



# **DESIGN REFERENCE GUIDE**

## **Healthcare Facilities**

Version 1.1  
January 2024

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## 1. About GreenRE

GreenRE Sdn Bhd is a wholly owned subsidiary of the Real Estate and Housing Development Association (REHDA). The GreenRE rating tool has been developed for the purposes as mentioned herein and may be subject to updating and/or modification in the future.

Any sale, modification, reproduction, display or distribution of GreenRE criteria or any copies thereof is not allowed without GreenRE Sdn Bhd's prior written consent. This may be obtained in writing to the following address or via email to [info@greenre.org](mailto:info@greenre.org)

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## 2. Introduction

The GreenRE assessment scheme was established in 2013 and is a recognized green building rating system tailored for the tropical climate. GreenRE sets parameters and establishes indicators to guide the design, construction and operation of buildings towards increased energy effectiveness and enhanced environmental performance.

The intent of this Design Reference Guide for Healthcare Facilities (referred to as “this Guideline”) is to establish environmentally friendly practices for the planning, design and construction of hospitals, which would help to mitigate their environmental impact.

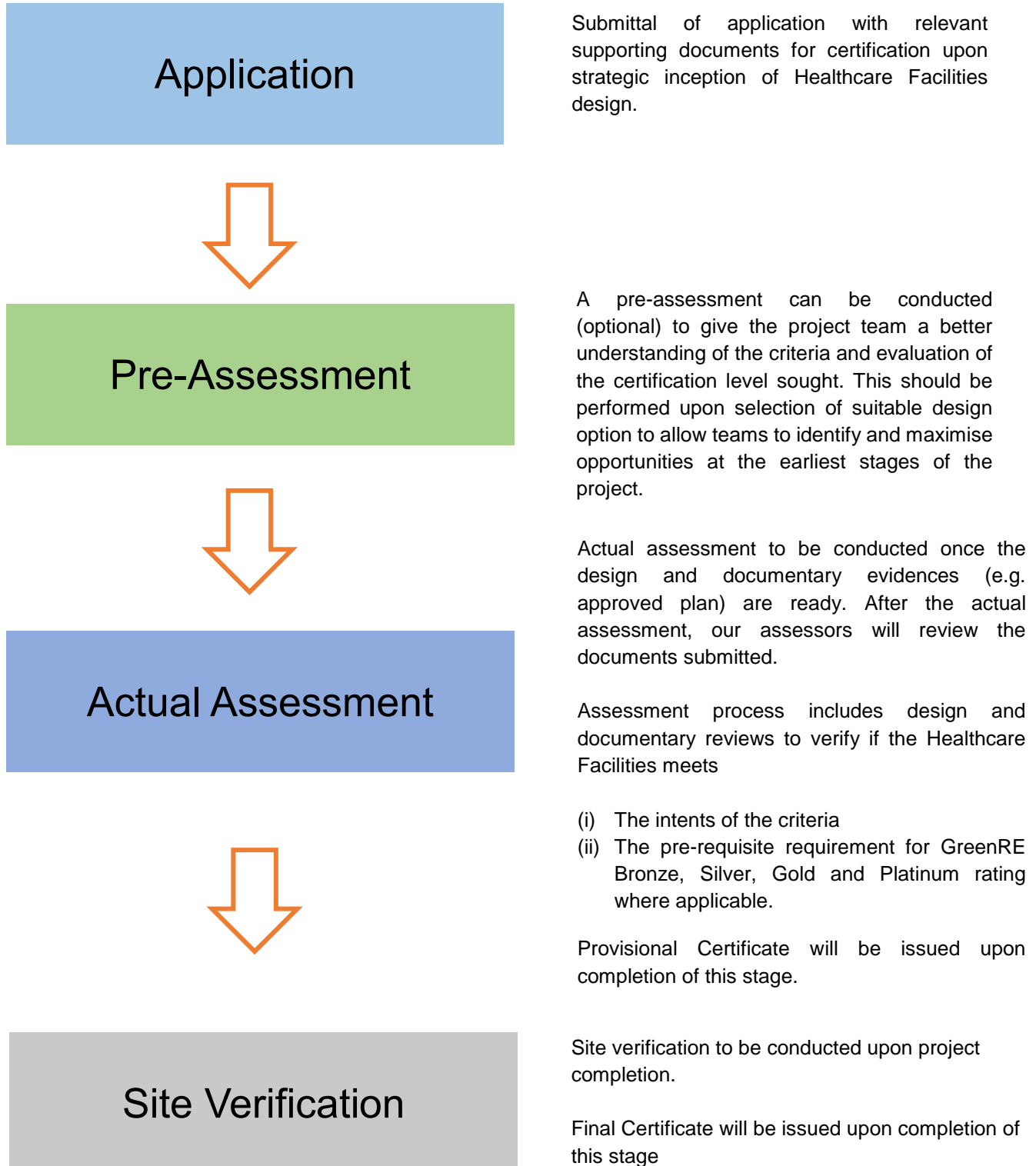
This Guideline is not intended to abridge safety, health, environmental or related requirements contained in other applicable laws, codes or policies administered by relevant authorities. Where there is a conflict between a requirement of this Guideline and such other regulations affecting the design, construction and operation of the project, the building regulations shall take precedence.

## 3. Revision Log

Revision	Description	Date Effective
1.0	Launched for Implementation	16 <sup>th</sup> July 2018
1.0	Revised for Implementation	January 2024

## 4. GreenRE Assessment Stages

The GreenRE Healthcare Facilities Certification process is as follows:



## 5. GreenRE Healthcare Facilities Rating System

### Overview:

The GreenRE healthcare facilities rating system is targeted for use in **new and existing hospital projects**. This rating system is divided into six (6) sections as follows:

Part 1 - Energy Efficiency: This category focuses on the approach that can be used in the building design and system selection to optimise the energy efficiency of buildings.

Part 2 - Water Efficiency: This category focuses on the selection of fittings and strategies enabling water use efficiency during construction and building operation.

Part 3 – Environmental Protection: This category focuses on the design, practices and selection of materials and resources that would reduce the environmental impacts of built structures.

Part 4 - Indoor Environmental Quality: This category focuses on the design strategies that would enhance the indoor environmental quality which include air quality, thermal comfort, acoustic control and daylighting.

Part 5 - Sustainable Practices and Green Innovation: This category focuses on the adoption of green operation and maintenance practices and new technologies that are innovative and have potential environmental benefits.

Part 6 - Carbon Emission of Development: This category focuses on the use of carbon calculator to calculate the carbon emission of the development.

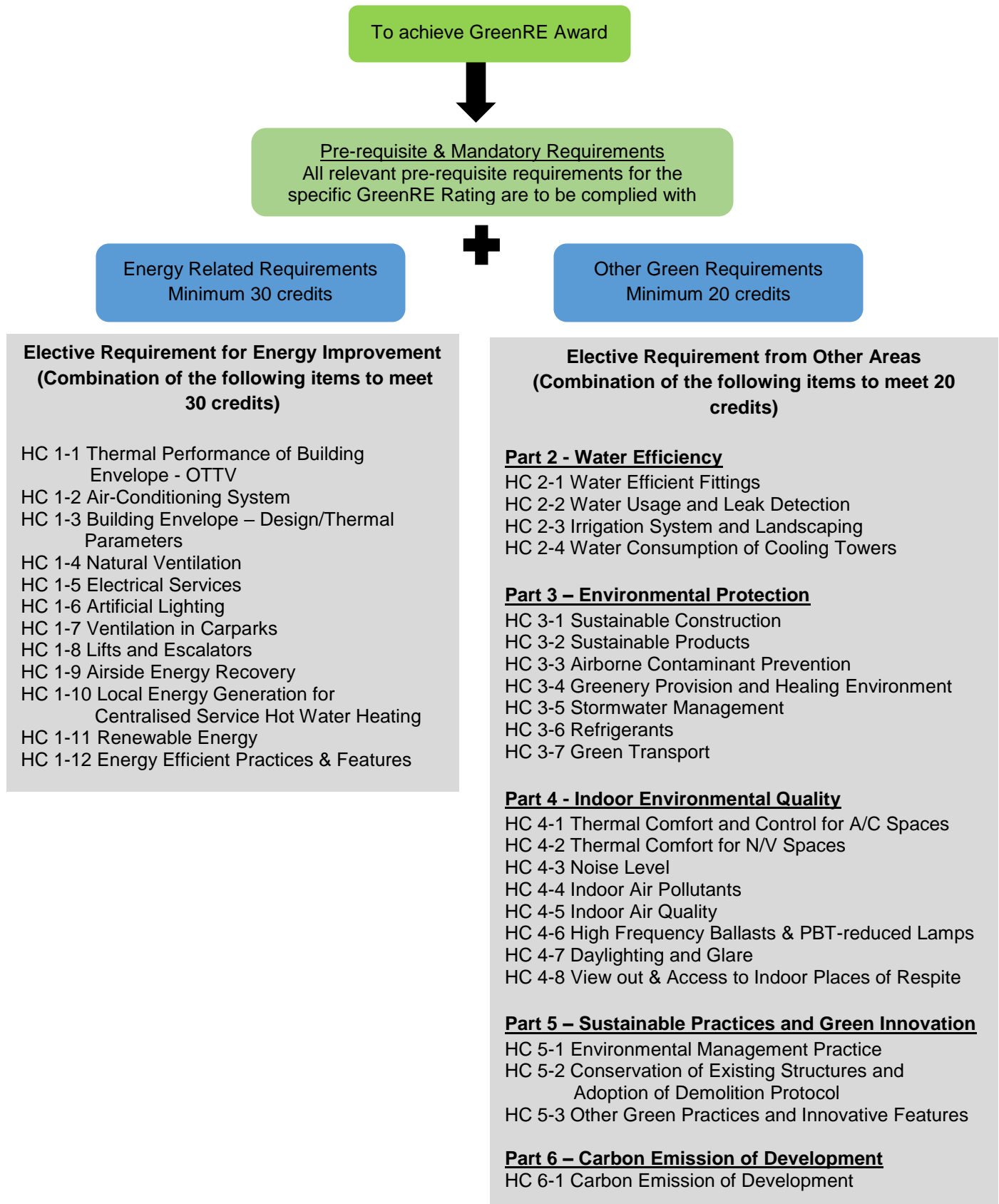
These environment impact categories are broadly classified under two main groups namely (I) Energy Related Requirements and (II) Other Green Requirements.

Energy Related Requirements consist of Part 1- Energy Efficiency where credits are allocated for the various energy efficient designs, practices and features used. A minimum of 30 credits must be obtained from this group to be eligible for certification.

Other Green Requirements consist of Part 2 - Water Efficiency; Part 3 - Environmental Protection; Part 4 - Indoor Environmental Quality; Part 5 - Sustainable Practices and Green Innovation. Credits are allocated for the water efficient features, environmentally friendly design practices, innovative green features used and carbon emission of development. A minimum of 20 credits must be obtained from this group to be eligible for certification.

This design guide is to be read in conjunction with Non-Residential Building toolkit (NRB v3.2 and v4.0) and Existing Non-Residential Building toolkit (ENRB v3.3).

## Framework:



## Credit Allocation:

Category		Credit Allocation
<b>(I) Energy Related Requirements</b>		
Minimum 30 Credits	<b>Part 1 : Energy Efficiency</b>	
	HC 1-1 Thermal Performance of Building Envelope - OTTV	12
	HC 1-2 Air-Conditioning System	31
	<b>Sub-Total (A) – HC 1-1 to 1-2</b>	<b>43</b>
	HC 1-3 Building Envelope – Design/Thermal Parameters	35
	HC 1-4 Natural Ventilation	20
	<b>Sub-Total (B) – HC 1-3 to 1-4</b>	<b>55</b>
	HC 1-5 Electrical Services	7
	HC 1-6 Artificial Lighting	12
	HC 1-7 Ventilation in Car parks	4
	HC 1-8 Lifts and Escalators	2
	HC 1-9 Airside Energy Recovery	6
	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
	<b>Sub-Total (C) – HC 1-5 to 1-12</b>	<b>63</b>
	<b>Category Score for Part 1 – Energy Efficiency: Prorate (A) + Prorate (B) + (C)</b>	<b>116</b>
<b>(II) Other Green Requirements</b>		
Minimum 20 Credits (Part 2 to 6)	<b>Part 2 : Water Efficiency</b>	
	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	3
	<b>Category Score for Part 2 – Water Efficiency</b>	<b>14</b>
	<b>Part 3 : Environmental Protection</b>	
	HC 3-1 Sustainable Construction	6
	HC 3-2 Sustainable Products	6
	HC 3-3 Airborne Contaminant Prevention	3
	HC 3-4 Greenery Provision and Healing Environment	5
	HC 3-5 Stormwater Management	2
	HC 3-6 Refrigerants	1
	HC 3-7 Green Transport	4
	<b>Category Score for Part 3 – Environmental Protection</b>	<b>27</b>
	<b>Part 4 : Indoor Environmental Quality</b>	
	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
	<b>Category Score for Part 4 – Indoor Environmental Quality</b>	<b>30</b>
	<b>Part 5 : Sustainable Practices and Green Innovation</b>	
	HC 5-1 Environmental Management Practice	8
	HC 5-2 Conservation of Existing Structures and Adoption of Demolition Protocol	4
	HC 5-3 Other Green Practices and Innovative Features	3
	<b>Category Score for Part 5 – Sustainable Practices and Green Innovation</b>	<b>15</b>
	<b>Part 6 : Carbon Emission of Development</b>	
	HC 6-1 Carbon Emission of Development	3
	<b>Category Score for Part 2 – 6 : Other Green Requirements</b>	<b>89</b>
<b>GreenRE Healthcare Facilities Score</b>		<b>205 (Max)</b>



## 6. GreenRE Healthcare Facilities Rating System Scoring

Score	Rating
91 and above	GreenRE Platinum
86 to < 90	GreenRE Gold
76 to < 85	GreenRE Silver
50 to < 75	GreenRE Bronze

## 7. GreenRE Healthcare Facilities Rating System Criteria

### Pre-requisites:

#### 1. GENERAL

- Building envelope design with Overall Thermal Transfer Value (OTTV) computed based on the methodology and guidelines stipulated in the MS1525:2014. (for new hospital projects only. This criterion will not be mandatory for existing hospitals.)  
GreenRE Gold - OTTV of 42 W/m<sup>2</sup> or lower  
GreenRE Platinum - OTTV of 40 W/m<sup>2</sup> or lower
- Building Energy Intensity (BEI) calculation
- Minimum score under HC 3-1 Sustainable Construction  
GreenRE Gold ≥ 3 credits  
GreenRE Platinum ≥ 5 credits
- Minimum score under HC 3-2 Sustainable Products  
GreenRE Gold ≥ 3 credits  
GreenRE Platinum ≥ 4 credits
- For GreenRE Platinum Rating - 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.
- For GreenRE Platinum Rating - 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.
- For GreenRE Platinum Rating - 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. (*Air-conditioned building only*)
- For GreenRE Gold and Platinum Rating - Use of Persistent Bio-cumulative Toxins (PBT) – reduced or free luminaries in at least 90% of all applicable areas.
- A full IAQ audit must be performed three yearly in accordance with Code of Practice on Indoor Air Quality, Department of Occupational Safety and Health, Ministry of Human Resources Malaysia (2005). This will be a pre-requisite for existing hospitals.

## 2. **MINIMUM SYSTEM EFFICIENCY**

- **Air-conditioned Buildings**

Minimum Design System Efficiency/Operating System Efficiency (DSE/OSE)

- For buildings using Water-Cooled Chilled Water Plant

GreenRE Rating	Building Cooling Load (RT)	
	< 500	≥ 500
	Efficiency (kW/RT)	
Bronze	0.85	0.75
Silver	0.80	0.70
Gold	0.75	0.68
Platinum	0.70	0.65

- For buildings using Air-Cooled Chilled Water Plant or Unitary Air-Conditioner

GreenRE Rating	Building Cooling Load (RT)	
	< 500	≥ 500
	Efficiency (kW/RT)	
Bronze	1.1	1.0
Silver	1.0	1.0
Gold	0.85	Case by case(i)
Platinum	0.78	

For building with building cooling load of more than 500RT, the use of air cooled central chilled water plant or other unitary air-conditioners are not encouraged for Gold and Platinum 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 seeking Gold / Platinum GreenRE rating will be assessed on a case-by-case basis.

- **Non-Air-conditioned Buildings**

To be eligible for GreenRE 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.

- 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  $\geq 0.6$  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.

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

### 3. **M&V SYSTEM REQUIREMENTS (FOR CENTRALIZED AC SYSTEMS ONLY)**

Provision of permanent measuring instruments for monitoring of water-cooled chilled-water system and air-cooled chilled water system operating system efficiency. The installed instrumentation shall have the capability to calculate resultant plant operating system efficiency (i.e. kW/RT) within 5% of its true value and in accordance with ASHRAE Guide 22 and AHRI 550/590. Heat balance test for water-cooled chilled water system is required for verification of the accuracy of the Measurement and Verification (M&V) instrumentation.

### 4. **BUILDING DEVELOPMENTS WITH MORE THAN 30% NON AIR-CONDITIONED SPACES**

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 <sup>2</sup> )	Aggregate Air- Conditioned Spaces (m <sup>2</sup> )	Ventilation Simulation Requirement	Energy Modelling Requirement	Justification on Energy Savings
$\geq 2000$	$\geq 5000$	Yes	Yes	No
$< 2000$	$\geq 5000$	No	Yes	No
$\geq 2000$	$< 5000$	Yes	No	Yes
$< 2000$	$< 5000$	No	No	Yes

#### **Important Notes:**

- Ventilation requirement stated paragraph is pre-requisite requirements to attain GreenRE Platinum rating.
- The stipulated energy savings and Design System Efficiency (DSE) of cooling system stated in previous section are pre-requisites to attain GreenRE Gold and Platinum ratings.

- 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 Suruhanjaya Tenaga efficiency ratings. The stipulated energy savings as stated in previous section are pre-requisites to attain GreenRE Gold and Platinum ratings.

(I) Energy Related Requirements

Part 1 – Energy Efficiency	GreenRE credit								
(A) Applicable to air-conditioned building areas (with aggregate air-conditioned areas > 1000 m²)									
<div>HC 1-1 Thermal Performance of Building Envelope- OTTV</div> <div>Enhance the overall thermal performance of building envelope to minimise heat gain, thus reducing the overall cooling load requirement.</div> <div>Note: Max. permissible OTTV = 50 W/m²</div> <div>Prerequisite Requirement: GreenRE Gold – OTTV of 42 W/m² or lower GreenRE Platinum – OTTV of 40 W/m² or lower</div>	<div>With reference to the maximum permissible OTTV value of 50 W/m² as a baseline,</div> <div>Credits scored = 1.2 x (50 – OTTV) where OTTV ≤ 50 W/m²</div> <div>(Maximum 12 credits)</div>								
<div>HC 1-2 Air-conditioning System</div> <div>Encourage the use of better energy efficient air- conditioning equipment to minimise energy consumption.</div> <div>(a) Water-cooled chilled-water plant<ul style="list-style-type: none"><li>Water-cooled chiller</li><li>Chilled-water pump</li><li>Condenser water pump</li><li>Cooling tower</li></ul></div> <div><table><tr><th rowspan="2">Baseline</th><th colspan="2">Peak building cooling load</th></tr><tr><th>≥500 RT</th><th>&lt;500RT</th></tr><tr><td>Prerequisite requirements Minimum Design System Efficiency (DSE) for central chilled-water plant</td><td>0.75 kW/RT</td><td>0.85 kW/RT</td></tr></table></div> <div>Prerequisite requirements for higher GreenRE ratings: GreenRE Gold &amp; 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 &lt; 500 RT</div>	Baseline	Peak building cooling load		≥500 RT	<500RT	Prerequisite requirements Minimum Design System Efficiency (DSE) for central chilled-water plant	0.75 kW/RT	0.85 kW/RT	<div>(a) Water-cooled chilled-water plant</div> <div>Peak building cooling load ≥ 500 RT</div> <div>15 credits for meeting the prescribed chilled-water plant efficiency of 0.75 kW/RT</div> <div>0.25 credits for every percentage improvement in the chilled-water plant efficiency over the baseline</div> <div>Credits scored = 0.25 x (% improvement)</div> <div>Peak building cooling load &lt; 500 RT</div> <div>12 credits for meeting the prescribed chilled-water plant efficiency of 0.85 kW/RT</div> <div>0.45 credits for every percentage improvement in the chilled-water plant efficiency over the baseline</div> <div>Credits scored = 0.45 x (% improvement)</div> <div>Up to 20 credits can be scored for HC 1-2a</div>
Baseline		Peak building cooling load							
	≥500 RT	<500RT							
Prerequisite requirements Minimum Design System Efficiency (DSE) for central chilled-water plant	0.75 kW/RT	0.85 kW/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

Baseline	Peak building cooling load	
	≥500RT	<500RT
<u>Prerequisite requirements</u> Minimum Design System Efficiency (DSE) for air-cooled chilled-water plant or unitary air-conditioners	1.0 kW/RT	1.1 kW/RT

*Note: Where there is a combination of central chilled water plant with unitary conditioners, the credits scored will only be based on the air-conditioner system with a larger aggregate capacity.*

**(c) Air Distribution System**

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

Option 1 – Fan System Motor Nameplate Power

Baseline Air Distribution System Type	Allowable Motor Nameplate Power	
	kW/ m <sup>3</sup> /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	

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

Peak building cooling load ≥ 500 RT

12 credits for meeting the prescribed air-conditioning system efficiency of 1.0 kW/RT

1.3 credits for every percentage improvement in the air- conditioning system efficiency over the baseline of 1.0 kW/RT

Credits scored = 1.3 x (% improvement)

Peak building cooling load < 500 RT

10 credits for meeting the prescribed air-conditioning system efficiency of 1.1 kW/RT

0.6 credits for every percentage improvement in the air- conditioning system efficiency over the baseline of 1.1 kW/RT

Credits scored = 0.60 x (% improvement)

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

**(c) Air Distribution System**

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

Credits scored = 0.2 x (% improvement)

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

## Option 2 – Fan System Input Power

Baseline Air Distribution System Type	Allowable Motor Nameplate Power*	
	kW/ m <sup>3</sup> /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 GreenRE'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 credits scored for HC 1-2 (a) and (b) will be prorated based on the air distribution system efficiency under HC 1-2 (c).*

(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  $\pm 0.05^{\circ}\text{C}$  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

2 credits

Applicable only to buildings with provision of water-cooled chilled-water plant



<p>measurement location to have two spare thermowells located at both sides of the temperature sensor for verification of reading accuracy.</p> <p>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.</p> <p>(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</p> <p>(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.</p> <p>(g) Sensors or similar automatic control devices are used to regulate outdoor air flow rate to maintain the concentration of CO<sub>2</sub>. Indoor CO<sub>2</sub> acceptable range ≤ 700ppm above outdoor concentration.</p>	<p>1 credit</p> <p>1 credit</p> <p>1 credit</p>
<p><b>Sub-total (A) : HC 1-1 to 1-2</b></p>	<p><b>Sum of GreenRE credits obtained from HC 1-1 to 1-2:</b></p> <p><b>Maximum 43 Credits</b></p>

**(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.

- (b) (i) Minimum west facing window openings

- (ii) Effective sunshading provision for windows on the west façade with minimum shading of 30%

- (c) Better thermal transmittance (U-value) of external west facing walls, which should be equal or less than 2 W/m<sup>2</sup>K.

- (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

Roof Weight Group (kg/m <sup>2</sup> )	Maximum U-value (W/m <sup>2</sup> K)
Light (Under 50)	0.4
Heavy (Over 50)	0.6

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.

Credits scored =  $15 - 0.3 \times (\% \text{ of west facing façade areas over total façade areas})$

(Up to 15 credits for HC 1-3 (a))

*Where there is no west facing façade, the total credits scored for (a) will be 30 credits and the following (b) to (d) will not be applicable for scoring.*

Credits scored =  $10 - 0.1 \times (\% \text{ of west facing window areas over total west facing facade areas})$

Credits scored =  $0.1 \times (\% \text{ of west facing window areas with sunshading devices over total west facing façade areas})$

(Up to 10 credits for HC 1-3 (b))

Credits scored =  $0.05 \times (\% \text{ of the external west facing wall areas with U-value of } 2 \text{ W/m}^2\text{K or less over total west facing façade areas})$

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

Credits scored = 1 credit for every 0.1 W/m<sup>2</sup>K reduction from baseline roof U-value  
(Up to 5 credits for HC 1-3 (d))

<p><b><u>HC 1-4 Natural Ventilation</u></b></p> <p>(a) <u>Natural Ventilation – prescriptive approach</u></p> <p>i. In <b>Occupied Spaces</b> where building design facilitates <i>optimum</i> natural ventilation through proper design of building layout that utilises prevailing wind conditions to achieve adequate cross ventilation;</p> <p>ii. In <b>Transient Spaces</b> such as:-</p> <ul style="list-style-type: none"> <li>• lift lobbies and atrium</li> <li>• toilets</li> </ul> <p>iii. In <b>Circulation Areas</b> such as:-</p> <ul style="list-style-type: none"> <li>• staircases and corridors</li> </ul> <p>where reverse airflow in transient and circulation areas is unlikely to affect the immediate adjacent rooms or department with controlled ventilation.</p> <p>(b) <u>Natural Ventilation – performance approach</u></p> <p>i. Use of CFD modelling or wind tunnel testing to optimise the effective building layout that maximises natural ventilation in the occupied spaces <u>Prerequisite requirement for GreenRE Platinum ratings</u></p> <p>ii. In conjunction with Wind-driven rain (WDR) simulation that minimises that impact of wind- driven rain into naturally-ventilated occupied spaces.</p>	<p>5 credits</p> <p>1.5 credits for each area in (ii) and (iii)</p> <p>(Up to 5 credits for (ii) and (iii))</p> <p>Extent of coverage: at least 90% of each applicable area</p> <p>5 credits</p> <p>5 credits</p>
<p><b>Sub-total (B) : HC 1-3 to 1-4</b></p>	<p><b>Sum of GreenRE credits obtained from HC 1-3 to 1-4:</b></p> <p><b>Maximum 55 Credits</b></p>

(C) General	GreenRE Credits																																				
<p><b><u>HC 1-5 Electrical Services</u></b> Encourage the provision of better energy efficient service transformers, UPS and related controls of energy monitoring</p> <p>a) <u>Energy Use and Sub-metering</u> Promote energy use monitoring with sub- metering to facilitate building operations, and to allow engagement of building occupants.</p> <p>l) Separately meter either</p> <p>i. Substantial energy <u>uses</u> such as space cooling, domestic hot water, ventilation, lighting and plug loads</p> <p style="text-align: center;"><b>OR</b></p> <p>ii. High energy load and tenancy <u>areas</u> such as OT, Radiography, Pathology, Dialysis, Medical Physics, Mortuary, CSSD, Pharmacy, Labs, Data Centres, IT Closet and Process areas (e.g. kitchen, laundries)</p> <p>II) And link all energy sub-meters to BMS, EMS or other automated system</p> <p>b) <u>Provision of low-loss service transformers</u></p> <p>Efficiency of service transformers to meet the requirements of MS-1525.</p> <p>c) <u>Provision of energy-efficient UPS (uninterrupted power supply)</u></p>	<p>2 credits</p> <p>2 credits</p> <p>All UPS operating in the following systems must meet the minimum efficiency: -</p> <p>i. <u>Double conversion on-line mode</u></p> <table><tr><th></th><th colspan="5">UPS Range (kVA)</th></tr><tr><th></th><th>≥5 to &lt;10</th><th>10 to &lt;20</th><th>20 - &lt;40</th><th>40 - &lt;200</th><th>≥200</th></tr><tr><td>25% load</td><td>82.5%</td><td>86.5%</td><td>87.5%</td><td>89.0%</td><td>90.0%</td></tr><tr><td>50% load</td><td>85.0%</td><td>91.0%</td><td>91.5%</td><td>92.0%</td><td>92.5%</td></tr><tr><td>75% load</td><td>87.0%</td><td>92.0%</td><td>92.5%</td><td>93.0%</td><td>93.5%</td></tr><tr><td>100% load</td><td>87.0%</td><td>92.0%</td><td>92.5%</td><td>93.0%</td><td>93.5%</td></tr></table>		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%
	UPS Range (kVA)																																				
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	<p>ii    <u>Line interactive or ECO mode</u></p> <table><tr><td></td><td colspan="5">UPS Range (kVA)</td></tr><tr><td></td><td>≥5 to &lt;10</td><td>10 to &lt;20</td><td>20 - &lt;40</td><td>40 - &lt;200</td><td>≥200</td></tr><tr><td>25% load</td><td>85.5%</td><td>90%</td><td>91%</td><td>91.5%</td><td>93%</td></tr><tr><td>50% load</td><td>91.5%</td><td>93%</td><td>93.5%</td><td>94%</td><td>95.5%</td></tr><tr><td>75% load</td><td>92.5%</td><td>93.5%</td><td>94%</td><td>94.5%</td><td>96%</td></tr><tr><td>100% load</td><td>92.5%</td><td>93.5%</td><td>94%</td><td>94.5%</td><td>96%</td></tr></table> <p>iii    <u>Stand-by mode</u></p> <table><tr><td></td><td colspan="5">UPS Range (kVA)</td></tr><tr><td></td><td>≥5 to &lt;10</td><td>10 to &lt;20</td><td>20 - &lt;40</td><td>40 - &lt;200</td><td>≥200</td></tr><tr><td>25% load</td><td>90%</td><td>94%</td><td>94.5%</td><td>95%</td><td>95.5%</td></tr><tr><td>50% load</td><td>93%</td><td>96%</td><td>96.5%</td><td>97%</td><td>97.5%</td></tr><tr><td>75% load</td><td>94%</td><td>96.5%</td><td>97%</td><td>97.5%</td><td>98%</td></tr><tr><td>100% load</td><td>94%</td><td>96.5%</td><td>97%</td><td>97.5%</td><td>98%</td></tr></table> <p>The credits 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</p> <p>(Up to 3 credits for HC 1-5 (c))</p>		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%		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%
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<p><b><u>HC 1-6 Artificial Lighting</u></b></p> <p>Encourage the use of energy efficient lighting to minimise energy consumption from lighting usage while maintaining proper lighting level.</p>	<p>With reference to the maximum lighting power budget (LPB) stated in MS1525:2014 as a baseline:</p> <p>Credits scored = 0.25 x (% improvement) *To be pro-rated based on areas – excluding tenant areas if lighting not provided.</p> <p>(Up to 12 credits pro-rated by area)</p>																																																																								
<p><b><u>HC 1-7 Ventilation in Carparks</u></b></p> <p>Encourage the use of energy efficient design and control of ventilation systems in carparks.</p> <p>(a) Carparks are designed with natural ventilation</p>	<p>4 credits</p>																																																																								

<p>(b) CO Sensors are used to regulate the demand for mechanical ventilation (MV)</p> <ul style="list-style-type: none"> <li>i. Fume extract (2.5 credits)</li> <li>ii. MV with or without supply (2 credits)</li> </ul>	<p>2.5 credits</p> <p>2 credits</p> <p>Note: Where there is a combination of different ventilation modes adopted for carpark design, the credits obtained under HC 1-7 will be prorated accordingly</p> <p>(Up to 4 credits for HC 1-7)</p>
<p><b><u>HC 1-8 Lifts and Escalators</u></b></p> <p>Encourage the use of energy efficient lifts and escalators.</p> <p>Lifts and/or escalators with AC variable voltage and variable frequency (VVVF) motor drive and sleep mode features.</p> <p>(a) Lifts</p> <p>(b) Escalators</p>	<p>1 credit</p> <p>1 credit</p> <p>Extent of coverage: <u>All</u> lifts and escalators</p>
<p><b><u>HC 1-9 Airside Energy Recovery</u></b></p> <p>Promote airside energy recovery to all healthcare ventilation systems.</p> <p>(a) Provision of run-around coil that could achieve the minimum 45% energy transfer efficiencies</p> <p>(b) Provision of either plate heat exchanger of minimum 50% energy transfer efficiency or thermal wheel of 65% energy transfer efficiency</p> <p>(c) Provision of any other energy-recovery device of minimum 50% energy transfer efficiency</p>	<p><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 GreenRE Platinum rating</u></p> <p>2 credits</p> <p>2 credits</p> <p>2 credits</p>

<p><b><u>HC 1-10 Local Energy Generation for Centralised Service Hot Water Heating</u></b></p> <p>Promote local energy generation from renewable sources or waterside energy recovery to meet service hot water heating demand in healthcare facilities.</p> <p><b><u>(1) Centralised Hot Water Heating Systems</u></b></p> <p>(a) Solar Thermal Hot Water System The solar thermal hot water system must meet minimum Solar Fraction (SF) of 0.5 or Solar Energy Factor (SEF) of 2.</p> <p>(b) Heat Pumps The heat pump meeting minimum heating COP of 3.5 under the standard testing conditions as follows: -</p> <ul style="list-style-type: none"> <li>• Heating water from 15°C to 55°C</li> <li>• Air source heat of 20°C dry bulb/15°C wet bulb for air-to-water heat pump</li> <li>• Water source heat of 15°C for water-to- water heat pump</li> </ul> <p>(c) Combined Heat and Power (CHP) System The CHP system such as co-generation or tri-generation must meet the minimum Effective Electrical Efficiency as follows: -</p> <table border="1"> <thead> <tr> <th>Type of CHP</th><th>Effective Electrical Efficiency</th></tr> </thead> <tbody> <tr> <td>Combustion turbine-based CHP</td><td>0.50</td></tr> <tr> <td>Reciprocating engine-based CHP</td><td>0.70</td></tr> </tbody> </table> <p>(d) Photovoltaic Thermal (PV/T) or other low and zero carbon technology hot water systems</p> <p><b><u>(2) Computation of Service Hot Water Demand</u></b></p> <p>To capture the actual service water heat load for healthcare facilities for domestic and service hot water demand and steam sterilization.</p> <p>(a) Service hot water demand for patients wards,</p>	Type of CHP	Effective Electrical Efficiency	Combustion turbine-based CHP	0.50	Reciprocating engine-based CHP	0.70	<p><u>1-10 is a Prerequisite requirement for GreenRE Platinum rating</u></p> <p><b><u>GreenRE Credits for Category I:</u></b></p> <p>1 credit for meeting the minimum efficiency for each category of centralised hot water system.</p> <p>Thereafter, additional credit for every 10% improvement from minimum efficiency stated for each category (max 5 credits)</p> <p>(Up to 6 credits for HC1-10)</p> <p><b><u>GreenRE Credits for Category II:</u></b></p> <p>Up to max 2 credits for computation of total hotwater service demand.</p>
Type of CHP	Effective Electrical Efficiency						
Combustion turbine-based CHP	0.50						
Reciprocating engine-based CHP	0.70						

kitchen and restaurant/café only (1 credit)

**And**

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

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

**HC 1-11 Renewable Energy**

Encourage the application of renewable energy sources in buildings

5 credits for every 1% replacement of electricity (based on total electricity consumption) by renewable energy

**OR**

3 credits for every 10% of roof area used for solar panels.

(Up to 20 credits)

*Condition: the credits scored for renewable energy provision shall not result in a double-grade jump in GreenRE rating (i.e. from GreenRE certified to Gold or Silver to Platinum rating)*



## **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 Building Energy Intensity (BEI)**

Formula to be standardized as follows:

$$BEI = [(TBEC - CPEC) / (GFA \text{ excluding carpark})] \times FVR$$

Where:

- a. TBEC = Total building energy consumption (kWh/year)
- b. CPEC = Car Park Energy Consumption in (kWh/year)
- c. GFA = Gross Floor Area (exclude car park area) (m<sup>2</sup>)
- d. FVR = Floor Vacancy Rate (NLA) (m<sup>2</sup>)

0.5 credit

0.5 credit

0.5 credit

2 credits for the use of any item in HC 1-12 (b)

0.5 credits

<p><b>Sub-total (C) : HC 1-5 to 1-12</b></p>	
<p><b>Category Score for Part 1: Energy Efficiency</b></p> <p> <u>Subtotal (A) x Air-conditioned Floor Area</u>  Total Floor Area  +  <u>Subtotal (B) x Non Air-conditioned Floor Area</u>  Total Floor Area  +  Subtotal (C) </p>	<p><b>Sum of GreenRE credits obtained from HC 1-1 to 1-12:</b></p> <p><b>Maximum 116 Credits</b></p>

**(II) Other Green Requirements**

Part 2: Water Efficiency	GreenRE Credits									
<b><u>HC 2-1 Water Efficiency Fittings</u></b>  Encourage the use of water efficient fittings that are certified under the Water Efficiency Products Labelling Scheme (WEPLS).  a. Basin taps and mixers b. Flushing cistern c. Shower taps and mixers or showerheads d. Sink/bib taps and mixers e. Urinals and urinal flush valve	<table><tr><th colspan="3">Rating Based on Water Efficiency Products Labelling Scheme (WEPLS)</th></tr><tr><td>Efficient *</td><td>Highly Efficient **</td><td>Most Efficient ***</td></tr><tr><td>2 credits</td><td>4 credits</td><td>6 credits</td></tr></table> <p>Credits can be scored based on the number and water efficiency rating of the fitting type used.</p> <p>(Up to 6 credits)</p>	Rating Based on Water Efficiency Products Labelling Scheme (WEPLS)			Efficient *	Highly Efficient **	Most Efficient ***	2 credits	4 credits	6 credits
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Efficient *	Highly Efficient **	Most Efficient ***								
2 credits	4 credits	6 credits								
<b><u>HC 2-2 Water Usage and Leak Detection</u></b>  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	<p>1 credit</p> <p>1 credit</p>									
<b><u>HC 2-3 Irrigation System and Landscaping</u></b>  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. (Size of tank based on irrigation volume requirements to be set. Size of tank to be limited to available roof area.)  b. Use of automatic water efficient irrigation system with rain sensor  c. Use of drought tolerant plants that require minimal irrigation	<p>1 credit</p> <p>1 credit</p> <p>Extent of Coverage: At least 50% of the landscape areas are served by the system</p> <p>1 credit</p> <p>Extent of Coverage: At least 50% of the landscape areas</p>									

**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
- 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 credit)
- 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 credit

$$\text{Water saving at cooling tower} = \frac{\text{Heat diverted} / \text{Latent heat of evaporation}}{\text{Density of water}}$$

1 credit

1 credit

**Category Score for Part 2:  
Water Efficiency**

**Sum of GreenRE credits obtained  
from HC 2-1 to 2-4:**

**Maximum 14 Credits**

Part 3: Environmental Protection	GreenRE Credit																								
<b><u>HC 3-1 Sustainable Construction</u></b>  Encourage recycling and the adoption of building designs, construction practices and materials that are environmentally friendly and sustainable. <p>a. Use of sustainable and recycled materials;</p> <p>Green Cements with approved industrial by-product (such as Ground Granulated Blast furnace Slag (GGBS), silica fume, fly ash) to replace Ordinary Portland Cement (OPC).</p> <p>b. Concrete Usage Index (CUI)</p> <p>Encourage more efficient concrete usage for building components.</p> <p><i>Prerequisite Requirement:</i>  <i>Minimum score under NRB 3-1:</i>  <i>GreenRE Gold ≥ 3 credits</i>  <i>GreenRE Platinum ≥ 5 credits</i></p>	<table> <tr> <th>% Replacement of OPC by approved industrial by-products</th><th>Credits Allocation</th></tr> <tr> <td>10</td><td>1</td></tr> <tr> <td>20</td><td>1.5</td></tr> <tr> <td>30</td><td>2</td></tr> <tr> <td>40</td><td>2.5</td></tr> <tr> <td>&gt;50</td><td>3</td></tr> </table> <p>(Up to 3 credits)</p> <table> <tr> <th>Project CUI (m<sup>3</sup>/m<sup>2</sup>)</th><th>Credits Allocation</th></tr> <tr> <td>≤ 0.70</td><td>1</td></tr> <tr> <td>≤ 0.60</td><td>1.5</td></tr> <tr> <td>≤ 0.50</td><td>2</td></tr> <tr> <td>≤ 0.40</td><td>2.5</td></tr> <tr> <td>≤ 0.35</td><td>3</td></tr> </table> <p>(Up to 3 credits)</p>	% Replacement of OPC by approved industrial by-products	Credits Allocation	10	1	20	1.5	30	2	40	2.5	>50	3	Project CUI (m <sup>3</sup> /m <sup>2</sup> )	Credits Allocation	≤ 0.70	1	≤ 0.60	1.5	≤ 0.50	2	≤ 0.40	2.5	≤ 0.35	3
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<b><u>HC 3-2 Sustainable Products</u></b>  Encourage the use of products that are environmentally friendly and sustainable. <p><i>Prerequisite Requirement:</i>  <i>Minimum score under NRB 3-1:</i>  <i>GreenRE Gold ≥ 3 credits</i>  <i>GreenRE Platinum ≥ 5 credits</i></p>	<table> <tr> <th>Extent of use of environmentally friendly product</th><th>Weightage for Credit Allocation</th></tr> <tr> <td>Low Impact</td><td>0.5</td></tr> <tr> <td>Medium impact</td><td>1</td></tr> <tr> <td>High Impact</td><td>2</td></tr> </table> <p>Credits scored will be based on the extent of use of environmentally friendly product.</p> <p>(Up to 6 credits)</p>	Extent of use of environmentally friendly product	Weightage for Credit Allocation	Low Impact	0.5	Medium impact	1	High Impact	2																
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### **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 environmental requirements of NREA. In addition,

- a. Generator sets powered by engines up to 560kWm to meet hot water service demand shall meet emission levels as below: -

Genset Power (kW <sub>m</sub> )	Oxides of Nitrogen (NOx) (g/kW <sub>hr</sub> )	Hydrocarbon (HC) (g/kW <sub>hr</sub> )	Carbon Monoxide (CO) (g/kW <sub>hr</sub> )
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 560kWm to meet hot water service demand shall meet emission levels as below: -

Genset Power (kW <sub>m</sub> )	Oxides of Nitrogen (NOx) (g/kW <sub>hr</sub> )	Hydrocarbon (HC) (g/kW <sub>hr</sub> )	Carbon Monoxide (CO) (g/kW <sub>hr</sub> )
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

2 credits

3 credits  
(Up to 3 credits for HC 3-3)

Note:

For generator sets  $\geq 750\text{kWm}$ , it shall be installed, operated and maintained in calibration a NOx Continuous Emission System (CEMS) with data gathering and retrieval capability

### **HC 3-4 Greenery Provision and Healing Environment**

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 credit)
  - OR
  - ii. Green roof and roof top gardens
    - for more than 50% of the roof areas (1 credit)
    - for at least 25% of the roof areas (0.5 credit)
  - iii. Staff gardens with sitting areas/ a quiet green space with benches
  - iv. Space for programs such as horticultural therapy, group and physical therapy

GnPR	Credits Allocation
1.0 to <3.0	1 credit
≥3.0	3 credits

1 credit

0.5 credit

0.5 credit

### **HC 3-5 Stormwater Management**

Encourage the treatment of stormwater runoff through provision of infiltration or design features before discharge to public drains.

Provision of infiltration features or design features for new development and redevelopment in accordance with MSMA.

Reduce post development stormwater peak discharge rate and quantity from exceeding pre-development peak discharge rate and quantity:

10 - 25% - 1 credit

> 25% - 2 credits

(Up to 2 credits)

<p><b><u>HC 3-6 Refrigerants</u></b></p> <p>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.</p> <ul style="list-style-type: none"> <li>a. Refrigerants with ozone depletion potential (ODP) of zero or with global warming potential (GWP) of less than 100.</li> <li>b. Use of refrigerant leak detection system in critical areas of plant rooms containing chillers and other equipment with refrigerants.</li> </ul>	<p>0.5 credit</p> <p>0.5 credit</p>
<p><b><u>HC 3-7 Green Transport</u></b></p> <p>Promote environmental friendly transport options and facilities to reduce pollution from individual car use.</p> <ul style="list-style-type: none"> <li>a. Good access (&lt;800m walking distance) to public transport networks such as MRT/LRT / BRT stations or bus stops.</li> <li>b. Provision of infrastructure for electric charging stations to at least 10% of available parking spaces.</li> <li>c. Provision of hybrid/electric vehicle charging stations and priority parking lots within the development.</li> <li>d. Provision of covered / sheltered bicycles parking lots (i.e with rack / bar) and adequate shower and changing facilities.</li> </ul>	<p>1 credit</p> <p>1 credit</p> <p>Extent of coverage: Minimum 1 number priority parking bays for every 100 carpark lots. EV chargers – 1 for every 200 parking bays. (Cap at 3) (1 credit)</p> <p>Extent of Coverage : Minimum 10 number and maximum 50 numbers of bicycle parking lots (1 credit)</p>
<p><b>Category Score for Part 3: Environmental Protection</b></p>	<p><b>Sum of GreenRE credits obtained from HC 3-1 to 3-7:</b></p> <p><b>Maximum 27 Credits</b></p>



Part 4: Indoor Environmental Quality	GreenRE Credits
<p><b><u>HC 4-1 Thermal Comfort and Control for A/C Spaces</u></b></p> <p>I. Air-conditioning system is designed to ensure consistent indoor thermal comfort such that</p> <p>a. <u>Public areas</u> The indoor operative temperature should be maintained between 23°C to 26°C, with relative humidity between 50 – 70%.</p> <p>b. <u>Patient and General Clinical Areas</u> The indoor operative temperature should be maintained at 23+2°C, with relative humidity &lt;65% or in accordance with ASHRAE guidelines.</p> <p>c. <u>Clinical areas with Specialized Ventilation Systems</u> The indoor operative temperature and relative humidity should be maintained according to HTM- 03-01, Appendix 2 / Ministry of Health Malaysia (MOH) guidelines whichever is more stringent or equivalent international healthcare standards.</p> <p>d. <u>Operating Theatre and Surgery</u> The indoor operative temperature should be maintained between 18°C to 24°C with relative humidity ranging from 50% to 60% or according to HTM-03-01 Appendix 2. / Ministry of Health Malaysia (MOH) guidelines whichever is more stringent.</p> <p>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 <u>Prerequisite requirement for GreenRE Platinum ratings</u></p>	<p>0.5 credit</p> <p>0.5 credit</p> <p>0.5 credit</p> <p>0.5 credit</p> <p>1 credit</p>

#### **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.

##### **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: -

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

- 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

- 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<sup>2</sup> or less.

##### **Post Occupancy Stage**

- a. Conduct post-occupancy thermal comfort survey six months after operation.
- b. Implement corrective measures to improve thermal comfort of staff and patients following the post-occupancy survey.

4 credits

2 credits

*N.B: one credit each of the above target levels for (b), capped at max 2 credits.*

1 credit

1 credit

1 credit

<p><b><u>HC 4-3 Noise Level</u></b></p> <p>Occupied spaces in healthcare facilities are designed to meet the acoustic performance of the appropriate standards</p> <p>a. <u>Public Spaces</u></p> <p>55dB (6am – 10pm) <math>L_{Aeq}</math>  45dB (10pm – 6am) <math>L_{Aeq}</math></p> <p style="text-align: center;"><b>AND</b></p> <p>b. <u>Patient Wards and Clinical Areas</u></p> <p>i. The values of noise intrusion from external sources do not exceed thresholds set out in HTM 08-01, Table 1 / Ministry of Health Malaysia (MOH) guidelines whichever is more stringent.</p> <p>ii. The values for internal noise from mechanical and electrical services do not exceed thresholds set out in HTM 08-01, Table 2 / Ministry of Health Malaysia (MOH) guidelines whichever is more stringent.</p> <p>iii. The sounds levels and impact noise within noise-sensitive rooms meet the specified requirement set out in HTM 08- 01 / Ministry of Health Malaysia (MOH) guidelines whichever is more stringent.</p>	<p>1 credit</p> <p>for compliance with both (a) and (b)</p>
<p><b><u>HC 4-4 Indoor Air Pollutants</u></b></p> <p>Minimize airborne contaminants mainly from inside sources to promote a healthy indoor environment.</p> <p>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</p> <p>b. Use of low-emission flooring materials, carpets, wall panels and large surface products certified by approved local certification bodies</p>	<p>1 credit</p> <p>1 credit</p>

#### **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 at least MERV 13 filters.

0.5 credit

ii. Patient and General Clinical Areas according to HTM03-01, Clause 4.130, 4.131 and 4.145

0.5 credit

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)

0.5 credit

b. Maintaining pressure differentials between various zones within the building to minimize 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–

1 credit

ii. the building envelope is designed to minimize the introduction of pollutants due to air leakage in accordance with MS-1525:2014.

0.5 credit

<p>c. Provision of Infection Control Measures in ventilation systems and interior contact surfaces such as:-</p> <ul style="list-style-type: none"> <li>i. install UGVI in AHUs</li> <li>ii. apply germicidal coating in ventilation systems and interior contact surfaces or</li> <li>iii. apply self-cleaning Titanium Dioxide for interior contact surfaces</li> </ul>	<p>1 credit</p>
<p>d. Conduct IAQ audit for air-conditioned occupied spaces where the minimum sampling points shall follow DOSH Industry Code of Practice on Indoor Air Quality 2010 for:</p> <ul style="list-style-type: none"> <li>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.</li> <li>ii. Additional sampling shall be conducted from clinical areas with specialized ventilation systems and operating theatres and surgery.</li> <li>iii. The tests shall be carried out by an accredited laboratory for procedures related to the analysis of indoor air quality parameters under DOSH requirements and certified by a competent person as stated in the Industry Code of Practice on Indoor Air Quality 2010.</li> <li>iv. Carry out half-yearly IAQ audit and monitoring using portable IAQ monitoring equipment which is capable of measuring temperature, RH, CO, CO<sub>2</sub>, particles, TVOC, O<sub>3</sub>, and 40 parameters pertaining to identification of molds and pollen.</li> </ul>	<p>2 credits</p> <p>for compliance with HC 4-5 (d) (i, ii, iii)</p>
<p>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.</p>	<p>1 credit</p>

#### **HC 4-6 High Frequency Ballasts & PBT-reduced lamps**

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 luminaires and / or low flicker LED drivers to at least 90% of all applicable areas.

1 credit

- b. Use of PBT-reduced or free luminaires in at least 90% of all applicable areas

1 credit

Prerequisite requirements for GreenRE Platinum rating.

#### **HC 4-7 Daylighting and Glare**

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 and acceptable glare levels specified in MS-1525:2014.

Credits scored based on the extent of perimeter daylight zones:

Distance from Façade Perimeters (m)	Credits Allocation
≥ 3.0	1
4.0 – 5.0	2
> 5.0	3

Extent of coverage: At least 50% of occupied spaces (excluding specialized zones such as OT, radiography rooms, mortuary etc) with daylighting provisions meeting the illuminance level and are within the acceptable glare exposure levels calculated / simulated using the Unified Glare Probability (UGP) formula. Glare control measures to be implemented where necessary.

(up to 3 credits)

#### **HC 4-8 View out & Access to Indoor Places of Respite**

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

Provision of indoor places of respite such as: -

- Internal courtyard
  - Interior atria and greenhouse gardens
  - Wide corridors that offer seating with views of nature.
  - Places to pause with seating adjacent to destination credits
  - Display areas of flora and fauna

1 credit

<ul style="list-style-type: none"> <li>• <u>Interaction and recreation areas</u> <ul style="list-style-type: none"> <li>○ Family consultation spaces with views</li> <li>○ Meditation spaces, religious or grieving rooms</li> <li>○ Resource areas and libraries with seating</li> <li>○ Exercise and therapy spaces</li> </ul> </li> </ul>	1 credit
<b>Category Score for Part 4: Indoor Environmental Quality</b>	<b>Sum of GreenRE credits obtained from HC 4-1 to 4-8: Maximum 30 Credits</b>

Part 5: Sustainable Practices and Green Innovation	GreenRE Credit
<p><b><u>HC 5-1 Environmental Management Practice</u></b></p> <p>Encourage the adoption of environmental friendly practices during construction and building operation.</p> <ol style="list-style-type: none"> <li>Implement effective environmental friendly programmes including monitoring and setting targets to minimise energy use, water use and construction waste during construction.</li> <li>Main builder has good track record in the adoption of sustainable, environmentally friendly and considerate practices during construction.</li> <li>Building quality is assessed under the Quality Assessment System in Construction (QLASSIC) or Construction Quality Assessment System (CONQUAS).</li> <li>To performs IBS content scoring based on CIDB IBS scoring scheme.</li> <li>Developer, main builder, M&amp;E consultant and architect are ISO 14000 certified.</li> <li>Project team comprises one Certified GreenRE/Green Mark Manager (GM)</li> <li>Provision of facilities or recycling bins for collection and storage of different recyclable waste such as paper, glass, plastic etc.</li> <li>Energy policy, energy targets and regular review with top management's commitment as part of an environmental strategy</li> <li>Targets to improve building water performance against own building water performance baseline should be set. To show intent, measures and implementation strategies of water efficiency improvement plans over the next three years. Committed water savings accrued from proposed measures should be quantified.</li> </ol>	<p>1 credit</p> <p>1 credit</p> <p>1 credit</p> <p>1 credit</p> <p>0.25 credit for each firm (Up to 1 credit)</p> <p>1 credit for certified GRM/GMM</p> <p>0.5 credit</p> <p>0.5 credit</p> <p>0.5 credit</p>



<p>j. Green procurement policy – Adoption of sustainable and environmental-friendly procurement and purchasing policy in the operation and maintenance of the building.</p>	<p>0.5 credit</p>
<p><b><u>HC 5-2 Conservation of existing structures and adoption of demolition protocol</u></b></p> <p>Encourage conservation of existing building structures and adoption of demolition protocol to maximise resource recovery.</p> <p>a. Conservation of existing building structure or building envelopes (by area)</p> <p>i. conserving &gt;50% of the existing structure or building envelope</p> <p>ii. conserving at least 25% of the existing structure or building envelope</p> <p>b. Adoption of demolition protocol to maximise resource recovery of demolition materials for reuse or recycling</p> <p>i. recovery rate of &gt;35% crushed concrete waste to be sent to the approved recyclers with proper facilities</p> <p>ii. recovery rate of at least 20% crushed concrete waste to be sent to the approved recyclers with proper facilities.</p>	<p>2 credits</p> <p>1 credit (up to 2 credits for (a))</p> <p>2 credits</p> <p>1 credit (up to 2 credits for (b))</p>

<p><b><u>HC 5-3 Other green practices and innovative features</u></b></p> <p>Encourage the use of green features which are innovative and have positive environmental impact.</p> <p>Examples:</p> <ul style="list-style-type: none"> <li>• Pneumatic waste collection system</li> <li>• Dual chute system</li> <li>• Self-cleaning façade system</li> <li>• Infiltration trenches</li> <li>• Integrated storm water retention/treatment into landscaping</li> <li>• Etc</li> </ul>	<p>0.5 credits for each item in the green and innovative features</p> <p>(up to 3 credits for HC 5-3)</p>
<p><b>Category Score for Part 5: Sustainable Practices and Green Innovation</b></p>	<p><b>Sum of GreenRE credits obtained from HC 5-1 to 5-3: Maximum 15 Credits</b></p>

Part 6: Carbon Footprint of Development	GreenRE Credit
<p><b><u>HC 6-1 CARBON FOOTPRINT OF DEVELOPMENT</u></b></p> <p>Recognise the carbon emission based on operational carbon footprint computation of the building comprising energy and water consumption</p> <p>To identify carbon debt and quantify environmental impact and embodied energy, as well as allow benchmarking of projects over time using BCA's online embodied carbon calculator.</p>	<p>1 credit</p> <p>1 credit – Carbon footprint calculation of any four (4) building materials listed</p> <p>2 credits – complete carbon footprint calculation for all building materials listed.</p> <p>(up to 2 credits)</p>
<p><b>Category Score for Part 6: Carbon Footprint Of Development</b></p>	<p><b>Sum of GreenRE credits obtained from HC 6-1</b></p> <p><b>Maximum 3 credits</b></p>
<p><b>GreenRE Score (Healthcare Facilities)</b></p> $\text{GreenRE Score (Healthcare Facilities)} = \sum \text{Category Score [(Part 1 – Energy Efficiency) + (Part 2 – Water Efficiency) + (Part 3–Environmental protection) + (Part 4 – Indoor Environmental Quality) + (Part 5 – Sustainable Practices and Green Innovation) + (Part 6 – Carbon Footprint of Development)]}$ <p>where Category Score for Part 1 <math>\geq</math> 30 credits and <math>\sum</math>Category Score for Parts 2, 3, 4 &amp; 5 <math>\geq</math> 20 credits</p>	