NRB 1-5 to 1-11		61
	Category Score for Part 1 – Energy Efficiency **Prorate Subtotal (A) + Prorate Subtotal (B) + Prorate Subtotal (C)**		**116 (Max)**
(II)	**Other Green Requirements**		
Minimum 20 points	**Part 2 : Water Efficiency**		
	NRB 2-1 Water Efficient Fittings		10
	NRB 2-2 Water Usage and Leak Detection		2
	NRB 2-3 Irrigation System and Landscaping		3
	NRB 2-4 Water Consumption of Cooling Towers		2
	Category Score for Part 2 – Water Efficiency		**17**
	Part 3 : Environmental Protection		
	NRB 3-1 Sustainable Construction		10
	NRB 3-2 Sustainable Products		8
	NRB 3-3 Greenery Provision		8
	NRB 3-4 Environmental Management Practice		7
	NRB 3-5 Green Transport		4
	NRB 3-6 Refrigerants		2
	NRB 3-7 Stormwater Management		3
	Category Score for Part 3 – Environmental Protection		**42**
	Part 4 : Indoor Environmental Quality		
	NRB 4-1 Thermal Comfort		1
	NRB 4-2 Noise Level		1
	NRB 4-3 Indoor Air Pollutants		2
	NRB 4-4 Indoor Air Quality (IAQ) Management		2
	NRB 4-5 High Frequency Ballasts		2
	Category Score for Part 4 – Indoor Environmental Quality		**8**
	Part 5 : Other Green Features		
	NRB 5-1 Green Features & Innovations		7
	Category Score for Part 5 – Other Green Features		**7**
		Green Mark Score :	**190 (Max)**

BCA Green Mark Award Rating and Prerequisite Requirements

Green Mark Score	Green Mark Rating
90 and above	Green Mark Platinum
85 to < 90	Green Mark Gold^{Plus}
75 to < 85	Green Mark Gold
50 to <75	Green Mark Certified

Prerequisite Requirements for Non-Residential Building Criteria

Air-Conditioned Buildings

Related Criteria

(1) Building envelope design with Envelope Thermal Transfer Value (ETTV) computed based on the methodology and guidelines stipulated in the Code on Envelope Thermal Performance for Buildings and this Standard.

Green Mark Gold^{Plus} – ETTV of 42 W/m^2 or lower

Green Mark Platinum – ETTV of 40 W/m^2 or lower

NRB 1-1 – Thermal Performance of Building Envelope

(2) To demonstrate the stipulated energy savings over its reference model using the energy modeling framework set out in Appendix E of the Certification Standard. Details and submission requirements on energy modeling can be found in Appendix E.

Green Mark Gold^{Plus} – At least 25% energy savings based on energy efficiency measures and improvements that reduce cooling load requirements

Green Mark Platinum – At least 30% energy savings based on energy efficiency measures and improvements that reduce cooling load requirements

(3) Prescribed Design System Efficiency (DSE) of building cooling systems to be as follows:

NRB 1-2(a) – Air–Conditioning System

(i) For Buildings using Water-Cooled Chilled-Water Plant:

Green Mark Rating	Peak Building Cooling Load (RT)	
	< 500	≥ 500
	Minimum Design System Efficiency[(1)] DSE (kW/RT)	
Certified	0.80	0.70
Gold	0.80	0.70
Gold^{Plus}	0.70	0.65
Platinum	0.70	0.65

Prerequisite Requirements for Non-Residential Building Criteria – *Cont'd*

Related Criteria

(ii) For Buildings using Air Cooled Chilled-Water Plant or Unitary Air-Conditioners:

NRB 1-2(b) – Air–Conditioning System

Green Mark Rating	Peak Building Cooling Load (RT)	
	< 500	≥ 500
	Minimum Design System Efficiency[1] DSE (kW/RT)	
Certified	0.90	0.80
Gold	0.90	Not applicable[2]
Gold^{Plus}	0.85	
Platinum	0.78	

Important notes :

(1) The efficiency of the overall air-conditioning system shall meet its design system efficiency as well as the corresponding minimum DSE stipulated for the respective air-conditioning system and Green Mark rating during the building operating hours specified below:

Office Buildings: Monday to Friday : 9 a.m. to 6 p.m. **Retail Malls :** Monday to Sunday :10 a.m. to 9 p.m.	**Hotels:** Monday to Sunday : 24 Hours **Other Building Types:** To be determined based on operating hours

(2) For building with peak building cooling load of more than 500 RT, the use of air cooled chilled-water plant or unitary air-conditioners are not applicable for Gold and higher ratings. In general, the system efficiency of the air cooled central chilled-water plant and other unitary air-conditioners are to be comparable with the stipulated efficiency for water-cooled central chilled-water plant. Buildings that are designed with air cooled systems and for higher Green Mark rating will be assessed on a case by case basis.

(4) Instrumentation for monitoring the water cooled chilled-water plant efficiency is to be provided in accordance with the requirement set in the criteria.

NRB 1-2(d) – Air–Conditioning System

(5) Minimum score under NRB 3-1 Sustainable Construction
Green Mark Gold^{Plus} ≥ 3 points
Green Mark Platinum ≥ 5 points

NRB 3-1 – Sustainable Construction

(6) Minimum score under NRB 3-2 Sustainable Products
Green Mark Gold^{Plus} ≥ 3 points
Green Mark Platinum ≥ 4 points

NRB 3-2 – Sustainable Products

Prerequisite Requirements for Non-Residential Building Criteria – *Cont'd*

Non Air-Conditioned Buildings

Related Criteria

(7) To be eligible for Green Mark Platinum rating, it is a requirement to use ventilation simulation modeling and analysis to identify the most effective building design and layout. The simulation results and the recommendations derived are to be implemented to ensure good natural ventilation with minimum weighted average wind velocity of 0.6 m/s within the units. Details and submission requirements on ventilation simulation can be found in Appendix C of the Certification Standard.

NRB 1-4(a)(ii) – Natural Ventilation

(8) Minimum score under NRB 3-1 Sustainable Construction

Green Mark Gold^{Plus} ≥ 3 points

Green Mark Platinum ≥ 5 points

NRB 3-1 – Sustainable Construction

(9) Minimum score under NRB 3-2 Sustainable Products

Green Mark Gold^{Plus} ≥ 3 points

Green Mark Platinum ≥ 4 points

NRB 3-2 – Sustainable Products

Building Developments with more than 30% Non Air-Conditioned Spaces

(10) Prerequisite requirement for building developments with a combination of ventilation mode and with aggregate non-air-conditioned spaces of more than 30% of the total constructed floor areas (excluding carparks and common areas) are as follows :

Aggregate Non Air-Conditioned Spaces (m^2)	**Aggregate Air-Conditioned Spaces (m^2)**	**Ventilation Simulation Requirement** See Note 1	**Energy Modeling Requirement** See Note 2	**Justification on Energy Savings** See Note 3
≥ 2000	≥ 5000	Yes	Yes	No
< 2000	≥ 5000	No	Yes	No
≥ 2000	< 5000	Yes	No	Yes
< 2000	< 5000	No	No	Yes

Important Notes :

(1) Ventilation requirement stated paragraph (7) is a pre-requisite requirement to attain Green Platinum rating.

(2) The stipulated energy savings and Design System Efficiency (DSE) of cooling system stated in paragraph (2) and (3) are pre-requisites to attain Green Mark Gold^{Plus} and Platinum rating.

(3) Detailed calculations to be provided to justify the savings in energy consumption from the use of salient energy efficient features /equipment. Energy savings will be based on the energy efficiency measures and improvements over the reference model established for similar building types. The reference ACMV system will be of the same type as the proposed system. The baseline used for the equipment will be in accordance with the minimum efficiency requirement stipulated in SS 530. For VRF system, the baseline COP of 3.37 shall be adopted. The stipulated energy savings stated in paragraph (2) are pre-requisites to attain Green Mark Gold^{Plus} and Platinum rating.

(4) Other pre-requisite stated paragraph (1), (4), (5), (6), (8) and (9) are applicable where relevant.

<table>
<tr><th>Part 1 – Energy Efficiency</th><th>Green Mark Points</th></tr>
<tr><td colspan="2">(A) Applicable to Air-Conditioned Building Areas (with an aggregate air-conditioned areas > 500 m^2)</td></tr>
<tr><td><u>NRB 1-1 Thermal Performance of Building Envelope – Envelope Thermal Transfer Value (ETTV)</u>

Enhance the overall thermal performance of building envelope to minimise heat gain thus reducing the overall cooling load requirement.

<u>Baseline</u> : Maximum Permissible ETTV = 50 W/m^2

<u>Prerequisite Requirement :</u>
Green Mark Gold^{Plus} – ETTV of 42 W/m^2 or less
Green Mark Platinum – ETTV of 40 W/m^2 or less</td><td>1.2 points for every reduction of 1 W/m^2 in ETTV from the baseline

Points scored = 1.2 x (50 - ETTV)
where ETTV ≤ 50 W/m^2

(Up to 12 points)</td></tr>
<tr><td><u>NRB 1-2 Air-Conditioning System</u>

Encourage the use of better energy efficient air-conditioned equipment to minimise energy consumption.

(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">Peak Building Cooling Load</th></tr><tr><th>≥ 500 RT</th><th>< 500 RT</th></tr><tr><td><u>Prerequisite Requirements</u>
Minimum Design System Efficiency (DSE) for central chilled-water plant</td><td>0.70 kW/RT</td><td>0.80 kW/RT</td></tr></table>
<u>Prerequisite Requirements for Higher Green Mark Rating :</u>
Green Mark Gold^{Plus} & Platinum : Minimum Design System Efficiency (DSE) of 0.65 kW/RT for peak building cooling load ≥ 500 RT and 0.7 kW/RT for peak building cooling load < 500 RT

(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
• Single-Spilt Unit
• Multi-Spilt Unit</td><td><u>(a) Water-Cooled Chilled-Water Plant</u>

Peak building cooling load ≥ 500 RT

15 points for meeting the prescribed chilled-water plant efficiency of 0.70 kW/RT

0.25 point for every percentage improvement in the chilled-water plant efficiency over the baseline

Points scored = 0.25 x (% improvement)

Peak building cooling load < 500 RT

12 points for meeting the prescribed chilled-water plant efficiency of 0.80 kW/RT

0.45 point for every percentage improvement in the chilled-water plant efficiency over the baseline

Points scored = 0.45 x (% improvement)

(Up to 20 points)

<u>(b) Air Cooled Chilled-Water Plant/ Unitary Air-Conditioners</u>

Peak building cooling load ≥ 500 RT

12 points for meeting the prescribed air-conditioning system efficiency of 0.80 kW/RT

1.3 points for every percentage improvement in the air-conditioning system efficiency over the baseline

Points scored = 1.3 x (% improvement)</td></tr>
</table>

Part 1 – Energy Efficiency	Green Mark Points
(A) Applicable to Air-Conditioned Building Areas (with an aggregate air-conditioned areas > 500 m^2)	

(b) Air Cooled Chilled-Water Plant / Unitary Air-Conditioners – *Cont'd*

Baseline	Peak Building Cooling Load	
	≥ 500 RT	< 500 RT
Prerequisite Requirements Minimum Design System Efficiency (DSE) for air cooled chilled-water plant or unitary conditioners	0.80 kW/RT	0.90 kW/RT

Prerequisite Requirements for Higher Green Mark Rating :
Green Mark Gold^{Plus} : Minimum Design System Efficiency (DSE) of 0.85kW/RT for peak building cooling load < 500 RT
Green Mark Platinum: Minimum DSE of 0.78kW/RT for peak building cooling load < 500 RT

Note (1) : Where there is a combination of central chilled water plant with unitary conditioners, the points scored will only be based on the air-conditioning system with a larger aggregate capacity.

Peak building cooling load < 500 RT

10 points for meeting the prescribed air-conditioning system efficiency of 0.90 kW/RT

0.6 point for every percentage improvement in the air-conditioning system efficiency over the baseline

Points scored = 0.6 x (% improvement)

(Up to 20 points)

(c) Air Distribution System :

- Air Handling Units (AHUs)
- Fan Coil Units (FCUs)

Option 1 – Fan System Motor Nameplate Power

Baseline : SS553:2009 Table 2 – Fan power limitation and as prescribed below :

Baseline Air Distribution System Type	Allowable Motor Nameplate Power	
	($kW/m^3/s$)	(W/CMH)
AHUs/FCUs ≥ 4kW (Constant Volume)	1.7	0.47
AHUs ≥ 4kW (Variable Volume)	2.4	0.67
Fan systems with nameplate motor power < 4 kW	No baseline	

Option 2 – Fan System Input Power

Baseline : ASHRAE 90.1:2010 Clause 6.5.3.1 and as prescribed below :

Baseline Air Distribution System Type	Allowable Fan System Input Power*	
	($kW/m^3/s$)	(W/CMH)
AHUs/FCUs ≥ 4kW (Constant Volume)	1.5	0.42
AHUs ≥ 4kW (Variable Volume)	2.1	0.58
Fan systems with nameplate motor power < 4 kW	0.6	0.17

* Applicable pressure drop adjustments can be considered based on ASHRAE 90.1 Table 6.5.3.1.1B and are subject to BCA's evaluation

Note (2) : For buildings with cooling provision from a licensed District Cooling System (DCS) supplier where the plant efficiency data is not available, the point scored for NRB 1-2(a) and (b) will be pro-rated based on the air distribution system efficiency under NRB 1-2(c).

(c) Air Distribution System

0.2 point for every percentage improvement in the air distribution system efficiency over the baseline

Points scored = 0.2 x (% improvement)

(Up to 6 points)

Part 1 – Energy Efficiency	Green Mark Points
(A) Applicable to Air-Conditioned Building Areas (with an aggregate air-conditioned areas > 500 m^2)	
(d) *Prerequisite Requirements :* Provision of permanent measuring instruments for monitoring of water-cooled chilled-water plant efficiency. The installed instrumentation shall have the capability to calculate a resultant plant efficiency (i.e. kW/RT) within 5 % of its true value and in accordance with ASHRAE Guide 22 and AHRI Standard 550/590. The following instrumentation and installation are also required to be complied with : (i) Location and installation of the measuring devices to meet the manufacturer's recommendation. (ii) Data acquisition system with a minimum resolution of 16 bit. (iii) All data logging with capability to trend at 1 minute sampling time interval. (iv) Flow meters are to be provided for chilled-water and condenser water loop and shall be of ultrasonic / full bore magnetic type or equivalent. (v) 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 or calibration range. All thermo-wells shall be installed in a manner that ensures that the sensors can be in direct contact with fluid flow. Provisions shall be made for each temperature measurement location to have two spare thermo-wells located at both side of the temperature sensor for verification of measurement accuracy. (vi) Dedicated power meters are to be provided for each of the following groups of equipment : chillers, chilled water pumps, condenser water pumps and cooling towers.	Applicable only to buildings with provision of water cooled chilled-water plant 1 point
(e) Verification of central water cooled chilled-water plant instrumentation : Heat balance – substantiating test for water cooled chilled-water plant to be computed in accordance with AHRI 550/590	1 point
(f) Provision of variable speed controls for chiller plant equipment such as chilled-water pumps and cooling tower fans to ensure better part-load plant efficiency.	1 point
(g) Sensors or similar automatic control devices are used to regulate outdoor air flow rate to maintain the concentration of carbon dioxide in accordance with Table 1 – Recommended IAQ Parameters of SS 554. Carbon dioxide acceptable range: ≤ 700 ppm above outdoor.	1 point
Exception: For buildings that are underground, NRB 1-1 may be excluded in the computation. The score under NRB 1-2 will be pro-rated accordingly.	
Sub-Total (A) :	Sum of Green Mark Points obtained from NRB 1-1 to 1-2

Part 1 – Energy Efficiency	Green Mark Points
(B) Applicable to Non Air-Conditioned Building Areas (with an aggregate non air-conditioned areas > 10 % of total floor area excluding carparks and common areas)	
<u>NRB 1-3 Building Envelope – Design / Thermal Parameters</u> Enhance the overall thermal performance of building envelope to minimise heat gain that would improve indoor thermal comfort and encourage natural ventilation or mechanical ventilation.	
(a) Minimum direct west facing façade through building design orientation. Note (3) : Orientation of façade that falls within the range of 22.5° N of W and 22.5° S of W will be defined as west facing facade. Core walls for lifts or staircases and toilets that are located within this range are exempted in computation.	Points scored = 15 – 0.3 x (% of west facing facade areas over total façade areas) (Up to 15 points) Where there is no west facing façade, the total points scored for this item will be <u>30 points</u>; the NRB 1-3 b(i), b(ii) and (c) as listed below will not be applicable.
(b)(i) Minimum west facing window openings.	Points scored = 10 - 0.1 x (% of west facing window areas over total west facing façade areas)
(b)(ii) Effective sunshading provision for windows on the west façade with minimum shading of 30%.	Points scored = 0.1 x (% of west facing window areas with sunshading devices over total west facing façade areas) (Up to 10 points for NRB 1-3 b(i) & b(ii))
(c) Better thermal transmittance (U-value) of external west facing walls. The U-value of external west facing walls should be equal or less than 2 W/m^{2}K.	Points scored = 0.05 x (% of the external west facing walls areas with U value of 2 W/m^{2}K or less over total west facing facades areas) (up to 5 points)
(d) Better thermal transmittance (U-value) of roof. <u>Baseline</u>: U-value for roof stated below depending on the weight range of roof structure: Weight Group / Weight range (kg/m^2) / Maximum Thermal Transmittance (W/m^{2}K) Light / Under 50 / 0.8 Medium / 50 to 230 / 1.1 Heavy / Over 230 / 1.5	1 point for every 0.1 W/m^{2}K reduction from the baseline roof U-value (Up to 5 points)
Exception : For existing buildings, NRB 1-3(a) may be excluded in computation, the total score obtained under NRB 1-3 (b), (c) and (d) will be prorated accordingly.	

Part 1 – Energy Efficiency	Green Mark Points
(B) Applicable to Non Air-Conditioned Building Areas (with an aggregate non air-conditioned areas > 10 % of total floor area excluding carparks and common areas)	
NRB 1-4 Natural Ventilation / Mechanical Ventilation (a) Natural Ventilation Encourage building design that facilitates good natural ventilation. (i) Proper design of building layout that utilises prevailing wind conditions to achieve adequate cross ventilation. (ii) Use of ventilation simulation modeling and analysis or wind tunnel testing to identify the most effective building design and layout to ensure good natural ventilation. *Prerequisite Requirement :* *Green Mark Platinum : Ventilation simulation modeling and analysis are to be carried out to ensure good natural ventilation with minimum weighted average wind velocity of 0.6 m/s within the functional spaces or units.* (b) Mechanical Ventilation Encourage energy efficient mechanical ventilation system design as the preferred ventilation mode to minimise air-conditioned spaces. Option 1 – Fan System Motor Nameplate Power Baseline : SS553:2009 Table 8 – Fan power limitation and as prescribed below :	1 point for every 10% of units/rooms with window openings facing north and south directions Points scored = 1 x (% of units/10) (Up to 10 points) 5 points Additional 5 points if the recommendations are implemented and meet the air-flow requirement (Up to 10 points) 0.6 point for every percentage improvement in the mechanical ventilation system efficiency over the baseline Points scored = 0.6 x (% improvement) (Up to 15 points)

Baseline Air Distribution System Type	Allowable Motor Nameplate Power	
	($kW/m^3/s$)	(W/CMH)
AHUs/FCUs ≥ 4kW (Constant Volume)	1.7	0.47
Fan systems with nameplate motor power < 4 kW	No baseline	

Option 2 – Fan System Input Power

Baseline : ASHRAE 90.1 : 2010 Clause 6.5.3.1 and as prescribed below :

Baseline Air Distribution System Type	Allowable Fan System Input Power *	
	($kW/m^3/s$)	(W/CMH)
AHUs/FCUs ≥ 4kW (Constant Volume)	1.5	0.42
Fan systems with nameplate motor power < 4 kW	0.6	0.17

* Applicable pressure drop adjustments can be considered based on ASHRAE 90.1 Table 6.5.3.1.1B and are subject to BCA's evaluation

Note (4) : Where there is a combination of naturally ventilated and mechanical ventilated spaces, points scored will be based on the predominant ventilation modes of normally occupied spaces.

Sub-Total (B) :	Sum of Green Mark Points obtained from NRB 1-3 to 1-4

<table>
<tr><th>Part 1 - Energy Efficiency</th><th>Green Mark Points</th></tr>
<tr><td colspan="2">(C) General</td></tr>
<tr><td><u>NRB 1-5 Daylighting</u>

Encourage design that optimises the use of effective daylighting to reduce energy use for artificial lighting.

(a) Use of daylighting and glare simulation analysis to verify the adequacy of ambient lighting levels in meeting the illuminance level and Unified Glare Rating (UGR) stated in SS 531:Part 1:2006 – Code of Practice for Lighting of Work Places.

(b) Daylighting for the following common areas:
(i) Toilets
(ii) Staircases
(iii) Corridors
(iv) Lift Lobbies
(v) Atriums
(vi) Carparks

Note (5) : All daylit areas must be integrated with automatic electric lighting control system.</td><td>Extent of coverage: At least 75% of the units with daylighting provisions meet the minimum illuminance level and are within the acceptable glare exposure.

Points scored based on the extent of perimeter daylight zones

<table><tr><th>Distance from the Façade Perimeters (m)</th><th>Points Allocation</th></tr><tr><td>≥ 3.0</td><td>1</td></tr><tr><td>4.0 – 5.0</td><td>2</td></tr><tr><td>> 5.0</td><td>3</td></tr></table>
(Up to 3 points)

Extent of Coverage : At least 80 % of each applicable area

0.5 point each

(Up to 3 points)</td></tr>
<tr><td><u>NRB 1-6 Artificial Lighting</u>

Encourage the use of energy efficient lighting to minimise energy consumption from lighting usage while maintaining proper lighting level.

<u>Baseline</u> : Maximum lighting power budget stated in SS 530</td><td>0.3 point for every percentage improvement in lighting power budget

Points scored = 0.3 x (% improvement)
(Including tenant lighting provision)
(Up to 12 points)

(Excluding tenant lighting provision)

(Up to 5 points)</td></tr>
<tr><td><u>NRB 1-7 Ventilation in Carparks</u>

Encourage the use of energy efficient design and control of ventilation systems in carparks.

(a) Carparks are designed with natural ventilation.

(b) CO sensors are used to regulate the demand for mechanical ventilation (MV).

Note (6) : Where there is a combination of different ventilation mode adopted for carpark design, the points obtained under NRB 1-7 will be prorated accordingly.</td><td>Naturally ventilated carparks – 4 points

Points scored based on the mode of mechanical ventilation provided

Fume extract – 2.5 points

MV with or without supply - 2 points

(Up to 4 points)</td></tr>
</table>

Part 1 - Energy Efficiency	Green Mark Points
(C) General	
NRB 1-8 Ventilation in Common Areas Encourage the use of energy efficient design and control of ventilation systems in the following common areas : (a) Toilets (b) Staircases (c) Corridors (d) Lift lobbies (e) Atrium	Extent of Coverage : At least 90 % of each applicable area Points scored based on the mode of ventilation provided in applicable areas Natural ventilation – 1.5 points for each area Mechanical ventilation – 0.5 point for each area (Up to 5 points)
NRB 1-9 Lifts and Escalators Encourage the use of energy efficient lifts and escalators. Lifts and/or escalators with AC variable voltage and variable frequency (VVVF) motor drive and sleep mode features.	Extent of Coverage : All lifts and escalators Lifts – 1 point Escalators – 1 point
NRB 1-10 Energy Efficient Practices & Features Encourage the use of energy efficient practices and features that are innovative and/or have positive environmental impact. (a) Computation of energy consumption based on design load in the form of energy efficiency index (EEI). (b) Use of vertical greenery system on east and west façade to reduce heat gain through building envelope (c) Use of energy efficient equipment or product that are certified by approved local certification body (d) Use of energy efficient features. Examples: ▪ Heat recovery system ▪ Sun pipes ▪ Regenerative lifts ▪ Light shelves ▪ Photocell sensors to maximise the use of daylighting	1 point 1 point for high impact 0.5 point for low impact Extent of Coverage : 90% of the applicable equipment type or product 0.5 point for each eligible certified equipment or products (Up to 2 points) 3 points for every 1% energy saving over total building energy consumption (Up to 8 points)

<table>
<tr><th>Part 1 – Energy Efficiency</th><th>Green Mark Points</th></tr>
<tr><td colspan="2">(C) General</td></tr>
<tr><td><u>NRB 1-11 Renewable Energy</u>
Encourage the application of renewable energy sources in buildings.</td><td>Point scored based on the expected energy efficiency index (EEI) and % replacement of electricity by renewable energy source

<table>
<tr><th rowspan="2">Expected Energy Efficiency Index (EEI)</th><td colspan="2">Every 1% replacement of electricity (based on total building electricity consumption) by renewable energy source</td></tr>
<tr><th>Include tenant's usage</th><th>Exclude tenant's usage</th></tr>
<tr><td>≥ 30 kWh/m^2/yr</td><td>5 points</td><td>3 points</td></tr>
<tr><td>< 30 kWh/m^2/yr</td><td>3 points</td><td>1.5 points</td></tr>
</table>

(Up to 20 Points)</td></tr>
<tr><td>Sub-Total (C) :</td><td>Sum of Green Mark Points obtained
from NRB 1-5 to 1-11</td></tr>
<tr><td>PART 1 – ENERGY EFFICIENCY CATEGORY SCORE :</td><td>Sub-Total (A) X <u>Air-Conditioned Building Floor Area</u>
Total Floor Area
+
Sub-Total (B) X <u>Non Air-Conditioned Building Floor Area</u>
Total Floor Area
+
Sub-Total (C)

where Sub-Total (A) = Sum of Green Mark Points obtained under Section (A) NRB 1-1 to 1-2
Sub-Total (B) = Sum of Green Mark Points obtained under Section (B) NRB 1-3 to 1-4
Sub-Total (C) = Sum of Green Mark Points obtained under Section (C) NRB 1-5 to 1-11</td></tr>
</table>

<table>
<tr><th>Part 2 – Water Efficiency</th><th colspan="3">Green Mark Points</th></tr>
<tr><td rowspan="4"><u>NRB 2-1 Water Efficient Fittings</u>
Encourage the use of water efficient fittings covered under the Water Efficiency Labelling Scheme (WELS).

(a) Basin taps and mixers
(b) Flushing cistern
(c) Shower taps, mixers or showerheads
(d) Sink/Bib taps and mixers
(e) Urinals and urinal flush valve</td><td colspan="2">Rating based on Water Efficiency Labelling Scheme (WELS)</td><td rowspan="4">Points scored based on the number and water efficiency rating of the fitting type used

(Up to 10 points)</td></tr>
<tr><td>Very Good</td><td>Excellent</td></tr>
<tr><td colspan="2">Weightage</td></tr>
<tr><td>8</td><td>10</td></tr>
<tr><td><u>NRB 2-2 Water Usage and Leak Detection</u>
Promote the use of sub-metering and leak detection system for better control and monitoring.

(a) Provision of private meters to monitor the major water usage such as irrigation, cooling tower and tenants' usage.

(b) Linking all private meters to the Building Management System (BMS) for leak detection.</td><td colspan="3">1 point

1 point</td></tr>
<tr><td><u>NRB 2-3 Irrigation System and Landscaping</u>
Provision of suitable systems that utilise rainwater or recycled water and use of plants that require minimal irrigation to reduce potable water consumption.

(a) Use of non potable water including rainwater for landscape irrigation.

(b) Use of automatic water efficient irrigation system with rain sensor.

(c) Use of drought tolerant plants that require minimal irrigation.</td><td colspan="3">1 point

Extent of Coverage : At least 50% of the landscape areas are served by the system
1 point

Extent of Coverage : At least 80% of the landscape areas
1 point</td></tr>
<tr><td><u>NRB 2-4 Water Consumption of Cooling Tower</u>
Reduce potable water use for cooling purpose.

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

(b) Use of NEWater or on-site recycled water from approved sources.</td><td colspan="3">1 point

1 point</td></tr>
<tr><td>PART 2 – WATER EFFICIENCY CATEGORY SCORE :</td><td colspan="3">Sum of Green Mark Points obtained from NRB 2-1 to 2-4</td></tr>
</table>

Part 3 – Environmental Protection	Green Mark Points
NRB 3-1 Sustainable Construction Encourage recycling and the adoption of building designs, construction practices and materials that are environmentally friendly and sustainable (a) Use of Sustainable and Recycled Materials (i) Green Cements with approved industrial by-product (such as Ground Granulated Blastfurnace Slag (GGBS), silica fume, fly ash) to replace Ordinary Portland Cement (OPC) by at least 10% by mass for superstructural works.	1 point
(ii) Recycled Concrete Aggregates (RCA) and Washed Copper Slag (WCS) from approved sources to replace coarse and fine aggregates for concrete production of main building elements. Note (7) : For structural building elements, the use of RCA and WCS shall be limited to maximum 10% replacement by mass of coarse/fine aggregates respectively or as approved by the relevant authorities.	1 point for every incremental of 0.5 times (0.5x) of the usage requirement (Up to 2x) **Quantity of RCA /WCS (tons)** / **Points Allocation** ≥ 0.5 x usage requirement : 1 ≥ 1.0 x usage requirement : 2 ≥ 1.5 x usage requirement : 3 ≥ 2.0 x usage requirement : 4 where usage requirement = 0.03 x (GFA in m^2) (Up to 5 points for NRB 3-1(a)(i) and (a)(ii))
(b) Concrete Usage Index (CUI) Encourage designs with efficient use of concrete for building components. *Prerequisite Requirement:* *Minimum points to be scored under this criterion:* *Green Mark Gold^{Plus} ≥ 3 points* *Green Mark Platinum ≥ 5 points*	**Project CUI (m^3/m^2)** / **Points Allocation** ≤ 0.70 : 1 ≤ 0.60 : 2 ≤ 0.50 : 3 ≤ 0.40 : 4 ≤ 0.35 : 5
NRB 3-2 Sustainable Products Promote use of environmentally friendly products that are certified by approved local certification body and are applicable to non-structural and architectural related building components. *Prerequisite Requirement:* *Minimum score under this criterion:* *Green Mark Gold^{Plus} ≥ 3 points* *Green Mark Platinum ≥ 4 points*	**Weightage based on the extent of environmental friendliness of products** **Good** / **Very Good** / **Excellent** 0.5 / 1.5 / 2 Points scored based on the weightage and the extent of coverage & impact 1 point for high impact item 0.5 point for low impact item (Up to 8 points)

Part 3 – Environmental Protection	Green Mark Points
NRB 3-3 Greenery Provision Encourage greater use of greenery, restoration of trees to reduce heat island effect. (a) Green Plot Ratio (GnPR) is calculated by considering the 3D volume covered by plants using the prescribed Leaf Area Index (LAI).	<table><tr><th>GnPR</th><th>Points Allocation</th></tr><tr><td>0.5 to < 1.0</td><td>1</td></tr><tr><td>1.0 to < 1.5</td><td>2</td></tr><tr><td>1.5 to < 3.0</td><td>3</td></tr><tr><td>3.0 to < 3.5</td><td>4</td></tr><tr><td>3.5 to < 4.0</td><td>5</td></tr><tr><td>≥ 4.0</td><td>6</td></tr></table>
(b) Restoration, conservation or relocation of existing trees on site.	1 point
(c) Use of compost recycled from horticulture waste.	1 point
NRB 3-4 Environmental Management Practice Encourage the adoption of environmental friendly practices during construction and building operation.	
(a) Implement effective environmental friendly programmes including monitoring and setting targets to minimise energy use, water use and construction waste.	1 point
(b) Main builder that has good track records in the adoption of sustainable, environmentally friendly and considerate practices during construction such as the Green and Gracious Builder Award.	1 point
(c) Building quality assessed under the Construction Quality Assessment System (CONQUAS).	1 point
(d) Developer, main builder, M & E consultant and architect that are ISO 14000 certified.	0.25 point for each firm (Up to 1 point)
(e) Project team comprises Certified Green Mark Manager (GMM), Green Mark Facilities Manager (GMFM) and Green Mark Professional (GMP).	0.5 point for certified GMM 0.5 point for certified GMFM 1 point for certified GMP (Up to 1 point)
(f) Provision of building users' guide that should include details of the environmental friendly facilities and features within the building and their functionalities in achieving the intended environmental performance during building operation.	1 point
(g) Provision of facilities or recycling bins for collection and storage of different recyclable waste such as paper, glass, plastic food waste etc.	1 point

Part 3 – Environmental Protection	Green Mark Points
NRB 3-5 Green Transport Promote environmental friendly transport options and facilities to reduce pollution from individual car use.	
(a) Good access to nearest MRT/LRT or bus stops.	1 point
(b) Provision of covered walkway to facilitate connectivity and the use of public transport.	1 point
(c) Provision of electric vehicle charging stations and priority parking lots within the development.	Extent of Coverage : Minimum one(1) electric vehicle charging station and priority parking lot for every 100 carpark lots *(Cap at 5)* 1 point
(d) Provision of sheltered bicycle parking lots with adequate shower and changing facilities.	Extent of Coverage : Minimum ten (10) bicycle parking lots *(Cap at 50)* Points scored based on the number of bicycle parking lots provided *(with adequate shower and changing facilities)* 1 point if the number provided ≥ 3% x Gross Floor Area (GFA)/10 0.5 point if the number provided ≥ 1.5% x Gross Floor Area (GFA)/10
NRB 3-6 Refrigerants Reduce the potential damage to the ozone layer and the increase in global warming caused by the release of ozone depleting substances and greenhouse gases.	
(a) Refrigerants with ozone depletion potential (ODP) of zero or with global warming potential (GWP) of less than 100.	1 point
(b) Use of refrigerant leak detection system in critical areas of plant rooms containing chillers and other equipments with refrigerants.	1 point
NRB 3-7 Stormwater Management Encourage treatment of stormwater run-off before discharge to the public drains. Provision of infiltration or design features as recommended in PUB's ABC Waters Design Guidelines : ▪ Bioretention swales/ other bioretention ▪ systems ▪ Rain gardens ▪ Constructed wetlands ▪ Cleansing biotopes ▪ Retention ponds	Points scored based on the extent of stormwater treatment. 3 points for treatment of run-off from more than 35% of total site area or paved area 2 points for treatment of run-off from 10% to 35% of total site area 1 point for treatment of run-off from up to 10% of total site area
PART 3 – ENVIRONMENTAL PROTECTION CATEGORY SCORE :	Sum of Green Mark Points obtained from NRB 3-1 to 3-7

Part 4 – Indoor Environmental Quality	Green Mark Points
NRB 4-1 Thermal Comfort Air-conditioning system is designed to allow for cooling load variation due to fluctuations in ambient air temperature and to maintain consistent indoor conditions for thermal comfort. Indoor operative temperature between 24 °C to 26 °C Relative humidity < 65%	1 point
NRB 4-2 Noise Level Occupied spaces in buildings are designed with good ambient sound levels as recommended in SS 553 Table 4 – Recommended ambient sound level.	1 point
NRB 4-3 Indoor Air Pollutants Minimise airborne contaminants, mainly from inside sources to promote a healthy indoor environment. (a) Use of low volatile organic compounds (VOC) paints certified by approved local certification body. (b) Use of environmental friendly adhesives certified by approved local certification body.	Extent of Coverage : At least 90% of the total internal wall areas 1 point Extent of Coverage : At least 90% of the applicable areas 1 point
NRB 4-4 Indoor Air Quality (IAQ) Management Ensure that building ventilation systems are designed and installed to provide acceptable IAQ under normal operating conditions. (a) Provision of filtration media and differential pressure monitoring equipment in Air Handling Units (AHUs) in accordance with SS 554: Clause 4.3.4.5 and its Annex E. (b) Implement effective IAQ management plan to ensure that building ventilation systems are clean and free from residuals left over from construction activities. Internal surface condition tests for ACMV systems are to be included.	1 point 1 point
NRB 4-5 High Frequency Ballasts *Applicable to offices, classrooms and the like* Improve workplace lighting quality by avoiding low frequency flicker associated with fluorescent lighting with the use of high frequency ballasts in the fluorescent luminaries.	Extent of Coverage : At least 90% of all applicable areas that are served by fluorescent luminaries 2 points
PART 4 – INDOOR ENVIRONMENTAL QUALITY CATEGORY SCORE :	Sum of Green Mark Points obtained from NRB 4-1 to 4-5

Part 5 – Other Green Features	Green Mark Points
NRB 5-1 Green Features and Innovations Encourage the use of other green features that are innovative and/or have positive environmental impact. Examples : ▪ Pneumatic waste collection system ▪ Carbon footprint of development ▪ Calculation of Concrete Usage Index (CUI) ▪ Dual chute system ▪ Self cleaning façade system ▪ Conservation of existing building structure	2 points for high impact item 1 point for medium impact item 0.5 point for low impact item (Up to 7 points)
PART 5 – OTHER GREEN FEATURES CATEGORY SCORE :	Sum of Green Mark Points obtained from NRB 5-1

Green Mark Score (Non-Residential)

Green Mark Score (Non-Res) = ∑Category Score [(Part 1 – Energy Efficiency) +
(Part 2 – Water Efficiency) +
(Part 3 – Environmental Protection) +
(Part 4 – Indoor Environmental Quality) +
(Part 5 – Other Green Features)]

where Category Score for Part 1 ≥ 30 points and
∑Category Score for Part 2, 3, 4 & 5 ≥ 20 points