BCA Green Mark for Healthcare Facilities

Version HC/1.0

Framework - BCA Green Mark for Healthcare Facilities (Version HC/1.0)

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

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 Parameters
- 1-4 Natural Ventilation

General
- 1-5 Electrical Services
- 1-6 Artificial Lighting
- 1-7 Ventilation in Carparks
- 1-8 Lifts and Escalators
- 1-9 Airside Energy Recovery
- 1-10 Local Energy Generation for Centralised Service Hot Water Heating
- 1-11 Renewable Energy
- 1-12 Energy Efficient Practices & Features

Other Green Requirements
Minimum 20 points

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 Airborne Contaminant Prevention
- 3-4 Greenery Provision and Healing Environment
- 3-5 Green and Universal Connectivity
- 3-6 Refrigerants

Part 4 - Indoor Environmental Quality

- 4-1 Thermal Comfort and Control for A/C Spaces
- 4-2 Thermal Comfort for N/V Spaces
- 4-3 Noise Level
- 4-4 Indoor Air Pollutants
- 4-5 Indoor Air Quality
- 4-5 High Frequency Ballasts & PBT-reduced Lamps
- 4-6 Daylighting and Glare
- 4-7 View out & Access to Indoor Places of Respite

Part 5 – Sustainable Practices and Green Innovation

- 5-1 Environmental Management Practice
- 5-2 Conservation of Existing Structures and Adoption of Demolition Protocol
- 5-3 Other Green Practices and Innovative Features

Point Allocations - BCA Green Mark for Healthcare Facilities (Version HC/1.0)

	Category		Point Allocations
(I)	**Energy Related Requirements**		
Minimum 30 points	**Part 1 : Energy Efficiency**		
	HC 1-1 Thermal Performance of Building Envelope - ETTV	Section (A) Applicable to air-con areas	12
	HC 1-2 Air-Conditioning System		30
	Sub-Total (A) – HC 1-1 to 1-2		**42**
	HC 1-3 Building Envelope – Design/Thermal Parameters	Section (B) Applicable to non air-con areas excluding carparks and common areas	35
	HC 1-4 Natural Ventilation		20
	Sub-Total (B) – HC 1-3 to 1-4		**55**
	HC 1-5 Electrical Services	Section (C) Generally applicable to all areas	8
	HC 1-6 Artificial Lighting		12
	HC 1-7 Ventilation in Carparks		4
	HC 1-8 Lifts and Escalators		2
	HC 1-9 Airside Energy Recovery		3
	HC 1-10 Local Energy Generation for Centralised Service Hot Water Heating		8
	HC 1-11 Renewable Energy		20
	HC 1-12 Energy Efficient Practices & Features		4
	Sub-Total (C) – HC 1-5 to 1-12		**61**
	Category Score for Part 1 – Energy Efficiency : Prorate (A) + Prorate (B) + (C)		**116 (60%)**
(II)	**Other Green Requirements**		
Minimum 20 points	**Part 2 : Water Efficiency**		
	HC 2-1 Water Efficient Fittings		6
	HC 2-2 Water Usage and Leak Detection		2
	HC 2-3 Irrigation System and Landscaping		3
	HC 2-4 Water Consumption of Cooling Towers		4
	Category Score for Part 2 – Water Efficiency		**15 (8%)**
	Part 3 : Environmental Protection		
	HC 3-1 Sustainable Construction		5
	HC 3-2 Sustainable Products		4
	HC 3-3 Airborne Contaminant Prevention		3
	HC 3-4 Greenery Provision and Healing Environment		5
	HC 3-5 Green and Universal Connectivity		2
	HC 3-6 Refrigerants		2
	Category Score for Part 3 – Environmental Protection		**21 (11%)**
	Part 4 : Indoor Environmental Quality		
	HC 4-1 Thermal Comfort and Control for A/C Spaces		3
	HC 4-2 Thermal Comfort for N/V Spaces		9
	HC 4-3 Noise Level		1
	HC 4-4 Indoor Air Pollutants		2
	HC 4-5 Indoor Air Quality		8
	HC 4-6 High Frequency Ballasts PBT-reduced Lamps		2
	HC 4-7 Daylighting and Glare		3
	HC 4-8 View out & Access to Indoor Places of Respite		2
	Category Score for Part 4 – Indoor Environmental Quality		**30 (15%)**
	Part 5 : Sustainable Practices and Green Innovation		
	HC 5-1 Green Features & Innovations		5
	HC 5-2 Conservation of Existing Structures and Adoption of Demolition Protocol		5
	HC 5-3 Other Green Practices and Innovative Features		3
	Category Score for Part 5 – Other Green Features		**13 (7%)**
	Green Mark Score :		**195 (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 Healthcare Facilities Criteria

Except for those are specifically stated, all of the below are pre-requisite requirements for attaining Green Mark Platinum rating.

Related Criteria

Air-Conditioned Buildings

(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

HC 1-1 – Thermal Performance of Building Envelope

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

(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

HC 1-2(a) – Air–Conditioning System

Prerequisite Requirements for Healthcare Facilities Criteria – *Cont'd*

Related Criteria

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

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

Important notes :

(i) 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.

(ii) 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.

HC 1-2(b) – Air–Conditioning System

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

HC 1-2(d) – Air–Conditioning System

(5) Provision of energy-recovery device for healthcare ventilation systems with no-recirculation (i.e. 100% of the room air to be exhausted). The energy transfer efficiency of energy-recovery device shall meet the requirement set in the criteria.

HC 1-9 – Air Side Energy Recovery

(6) Use of local energy generation from renewable sources or waterside energy recovery for healthcare facilities with centralised hot water heating system. The performance of service hot water system shall meet the efficiencies described in the criteria. Computation of service hot water demand is required to capture the actual service water heat load for healthcare facilities for domestic and service hot water demand and steam sterilization.

HC 1-10 – Local Energy Generation for Centralised Service Hot Water Heating

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

HC 3-1 – Sustainable Construction

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

HC 3-2 – Sustainable Products

Prerequisite Requirements for for Healthcare Facilities Criteria – *Cont'd*	
(9) Adopting a user-centric design philosophy, to be certified under the BCA Universal Design (UD) Mark.	HC 3-5a – Green and Universal Connectivity
(10) Control of indoor thermal environment by re-heating the air is achieved by means of site-recovered energy (including condenser heat) or site solar energy.	HC 4-1II – Thermal comfort and Control for A/C system
(11) Use of Persistent Bio-cumulative Toxins (PBT) – reduced or free luminaries in at least 90% of all applicable areas.	HC 4-6b – High Frequency Ballasts PBT-reduced Lamps

Prerequisite Requirements for Healthcare Facilities Criteria – *Cont'd*

Non Air-Conditioned Buildings	**Related Criteria**
(12) To be eligible for Green Mark Platinum rating, it is a requirement to use ventilation simulation modelling and analysis to identify the most effective building design and layout. ***Option 1:*** 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 occupied spaces. Details and submission requirements on ventilation simulation can be found in Appendix C of the Certification Standard. ***Or*** ***Option 2:*** The simulation results and the recommendations derived are to be implemented to ensure good natural ventilation with a minimum 70% of the occupied spaces must have an area weighted average wind velocity of ≥ 0.6 m/s. Details and submission requirements on ventilation simulation can be found in Appendix C of the Certification Standard. For occupied spaces where the area weighted wind velocity is less than 0.6 m/s, thermal comfort modelling shall be performed and shall meet the thermal comfort criteria for naturally ventilated spaces in tropical climate.	HC 1-4(b)(i) – Natural Ventilation
Perform thermal comfort modelling based on the following PMV equation: PMV= -11.7853 +0.4232T-0.57889V and to comply with the thermal comfort criteria for naturally-ventilated spaces in tropical climate as set out below: PMV Range: -0.5<PMV<+0.5; PPD: <10	HC 4-2a – Thermal Comfort for NV Spaces
(13) Use of local energy generation from renewable sources or waterside energy recovery for healthcare facilities with centralised hot water heating system. The performance of service hot water system shall meet the efficiencies described in the criteria. Computation of service hot water demand is required to capture the actual service water heat load for healthcare facilities for domestic and service hot water demand and steam sterilization.	HC 1-10 – Local Energy Generation for Centralised Service Hot Water Heating
(14) Minimum score under HC 3-1 Sustainable Construction Green Mark Gold^{Plus} ≥ 3 points Green Mark Platinum ≥ 5 points	HC 3-1 – Sustainable Construction
(15) Minimum score under HC 3-2 Sustainable Products Green Mark Gold^{Plus} ≥ 3 points Green Mark Platinum ≥ 4 points	HC 3-2 – Sustainable Products
(16) Adopting a user-centric design philosophy, to be certified under the BCA Universal Design (UD) Mark.	HC 3-5a – Green and Universal Connectivity

Prerequisite Requirements for Healthcare Facilities Criteria – *Cont'd*

(17) Use of Persistent Bio-cumulative Toxins (PBT) – reduced or free luminaries in at least 90% of all applicable areas.

HC 4-6b – High Frequency Ballasts PBT-reduced Lamps

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

(18) 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 Modelling 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 (12) is pre-requisite requirements to attain Green Mark 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.

BCA Green Mark for Healthcare Facilities Scheme (Version HC/1.0)

<table>
<tr><th colspan="2">Energy Related Requirements</th></tr>
<tr><th>Part 1: Energy Efficiency</th><th>Green Mark Points</th></tr>
<tr><th colspan="2">(A) Applicable to air-conditioned building areas (with aggregate air-conditioned areas > 500 m^2)</th></tr>
<tr><td><u>HC 1-1 Thermal Performance of Building Envelope-ETTV</u>

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

Note: Max. permissible ETTV = 50 W/m^2

<u>Prerequisite requirements for higher Green Mark ratings:</u>
Green Mark Gold^{Plus} – ETTV ≤ 42 W/m^2
Green Mark Platinum – ETTV ≤ 40 W/m^2</td><td>With reference to the maximum permissible ETTV value of 50 W/m^2 as a baseline,

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

(Maximum 12 points)</td></tr>
<tr><td><u>HC1-2 Air-conditioning System</u>

Encourage the use of better energy efficient air-conditioning 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 ratings:</u>
Green Mark Gold^{Plus} & Platinum: Minimum Design System (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-split unit
• Multi-split unit</td><td>(a) Water-cooled chilled-water plant

Peak building cooling load ≥ 500 RT

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

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

i.e. Points scored = 0.25 x (% efficiency improvement)

Peak building cooling load < 500 RT

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

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

i.e. Points scored = 0.45 x (% efficiency improvement)

<u>Up to 20 points can be scored for HC 1-2 (a)</u>

(b) Air-cooled chilled-water plant/ unitary air-conditioners

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 of 0.80 kW/RT

i.e. Points scored = 1.3 x (% efficiency improvement)</td></tr>
</table>

Energy Related Requirements

Part 1: Energy Efficiency	**Green Mark Points**

(A) Applicable to air-conditioned building areas (with aggregate air-conditioned areas > 500 m^2)

Baseline	Peak building cooling load	
	≥ 500 RT	< 500 RT
Prerequisite requirements Minimum Design System Efficiency (DSE) for air-cooled chilled-water plant or unitary air-conditioners	0.80 kW/RT	0.90 kW/RT

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

Note: Where there is a combination of central chilled water plant with unitary conditioners, the points scored will only be based on the air-con 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 points for every percentage improvement in the air-conditioning system efficiency over the baseline of 0.90 kW/RT

i.e. Points scored = 0.60 x (% efficiency improvement)

Up to 20 points can be scored for HC 1-2 (b)

(c) Air Distribution System

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

Option 1 – Fan System Motor Nameplate Power
Baseline: SS 553:2009 Table 2 – Fan power limitation (as prescribed below)

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

Option 2 – Fan System Input Power
Baseline: ASHRAE 90.1:2010 Clause 6.5.3.1 (as prescribed below)

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

*Applicable pressure drop adjustments can be considered based on ASHRAE 90.1 Table 6.5.3.1B and are subject to BCA's evaluation

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

(c) Air Distribution System

0.2 points for every percentage improvement in the air distribution system efficiency over the baseline as indicated in the tables for Option 1 or Option 2

i.e. Points scored = 0.2 x (% efficiency improvement)

Up to 6 points can be scored for HC 1-2 (c)

Energy Related Requirements	
Part 1: Energy Efficiency	**Green Mark Points**
(A) Applicable to air-conditioned building areas (with 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 the resultant plant efficiency (i.e. kW/RT) within 5% of its actual value and be in accordance with ASHRAE Guide 22 and AHRI Standard 550/590. Compliance of the following instrumentation and installations is also required: i. Location and installation of the measuring devices to meet the manufacturer's recommendations. ii. Data acquisition system with a minimum resolution of 16 bits. iii. All data logging capable of trending at a sampling interval of 1 min. 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 sides of the temperature sensor for verification of reading 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.	1 point Applicable only to buildings with provision of water-cooled chilled-water plant
(e) Verification of central water-cooled chilled-water pump instrumentation. For heat balance, substantiating test for water-cooled chilled-water pump is 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 CO_2 in accordance with Table 1 – Recommended IAQ Parameters of SS 554, where $CO_2 \leq 770$ ppm above outdoor levels is within the acceptable range.	1 point
Sub-total (A) – HC 1-1 to 1-2	**42**

Energy Related Requirements	
Part 1: Energy Efficiency	**Green Mark Points**
(B) Applicable to non air-conditioned building areas (with aggregate non air-conditioned areas > 10% of total floor area excluding carparks and common areas)	
HC 1-3 Building Envelope – Design/Thermal Parameters Enhance the overall thermal performance of building envelope to minimise heat gain that will improve indoor thermal comfort and encourage the use of natural or mechanical ventilation.	
(a) Minimum direct west facing façade through building design orientation Note: 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 façade. 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 façade areas over total façade areas) (Up to 15 points for HC 1-3 (a)) *Where there is no west facing façade, the total points scored for (a) will be 30 points and the following (b) to (d) will not be applicable for scoring.*
(b) (i) Minimum west facing window openings	Points scored = 10 – 0.1 x (% of west facing window areas over total west facing facade areas)
(ii) Effective sunshading provision for widows 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 HC 1-3 (b))
(c) Better thermal transmittance (U-value) of external west facing walls, which should be equal or less than 2 $W/m^2.K$.	Points scored = 0.05 x (% of the external west facing wall areas with U-value of 2 W/m^2K or less over total west facing façade areas) (Up to 5 points for HC 1-3 (c))
(d) Better thermal transmittance (U-value) of roof Baseline: U-value for roof as stated below, which depends on the weight range of roof structure	Points scored = 1 point for every 0.1 W/m^2K reduction from baseline roof U-value (Up to 5 points for HC 1-3 (d))

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

Exception: For existing buildings HC 1-3 (a) may be excluded in computation, the total score obtained under HC 1-3 (b), (c) and (d) will be prorated accordingly.

Energy Related Requirements	
Part 1: Energy Efficiency	**Green Mark Points**
(B) Applicable to non air-conditioned building areas (with aggregate non air-conditioned areas > 10% of total floor area excluding carparks and common areas)	
HC 1-4 Natural Ventilation (a) Natural Ventilation – prescriptive approach i. In **Occupied Spaces** where building design facilitates *optimum* natural ventilation through proper design of building layout that utilises prevailing wind conditions to achieve adequate cross ventilation; ii. In **Transient Spaces** such as:- • lift lobbies and atrium • toilets iii. In **Circulation Areas** such as:- • staircases and corridors where reverse airflow in transient and circulation areas is unlikely to affect the immediate adjacent rooms or department with controlled ventilation. (b) Natural Ventilation – performance approach i. Use of CFD modelling or wind tunnel testing to optimise the effective building layout that maximises natural ventilation in the occupied spaces *Prerequisite requirement for Green Mark Platinum ratings* ii. In conjunction with Wind-driven rain (WDR) simulation that minimises that impact of wind-driven rain into naturally-ventilated occupied spaces	5 points 1.5 points for each area in (ii) and (iii) (Up to 5 points for (ii) and (iii)) Extent of coverage: at least 90% of each applicable area 5 points 5 points
Sub-total (B) – HC 1-3 to 1-4	**55**

Energy Related Requirements	
Part 1: Energy Efficiency	**Green Mark Points**
(C) General	

HC 1-5 Electrical Services

Encourage the provision of better energy efficient service transformers, UPS and related controls of energy monitoring

a) Energy Use and Sub-metering

2 points

Promote energy use monitoring with sub- metering to facilitate building operations, and to allow engagement of building occupants

I) Separately meter either
   i. Substantial energy uses such as space cooling, domestic hot water, ventilation, lighting and plug loads

OR

   ii. High energy load and tenancy areas such as OT, Radiography, Pathology, Dialysis, Medical Physics, Mortuary, CSSD, Pharmacy, Labs, Data Centres, IT Closet and Process areas (e.g. kitchen, laundries)

II) And link all energy sub-meters to BMS, EMS or other automated system

b) Provision of low-loss service transformers

All the low loss service transformers must the performance metric stipulated below :-

Transformer capacity > 1MVA		
No load loss at rated voltage	Full load loss at rated voltage	Points Allocated
< 0.25% of rated load	< 2.5% of rated load	2
< 0.2% of rated load	< 1.5% of rated load	3
15 kVA ≤ Transformer capacity ≤ 1MVA		
No load loss at rated voltage	Full load loss at rated voltage	Points Allocated
< 0.35% of rated load	< 2.5% of rated load	2
< 0.25% of rated load	< 1.5% of rated load	3

(Up to 3 points for HC 1-5 (b))

Energy Related Requirements	
Part 1: Energy Efficiency	**Green Mark Points**
(C) General	

c) Provision of energy-efficient UPS (uninterrupted power supply)

All UPS operating in the following systems must meet the minimum efficiency :-

i. Double conversion on-line mode

	UPS Range (kVA)				
	≥5 to <10	10 to <20	20 - <40	40 - <200	≥200
25% load	82.5%	86.5%	87.5%	89.0%	90.0%
50% load	85.0%	91.0%	91.5%	92.0%	92.5%
75% load	87.0%	92.0%	92.5%	93.0%	93.5%
100% load	87.0%	92.0%	92.5%	93.0%	93.5%

ii. Line interactive or ECO mode

	UPS Range (kVA)				
	≥5 to <10	10 to <20	20 - <40	40 - <200	≥200
25% load	85.5%	90%	91%	91.5%	93%
50% load	91.5%	93%	93.5%	94%	95.5%
75% load	92.5%	93.5%	94%	94.5%	96%
100% load	92.5%	93.5%	94%	94.5%	96%

iii. Stand-by mode

	UPS Range (kVA)				
	≥5 to <10	10 to <20	20 - <40	40 - <200	≥200
25% load	90%	94%	94.5%	95%	95.5%
50% load	93%	96%	96.5%	97%	97.5%
75% load	94%	96.5%	97%	97.5%	98%
100% load	94%	96.5%	97%	97.5%	98%

The points awarded will be based on the aggregated kVA meeting the minimum efficiency as a proportion to the total installed kVA for UPS rated ≥ 5 kVA

(Up to 3 points for HC 1-5 (c))

Energy Related Requirements	
Part 1: Energy Efficiency	**Green Mark Points**
(C) General	
HC 1-6 Artificial Lighting Encourage the use of energy efficient lighting to minimise energy consumption from lighting usage while maintaining proper lighting level.	With reference to the maximum lighting power budget (LPB) stated in SS 530 as a baseline, Points scored = 0.3 x (% improvement in LPB) When tenant lighting provision is included, up to 12 points can be scored. When tenant lighting provision is excluded, up to 5 points can be scored.
HC 1-7 Ventilation in Carparks 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) i. Fume extract (2.5 points) ii. MV with or without supply (2 points)	4 points 2.5 points 2 points Note: Where there is a combination of different ventilation modes adopted for carpark design, the points obtained under HC 1-7 will be prorated accordingly (Up to 4 points for HC 1-7)
HC 1-8 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. a. Lifts b. Escalators	1 point 1 point Extent of coverage: All lifts and escalators

<table>
<tr><th colspan="2">Energy Related Requirements</th></tr>
<tr><th>Part 1: Energy Efficiency</th><th>Green Mark Points</th></tr>
<tr><td colspan="2">(C) General</td></tr>
<tr><td></td><td></td></tr>
<tr><td><u>HC 1-9 Airside Energy Recovery</u>

Promote airside energy recovery to all healthcare ventilation systems.

a. Provision of run-around coil that could achieve the minimum 45% energy transfer efficiencies

b. Provision of either plate heat exchanger of minimum 50% energy transfer efficiency or thermal wheel of 65% energy transfer efficiency

c. Provision of any other energy-recovery device of minimum 50% energy transfer efficiency</td><td><u>Provision of energy-recovery device for healthcare ventilation systems with no-recirculation (i.e. 100% of the room air to be exhausted) is a prerequisite requirement for Green Mark Platinum rating</u>

1 point

1 point

1 point</td></tr>
<tr><td><u>HC 1-10 Local Energy Generation for Centralised Service Hot Water Heating</u>

Promote local energy generation from renewable sources or waterside energy recovery to meet service hot water heating demand in healthcare facilities.

I. <u>Centralised Hot Water Heating Systems</u>

a. <u>Solar Thermal Hot Water System</u>
The solar thermal hot water system must meet minimum Solar Fraction (SF) of 0.5 or Solar Energy Factor (SEF) of 2.

b. <u>Heat Pumps</u>
The heat pump meeting minimum heating COP of 3.5 under the standard testing conditions as follows: -
• Heating water from 15℃ to 55℃
• Air source heat of 20℃ dry bulb/15℃ wet bulb for air-to-water heat pump
• Water source heat of 15℃ for water-to-water heat pump

c. <u>Combined Heat and Power (CHP) System</u>
The CHP system such as co-generation or tri-generation must meet the minimum Effective Electrical Efficiency as follows: -

<table><tr><th>Type of CHP</th><th>Effective Electrical Efficiency</th></tr><tr><td>Combustion turbine-based CHP</td><td>0.50</td></tr><tr><td>Reciprocating engine-based CHP</td><td>0.70</td></tr></table>
d. <u>Photovoltaic Thermal (PV/T)</u> or other <u>low and zero carbon technology hot water systems</u></td><td><u>1-10 is a Prerequisite requirement for Green Mark Platinum rating</u>

<u>Green Mark Points for Category I</u>:

• 1 points for meeting the minimum efficiency for each category of centralised hot water system.

• Thereafter, additional point for every 10% improvement from minimum efficiency stated for each category (max 5 pts)

• Total points = 6 points</td></tr>
</table>

<table>
<tr><th colspan="2">Energy Related Requirements</th></tr>
<tr><th>Part 1: Energy Efficiency</th><th>Green Mark Points</th></tr>
<tr><th colspan="2">(C) General</th></tr>
<tr><td>

II. <u>Computation of Service Hot Water Demand</u>

To capture the actual service water heat load for healthcare facilities for domestic and service hot water demand and steam sterilization.

a. Service hot water demand for patients wards, kitchen and restaurant/café only (1 pt)

<u>and</u>

b. Additional Service hot water demand for clinical & surgery, supply and sterilizing (additional 1 pt)

The SWH design flow rate is recommended to be computed based on the design flow rate per space type: -

Space type	Design flow rate (litre/hr/person)
Patient room	69.6 (litre/hr) or 9(litre/min/person)
Kitchen	503.4 (litre/hr)
Café/Restaurant	1.434
Examination/treatment room/intensive care	1.434
Imaging/laboratory	2.869
Pharmacy	0.719
Procedure room/trauma/triage	2.869
Operating suite	4.780
Laundry/soiled linen	2.869
Sterilising	2.869

</td><td>

<u>Green Mark Points for Category II:</u>

- Up to max 2 pts for computation of total hot water service demand.

</td></tr>
<tr><td>

<u>HC 1-11 Renewable Energy</u>

Encourage the application of renewable energy sources in buildings

</td><td>

Point scored is based on the expected energy efficiency index (EEI) and % replacement of electricity by renewable energy source or local energy generation.

<table>
<tr><th rowspan="2">Expected Energy Efficiency Index (EEI)</th><th colspan="2">Every 1% electricity replacement (based on total building electricity consumption) by renewable energy source or local energy generation</th></tr>
<tr><th>Include tenant's usage</th><th>Exclude tenant's usage</th></tr>
<tr><td>≥100kWh/m^2/yr</td><td>5 points</td><td>3 points</td></tr>
<tr><td>< 100kWh/m^2/yr</td><td>3 points</td><td>1.5 points</td></tr>
</table>

(Up to 20 points)

Condition: the points scored for renewable energy provision shall not result in a double-grade jump in GM rating (i.e. from GM certified to Gold^{plus} or Gold to Platinum rating)

</td></tr>
<tr><td></td><td></td></tr>
</table>

Energy Related Requirements	
Part 1: Energy Efficiency	**Green Mark Points**
(C) General	
HC 1-12 Energy Efficient Practices & Features Encourage the implementation of energy-efficient features and practices that are innovative and reduce building energy consumption. a. **Daylighting in common areas** To use Photocell sensors for maximising the use of daylighting in the following common areas: i. Circulation areas (staircases and corridors) ii. Transient spaces (lift lobbies, atrium and toilets) iii. Carparks b. **Use of energy-efficient features** i. Sun pipes ii. Light shelves c. **Computation of energy consumption based on design load in the form of energy efficiency index (EEI)**	 0.5 points 0.5 points 0.5 points 2 points for the use of any item in HC 1-12 (b) 0.5 points
Sub-total (C) – HC 1-5 to 1-12	**61**
Category Score for Part 1 – Energy Efficiency **Subtotal (A) x Air-conditioned Floor Area / Total Floor Area + Subtotal (B) x Non Air-conditioned Floor Area / Total Floor Area + Subtotal (C)**	**116 (60%)**

Other Green Requirements	
Part 2: Water Efficiency	**Green Mark Points**
HC 2-1 Water Efficiency Fittings Encourage the use of water efficient fittings covered under the Water Efficiency Labelling Scheme (WELS). a. Basin taps and mixers b. Flushing cisterns c. Shower taps, mixers or showerheads d. Sink/ bib taps and mixers e. Urinals and urinal flush valve	<table><tr><th colspan="2">Rating based on WELS</th></tr><tr><td>Very Good</td><td>Excellent</td></tr><tr><th colspan="2">Weightage</th></tr><tr><td>4</td><td>6</td></tr></table> Points scored based on the number and water efficiency rating of the fitting type used. (Up to 6 points)
HC 2-2 Water Usage and Leak Detection 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	 1 point 1 point
HC 2-3 Irrigation System and Landscaping Provide 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 • Extent of coverage: At least 50% of the landscape areas are served by the system c. Use of drought tolerant plants that require minimal irrigation • Extent of coverage: At least 80% of the landscape areas	 1 point 1 point 1 point
HC 2-4 Water Consumption of Cooling Towers To minimise water loss in cooling tower and seek alternate water sources to reduce portable water use for cooling purposes. a. Use of cooling tower water treatment system that can achieve 7 or better cycles of concentration at acceptable water quality (1 pt) b. Install devices including the use of heat pump that reduce heat load to be removed via cooling towers. The computation of water saving is accorded as below (1 pt)	 1 point 1 point

Other Green Requirements	
Part 2: Water Efficiency	**Green Mark Points**
	$$Water\ saving\ at\ cooling\ tower = \frac{Heat\ diverted / Latent\ heat\ of\ evaporation}{Density\ of\ water}$$
c. Cooling towers shall be equipped with makeup and blowdown meters to monitor water loss, as well as effective drift eliminators and other structural features that minimise the formation and release of drift	1 point
d. Use of NEWater or on-site recycled water from approved sources	1 point
Category Score for Part 2 – Water Efficiency	**15 (8%)**

Other Green Requirements	
Part 3: Environmental Protection	**Green Mark Points**
HC 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 pt)	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.	1 point for every incremental of 0.5 times of the usage requirement, i.e. **Quantity of RCA/ WCS (tons)** / **Points Allocation** ≥ 0.5 * usage requirement: 1 point ≥ 1.0 * usage requirement: 2 points ≥ 1.5 * usage requirement: 3 points ≥ 2.0 * usage requirement: 4 points Where usage requirement = 0.03*GFA(m^2) *Note: 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.*
b. Concrete Usage Index (CUI) Encourage design with efficient use of concrete for building components.	**Project CUI (m^3/m^2)** / **Points Allocation** ≤ 0.70: 1 point ≤ 0.60: 2 points ≤ 0.50: 3 points ≤ 0.40: 4 points ≤ 0.35: 5 points
Pre-requisite Requirement: *Minimum points to be scored under this criterion:* *Green Mark GoldPlus ≥ 3 points* *Green Mark Platinum ≥ 5 points*	(Up to 5 points for HC 3-1)

Other Green Requirements

Part 3: Environmental Protection	**Green Mark Points**
HC 3-2 Sustainable Products Promote the use of: a. Environmentally friendly products b. Persistent-biocumulative toxins free products that are applicable to non-structural and architectural-related building components and are certified by approved local certification bodies. *Pre-requisite Requirement:* *Minimum points to be scored under this criterion:* *Green Mark GoldPlus ≥ 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 extent of coverage and impact: 1 point for high impact item 0.5 point for low impact item (Up to 4 points for HC 3-2)
HC 3-3 Airborne Contaminant Prevention Prevent air-borne contaminant releases and NOx emissions from fuel burning processes. The emission limits of Carbon Monoxide (CO), Oxides of Nitrogen (NOx) and Particulate Matters (PM) from fuel burning process shall comply with the Code of Practice on Pollution Control (2000 edition) by NEA. In addition, a. Generator sets powered by engines up to 560kW$_m$ to meet hot water service demand shall meet Stage II emission : -	2 points

Genset Power (kW$_m$)	Oxides of Nitrogen (NOx) (g/kWhr)	Hydrocarbon (HC) (g/kWhr)	Carbon Monoxide (CO) (g/kWhr
18-36	8.0	1.5	5.5
37-55	7.0	1.3	5.0
56-74	7.0	1.3	5.0
75-129	6.0	1.0	5.0
130-560	6.0	1.0	3.5

OR

b. Generator sets powered by engines up to 560kW$_m$ to meet hot water service demand shall meet Stage III emission : -

3 points

(Up to 3 points for HC 3-3)

Genset Power (kW$_m$)	Oxides of Nitrogen (NOx) (g/kWhr)	Hydrocarbon (HC) (g/kWhr)	Carbon Monoxide (CO) (g/kWhr
18-36	7.5		5.5
37-55	4.7		5.0
56-74	4.7		5.0
75-129	4.0		5.0
130-560	4.0		3.5

Note:
For generator sets ≥750kW$_m$, it shall be installed, operated and maintained in calibration a NOx Continuous Emission System (CEMS) with data gathering and retrieval capability

<table>
<tr><th colspan="2">Other Green Requirements</th></tr>
<tr><th>Part 3: Environmental Protection</th><th>Green Mark Points</th></tr>
<tr><td><u>HC 3-4 Greenery Provision and Healing Environment</u>

Encourage greater use of greenery, restoration of trees to reduce heat island effect, as well as provide places of respite.

a. Green Plot Ratio (GnPR) is calculated by considering the 3D volume covered by plants using the prescribed Leaf Area Index (LAI).

b. Provision of outdoor places of respite as follows :-

i. Healing gardens/Meditative gardens/Restorative, Rehabilitative and Enabling gardens serving at least one floor of patient ward (1 point)
OR
Green roof and roof top gardens

-for more than 50% of the roof areas (1 point)

- for at least 25% of the roof areas (0.5 point)

ii. Staff gardens with sitting areas/ a quiet green space with benches

iii. Space for programs such as horticultural therapy, group and physical therapy</td><td><table><tr><th>GnPR</th><th>Points Allocation</th></tr><tr><td>1.0 to <3.0</td><td>1 point</td></tr><tr><td>≥3.0</td><td>3 points</td></tr></table>
1 point

0.5 points

0.5 points</td></tr>
<tr><td><u>HC 3-5 Green and Universal Connectivity</u>

Provide user-friendly accessibility and connectivity in the healthcare facilities to connect patients, staffs and visitors around the development and natural environment.

a. Development adopting a user-centric design philosophy to be assessed under the BCA Universal Design (UD) Mark
<u>Prerequisite requirement for Green Mark Platinum ratings</u>

b. Provision of shuttle services with information on routes and timetables</td><td>1 point

1 point</td></tr>
<tr><td><u>HC 3-6 Refrigerants</u>

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

b. Use of refrigerant leak detection system in critical areas of plant rooms containing chillers and other equipment with refrigerants</td><td>1 point

1 point</td></tr>
<tr><td>Category Score for Part 3 – Environmental Protection</td><td>21 (11%)</td></tr>
</table>

Other Green Requirements	
Part 4: Indoor Environmental Quality	**Green Mark Points**
HC 4-1 Thermal Comfort and Control for A/C Spaces	
I. Air-conditioning system is designed to ensure consistent indoor thermal comfort such that	
a. Public areas The indoor operative temperature should be maintained between 24℃ to 26℃, with relative humidity <65%, in accordance with SS553, Clause 7.2.	0.5 points
b. Patient and General Clinical Areas The indoor operative temperature should be maintained at 24±2℃, with relative humidity <65%., or according to ASHRAE Handbook 2007 Table 3	0.5 points
c. Clinical areas with Specialized Ventilation Systems The indoor operative temperature and relative humidity should be maintained according to HTM-03-01, Appendix 2 or equivalent international healthcare standards.	0.5 points
d. Operating Theatre and Surgery The indoor operative temperature should be maintained between 18℃ to 24℃ with relative humidity ranging from 50% to 60% or according to HTM-03-01, Appendix 2.	0.5 points
II. Control of indoor thermal environment by re-heating the air is achieved by means of site-recovered energy (including condenser heat) or site solar energy *Prerequisite requirement for Green Mark Platinum ratings*	1 point
HC 4-2 Thermal Comfort for N/V Spaces Mixed-mode or assisted form of natural ventilation to achieve thermal comfort for naturally ventilated occupied spaces, while maximising natural ventilation effects that present	
Design Stage	
a. Perform thermal comfort modelling based on the following PMV equation: - PMV = -11.7853 +0.4232T-0.57889V and meeting the thermal comfort criteria for naturally-ventilated spaces in tropical climate as set out below :-	4 points

PMV Range	PPD
$-0.5 < PMV < +0.5$	<10

Other Green Requirements	
Part 4: Indoor Environmental Quality	**Green Mark Points**
b. Perform further indoor air quality evaluation in at least two of the following target levels :- i. Draft rate ii. Air diffusion performance index iii. Mean age of air iv. Air change effectiveness	2 points *N.B: one point each of the above target levels for (b), capped at max 2 points.*
c. Provide comfort system controls to both single occupant patient room and all shared multi-occupant spaces to enable adjustments that meet the group needs and preferences such that control directly accessible to occupants must be provided either (a) for every six occupants or less or (b) for every 84m^2 or less.	1 point
<u>Post Occupancy Stage</u>	
a. Conduct post-occupancy thermal comfort survey six months after operation	1 point
b. Implement corrective measures to improve thermal comfort of staff and patients following the post-occupancy survey	1 point
<u>HC 4-3 Noise Level</u> Occupied spaces in healthcare facilities are designed to meet the acoustic performance of the appropriate standards a. <u>Public Spaces</u> Internal ambient sound levels meet the recommendation set out in SS553 **AND** b. <u>Patient Wards and Clinical Areas</u> i. The values of noise intrusion from external sources do not exceed thresholds set out in HTM 08-01, Table 1. ii. The values for internal noise from mechanical and electrical services do not exceed thresholds set out in HTM 08-01, Table 2. iii. The sounds levels and impact noise within noise-sensitive rooms meet the specified requirement set out in HTM 08-01.	1 point for compliance with both (a) and (b)

Other Green Requirements	
Part 4: Indoor Environmental Quality	**Green Mark Points**
HC 4-4 Indoor Air Pollutants Minimize airborne contaminants mainly from inside sources to promote a healthy indoor environment a. Use of (a) **low volatile organic compounds (VOCs)** paints, primers, varnishes and coating materials and (b) **environmental friendly adhesives** certified by approved local certification b. Use of **low-emission flooring materials, carpets, wall panels and large surface products** certified by approved local certification bodies	 1 point 1 point
HC 4-5 Indoor Air Quality Indoor mechanically-ventilated spaces are designed to achieve good indoor air quality performance to ensure comfort and well-being of the staff and patients. a. **Provision of filtration media and pressure monitoring and/or fault-indicator alarms in Air Handling Units (AHUs) for**: - i. Public areas according to SS554, Clause 4.3.4.5.1 and Clause 4.3.4.5.3 ii. Patient and General Clinical Areas according to HTM03-01, Clause 4.130, 4.131 and 4.145 iii. Clinical areas with specialized ventilation systems to be fitted with HEPA filters, which include Operating Theatre, Airborne Infection Isolation Rooms, Intensive Care Units (ICU), High Dependency Units (HDU), Pharmacy and Central Sterile and Supply Department (CSSD) b. **Maintaining pressure differentials between various zones within the building to minimise unwanted movement of contaminants between zones such as through** i. provision of Airflow Control Devices for clinical areas that require maintaining pressure differences with adjacent areas and interfacing the airflow control with Facility's BMS for control and monitoring– ii. the building envelope is designed to minimise the introduction of pollutants due to infiltration from outside the structure according to SS212	 0.5 points 0.5 points 0.5 points 1 point 0.5 points

Other Green Requirements	
Part 4: Indoor Environmental Quality	**Green Mark Points**
c. **Provision of Infection Control Measures in ventilation systems and interior contact surfaces such as** – i. install UGVI in AHUs ii. apply germicidal coating in ventilation systems and interior contact surfaces or iii. apply self-cleaning Titanium Dioxide for interior contact surfaces	1 point
d. **Conduct IAQ audit for air-conditioned occupied spaces where the minimum sampling points shall follow SS554, Table 3** for	
i. A minimum of 10 rooms, including patient ward and all waiting and sub-waiting areas shall be selected for air sampling for each air system	2 points for compliance with HC 4-5 (d) (i, ii, iii)
ii. Additional sampling shall be conducted from clinical areas with specialized ventilation systems and operating theatres and surgery	
iii. The tests shall be carried out by an accredited laboratory for procedures related to the analysis of indoor air quality parameters under Singapore Laboratory Accreditation Scheme (SINGLAS) administered by the Singapore Accreditation Council (SAC) and certified by a competent person as stated in the Code of Practice.	
iv. Carry out half-yearly IAQ audit and monitoring using portable IAQ monitoring equipment which is capable of measuring temperature, RH, CO, CO_2, particles, TVOC, O_3, and 40 parameters pertaining to identification of molds and pollen	1 point
e. **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 testing for ACMV systems are to be included.	1 point

<table>
<tr><th colspan="2">Other Green Requirements</th></tr>
<tr><th>Part 4: Indoor Environmental Quality</th><th>Green Mark Points</th></tr>
<tr><td><u>HC 4-6 High Frequency Ballasts & PBT-reduced lamps</u>

Careful selection of lamps to reduce flickering and minimize persistent bio-cumulative toxins to ensure staff's and patients' health and well-being.

(a) Use of high frequency ballasts in the fluorescent luminaries in at least 90% of all applicable areas

(b) Use of PBT-reduced or free luminaries in at least 90% of all applicable areas
<u>Prerequisite requirements for Green Mark Platinum ratings</u></td><td>1 point

1 point</td></tr>
<tr><td><u>HC 4-7 Daylighting and Glare</u>

Encourage design that optimizes the use of effective daylighting to reduce energy use for artificial lighting in occupied spaces.

Use of daylighting and glare simulation analysis to verify the adequacy of ambient lighting levels in meeting the luminance level and Unified Glare Rating (UGR) stated in SS 531:Part 1:2006 – Code of Practice for Lighting of Work Places.</td><td>Points scored based on the extent of perimeter daylight zones

<table><tr><th>Distance from 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>
Extent of coverage: At least 75% of occupied spaces (except wards) with daylighting provisions meeting the illuminance level and are within the acceptable glare exposure.</td></tr>
<tr><td><u>HC 4-8 View out & Access to Indoor Places of Respite</u>

Introduce connections to the outdoors through views out into regularly occupied areas.

Provision of indoor places of respite such as:-

• <u>Internal courtyard</u>
o Interior atria and greenhouse gardens
o Wide corridors that offer seating with views of nature.
o Places to pause with seating adjacent to destination points
o Display areas of flora and fauna

• <u>Interaction and recreation areas</u>
o Family consultation spaces with views
o Meditation spaces, chapels or grieving rooms
o Resource areas and libraries with seating
o Exercise and therapy spaces</td><td>1 point

1 point</td></tr>
<tr><td>Category Score for Part 4 – Indoor Environmental Quality</td><td>30 (15%)</td></tr>
</table>

Other Green Requirements	
Part 5: Sustainable Practices and Green Innovation	**Green Mark Points**
HC 5-1 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	0.5 points
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 who are ISO 14000 certified	0.25 points 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 points for certified GMM 0.5 points for certified GMFM 1 point for certified GMP (up to 1 point)
f. Provision of facilities or recycling bins for collection and storage of different recyclable waste such as paper, glass, plastic etc.	0.5 points
HC 5-2 Conservation of existing structures and adoption of demolition protocol Encourage conservation of existing building structures and adoption of demolition protocol to maximise resource recovery.	
a. Conservation of existing building structure or building envelopes (by area)	
i. conserving >50% of the existing structure or building envelope	2 points
ii. conserving at least 25% of the existing structure or building envelope	1 point (up to 2 points for (a))
b. Adoption of demolition protocol to maximise resource recovery of demolition materials for reuse or recycling	
i. recovery rate of >35% crushed concrete waste to be sent to the approved recyclers with proper facilities	2 points
ii. recovery rate of at least 20% crushed concrete waste to be sent to the approved recyclers with proper facilities	1 point (up to 2 points for (b))

Other Green Requirements	
Part 5: Sustainable Practices and Green Innovation	**Green Mark Points**
Refer to details regarding demolition protocol at http:www.bca.gov.sg/SustainableConstruction/sc_demolition.html for compliance. c. Calculation of carbon footprint of the development comprising energy usage data of production and on-site construction of building materials listed in the prescribed form i. submission of complete carbon footprint calculation for all building materials listed and in the prescribed format or a complete carbon footprint report of the development prepared by an independent carbon consultant ii. submission of carbon footprint calculation for any four building materials listed and in the prescribed format	 1 point 0.5 points (up to 1 point for (c))
<u>HC 5-3 Other green practices and innovative features</u> Examples: - ▪ **<u>Process water management</u>** to measure, manage and improve their efficiency in process water consumption using Water Efficiency Management Plan (WEMP) can be found in the PUB website: *www.pub.gov.sg/conserve/Documents/WEMP.xls* *NB: This point is not applicable for mandatory WEMP submission in healthcare premises with water consumption >5,000m^3/month.* ▪ **<u>Testing and commissioning of building energy systems</u>** by a third-party commissioning authority to develop Owner Project Requirement (OPR) based on design team's Basis of Design (BOD), implement the commissioning plan, verify the installation and commissioning of the systems and complete a commissioning report ▪ Other green and innovative features such as: - o Pneumatic waste collection system o Recycling of AHU condensate o Use of grey water recycling system o Use of non-chemical termite treatment system o Stormwater management as recommended by PUB's ABC Water Design Guidelines.	 1 point 1 point 0.5 points for each item in the green and innovative features (up to 3 points for HC 5-3)
Category Score for Part 5 – Sustainable Practices and Green Innovation	**13 (7%)**

Green Mark Score (Healthcare Facilities)

Green Mark Score (Healthcare Facilities) = ∑Category Score [(Part 1 – Energy Efficiency) +
(Part 2 – Water Efficiency) +
(Part 3 – Environmental Protection) +
(Part 4 – Indoor Environmental Quality) +
(Part 5 – Sustainable Practices and Green Innovation)}

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