



DESIGN REFERENCE GUIDE

HEALTHCARE FACILITIES

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1. About GreenRE

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2. Introduction

The GreenRE assessment scheme was established in 2013 and is a recognised 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 New 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	16th July 2018
1.0	Revised for Implementation	January 2024
1.1	Revised for Implementation	April 2025
2.0	Revised for Implementation	February 2026

4. GreenRE Assessment Stages

The GreenRE New Healthcare Facilities Certification process is as follows:



Application

- Submittal of application with relevant supporting documents for certification upon strategic inception of New Facilities design.



Pre-Assessment

- A pre-assessment can be conducted (optional) to give the project team a better understanding of the criteria and evaluation of the certification level sought. This should be performed upon selection of suitable design option to allow teams to identify and maximise opportunities at the earliest stages of the project.



Actual Assessment

- Actual assessment to be conducted once the design and documentary evidences (e.g. approved plan) are ready. After the actual assessment, our assessors will review the documents submitted. Assessment process includes design and documentary reviews to verify if the New Healthcare Facilities meets:
 - i. The intents of the criteria
 - ii. The pre-requisite requirement for GreenRE Bronze, Silver, Gold and Platinum rating where applicable.
- Provisional Certificate will be issued upon completion of this stage.



Site Verification

- Site verification to be conducted upon project completion.
- Final Certificate will be issued upon completion of this stage.

5. GreenRE Healthcare Facilities Rating System

OVERVIEW:

The GreenRE Healthcare Facilities rating system is targeted for use in **new 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. The number of credits achievable for this group is capped at 50 credits (exclude 20 bonus credits that are obtainable under NHC 1-11 – Renewable Energy).

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 & Part 6 – Carbon Emission of Development. 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. The number of credits achievable for this group is also capped at 50 credits.

The maximum GreenRE score achievable for a project is capped at 100 credits and this does not include 20 bonus credits that are obtainable under Energy Related Requirements if a project uses renewable energy sources. The credit scored for renewable energy provision shall not result in a double grade jump in GreenRE rating (i.e. from GreenRE Bronze or Silver to Gold or Platinum)

Under the new healthcare facilities criteria, the environmental impact category Part 1 – Energy Efficiency applies to both air-conditioned and non-air-conditioned spaces. Where there is a combination of air-conditioned and non-air-conditioned spaces, the credits allocated are to be prorated in accordance with the respective floor areas.

For simplicity, credits applicable to air-conditioned areas are accounted only if the aggregate air-conditioned areas exceed 1000 m². Similarly, credits applicable to non-air-conditioned areas are accounted only if the aggregate non-air-conditioned areas are more than 10% of the total floor areas excluding carparks and common areas.

Framework:



To achieve GreenRE Award



Pre-requisite & Mandatory Requirements



Energy Related Requirements
Minimum 30 credits



Other Green Requirements
Minimum 20 credits

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

Elective Requirement for Other Areas
(Combination of the following items to meet 20 credits)

PART 1 - ENERGY EFFICIENCY

- NHC 1-1 Thermal Performance of Building Envelope - OTTV
- NHC 1-2 Air-Conditioning System
- NHC 1-3 Building Envelope – Design/Thermal Parameters
- NHC 1-4 Natural Ventilation
- NHC 1-5 Electrical Services
- NHC 1-6 Artificial Lighting
- NHC 1-7 Ventilation in Carparks
- NHC 1-8 Lifts and Escalators
- NHC 1-9 Airside Energy Recovery
- NHC 1-10 Local Energy Generation for Centralised Service Hot Water Heating
- NHC 1-11 Renewable Energy
- NHC 1-12 Energy Efficient Practices & Features

PART 2 - WATER EFFICIENCY

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

PART 3 – ENVIRONMENTAL PROTECTION

- NHC 3-1 Sustainable Construction
- NHC 3-2 Sustainable Products
- NHC 3-3 Airborne Contaminant Prevention
- NHC 3-4 Greenery Provision and Healing Environment
- NHC 3-5 Stormwater Management
- NHC 3-6 Refrigerants
- NHC 3-7 Green Transport

PART 4 - INDOOR ENVIRONMENTAL QUALITY

- NHC 4-1 Thermal Comfort and Control for A/C Spaces
- NHC 4-2 Thermal Comfort for N/V Spaces
- NHC 4-3 Noise Level
- NHC 4-4 Indoor Air Pollutants
- NHC 4-5 Indoor Air Quality
- NHC 4-6 High Frequency Ballasts & PBT-reduced Lamp
- NHC 4-7 Daylighting and Glare
- NHC 4-8 View out & Access to Indoor Places of Respite

PART 5 – SUSTAINABLE PRACTICES AND GREEN INNOVATION

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

PART 6 – CARBON EMISSION OF DEVELOPMENT

- NHC 6-1 Carbon Emission of Development

CREDIT ALLOCATION:

	Category	Credits Allocations
(I) Energy Related Requirements		
Minimum 30 credits	Part 1: Energy Efficiency	
	NHC 1-1 Thermal Performance of Building Envelope - OTTV	12
	NHC 1-2 Air-Conditioning System	31
	Sub-Total (A) – NHC 1-1 to 1-2	43
	NHC 1-3 Building Envelope – Design/Thermal Parameters	35
	NHC 1-4 Natural Ventilation/ Mechanical Ventilation	20
	Sub-Total (B) – NHC 1-3 to 1-4	55
	NHC 1-5 Electrical Services	7
	NHC 1-6 Artificial Lighting	12
	NHC 1-7 Ventilation in Carparks	4
	NHC 1-8 Lifts and Escalators	2
	NHC 1-9 Airside Energy Recovery	6
	NHC 1-10 Local Energy Generation for Centralised Service Hot Water Heating	8
NHC 1-11 Renewable Energy	20	
NHC 1-12 Energy Efficient Practices & Features	4	
Sub-Total (C) – NHC 1-5 to 1-12	63	
Category Score for Part 1 – Energy Efficiency: Prorate (A) + Prorate (B) + (C)	116	
(II) Other Green Requirements		
Minimum 20 credits (Part 2 to 6)	Part 2: Water Efficiency	
	NHC 2-1 Water Efficient Fittings	6
	NHC 2-2 Water Usage and Leak Detection	2
	NHC 2-3 Irrigation System and Landscaping	3
	NHC 2-4 Water Consumption of Cooling Towers	3
	Category Score for Part 2 – Water Efficiency	14
	Part 3: Environmental Protection	
	NHC 3-1 Sustainable Construction	6
	NHC 3-2 Sustainable Products	6
	NHC 3-3 Airborne Contaminant Prevention	3
	NHC 3-4 Greenery Provision and Healing Environment	5
	NHC 3-5 Stormwater Management	2
	NHC 3-6 Refrigerants	1
	NHC 3-7 Green Transport	4
	Category Score for Part 3 – Environmental Protection	27
	Part 4: Indoor Environmental Quality	
	NHC 4-1 Thermal Comfort and Control for A/C Spaces	3
	NHC 4-2 Thermal Comfort for N/V Spaces	9
	NHC 4-3 Noise Level	1
	NHC 4-4 Indoor Air Pollutants	2
NHC 4-5 Indoor Air Quality	8	
NHC 4-6 High Frequency Ballasts PBT-reduced Lamps	2	
NHC 4-7 Daylighting and Glare	3	
NHC 4-8 View out & Access to Indoor Places of Respite	2	
Category Score for Part 4: Indoor Environmental Quality	30	
Part 5: Sustainable Practices and Green Innovation		
NHC 5-1 Environmental Management Practice	8	
NHC 5-2 Conservation of Existing Structures and Adoption of Demolition Protocol	4	
NHC 5-3 Other Green Practices and Innovative Features	3	
Category Score for Part 5: Other Green Features	15	
Part 6: Carbon Emission of Development		
NHC 6-1 Carbon Emission of Development	3	
Category Score for Part 6 – Carbon Emission of Development	3	
Category Score for Part 2 to Part 6 – Other Green Requirements	89	
GreenRE New Healthcare Facilities Score:		205 (Max)

6. GreenRE Healthcare Facilities Rating System Scoring



Score:
91 and above

GreenRE Platinum



Score:
86 to < 90

GreenRE Gold



Score:
76 to < 85

GreenRE Silver



Score:
50 to < 75

GreenRE Bronze



7. GreenRE New Healthcare Facilities Rating System Criteria

PRE-REQUISITE



GENERAL

- Building envelope design with Overall Thermal Transfer Value (OTTV) computed based on the methodology and guidelines stipulated in the MS1525:2019.

GreenRE Gold	OTTV of 42 W/m ² or lower
GreenRE Platinum	OTTV of 40 W/m ² or lower

- To demonstrate the 6% energy saving over its reference model using static calculation for GreenRE Bronze and Silver.

- Building Energy Intensity (BEI) calculation

- Minimum score under NHC 1-6 Artificial Lighting

GreenRE Gold	≥ 5 credits
GreenRE Platinum	≥ 5 credits

- NHC 2-1 Water Efficient Fittings - To demonstrate reduction of potable water usage by 10% from baseline.

- Minimum score under NHC 3-1 Sustainable Construction

GreenRE Gold	≥ 3 credits
GreenRE Platinum	≥ 5 credits

- Minimum score under NHC 3-2 Sustainable Products

GreenRE Gold	≥ 3 credits
GreenRE Platinum	≥ 4 credits

- NHC 3-4 (a) Green Plot Ratio site inventory analysis and carbon sequestration calculation.

- NHC 5-1(a) Environmental Management Plan (EMP) during construction.

- NHC 4-1(a) To meet the minimum requirement of ASHRAE 62.1. Ventilation for Acceptable Indoor Air Quality.

- NHC 5-1(g) Provision of facilities or recycling bins for collection and storage of different recyclable waste such as paper, glass, plastic etc and establish the Waste Management Route and provide recycler details.
- Provision of Building User Guide and Sustainable Operation Management Guide.
- NHC 6-1(a) & (b) & (c) Calculation of operation and embodied carbon
- 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 New 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 New Healthcare Facilities for domestic and service hot water demand and steam sterilisation.
- 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 luminaires in at least 90% of all applicable areas.



MINIMUM SYSTEMS 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 ⁽¹⁾ (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-Conditioners:

GreenRE Rating	Building Cooling Load (RT)	
	< 500	≥ 500
	Efficiency ⁽¹⁾ (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 (e.g. stratified and/or multi-block developments) and seeking Gold / Platinum GreenRE rating will be assessed on a case-by-case basis.



ENERGY EFFICIENCY COMPLIANCE

Projects shall demonstrate the stipulated performance through either option listed below (Gold and Platinum projects with air-conditioning system only):



Option 1: Energy Saving

- To demonstrate the stipulated energy savings over its reference model using an energy modelling framework set out. Details and submission requirements on energy modelling can be found in Appendix A Energy Modelling Guideline.

Type of AC System	Energy Saving Required (%)	
	Gold	Platinum
Centralized Air Conditioning system / Unitary system	25	30



Option 2 – Building Energy Intensity (BEI) Benchmarking

- To demonstrate the stipulated Building Energy Intensity (BEI) using an energy modelling framework set out. Details and submission requirements on energy modelling can be found in Appendix A Energy Modelling Guideline. (Baseline – MS1525:2007)

BEI is derived using the following equation:

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

Where:

TBEC = Total building energy consumption excluding the renewable energy replacement (kWh/year)

CPEC = Car Park Energy Consumption in (kWh/year)

GFA = Gross Floor Area (exclude car park area) (m²)

GLA = Gross Lettable Area (m²)

FVR = Floor Vacancy Rate (NLA) (m²)

NF = Normalizing factor based on a typical weekly operating hour that is 52 Hrs/week [only for office category]

OH = Weighted weekly operating hours (hrs/week) [only for office category]

Note:

- Design BEI is based on 100% occupancy rate for consistency.
- All major active equipment to be included in the estimation of TBEC.
- During verification stage, if the occupancy rate is low, e.g., only 20% occupancy rate, it needs to be projected to 80% to get the BEI which reflects the actual operation situation

Building Type	Gold (kWh/m ² /year)	Platinum (kWh/m ² /year)
Hospital (Private and General)	375	340
Community Hospitals	230	120
Polyclinics	150	135
Nursing / Youth Homes	90	80



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.

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 ≥ 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
$-0.1 < PMV < +0.1$	< 10



BUILDING DEVELOPMENTS WITH MORE THAN 30% NON AIR-CONDITIONED SPACES

Pre-requisite 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 Non Air-Conditioned Spaces (m ²)	Ventilation Simulation Requirement	Energy Modelling Requirement	Justification on Energy Savings
≥ 2000	≥ 5000	Yes	Yes	No
< 2000	≥ 5000	No	Yes	No
≥ 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.



MANDATORY REQUIREMENTS:



BUILDING ENVELOPE - OTTV

- The OTTV of the building envelope for a building, having a **total air-conditioned area exceeding 1000 m² and above should not exceed 50 W/m².**



ROOF

- In the **case of an air-conditioned building**, the concept of Roof Thermal Transfer Value (RTTV) is applied if the roof is provided with skylight and the entire enclosure below is fully air-conditioned.
- For roofs with skylight, the maximum recommended RTTV is 25 W/m².



ROOF – U-VALUE

- **The roof of the building** shall not have a thermal transmittance (U-Value) greater than that tabulated in Table 2-1.

Roof Weight Group	Maximum U-Value (W/m ² K)
Light (Under 50 kg/m ²)	0.4
Heavy (Above 50 kg/m ²)	0.6

Table 2-1 Maximum U-Value for Roof (W/m²K)

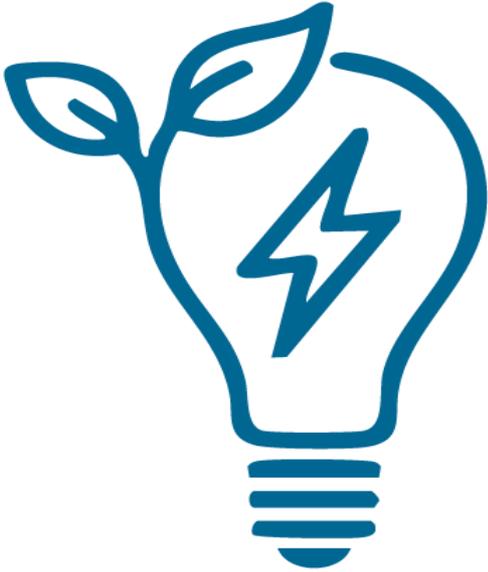


ENERGY MANAGEMENT SYSTEM

- To Install Energy Management System where air-conditioned space is greater than 4000m²



Provision of differently-able amenities based on recommended or best practices as UBBL, MS1183 Part-8, MS1184, MS1331 and etc.



Part 1

Energy Efficiency



Part 1 – Energy Efficiency

(I) ENERGY RELATED REQUIREMENTS

(A) Applicable to Air-Conditioned Building Area (with an aggregate air-conditioned area $\geq 1000\text{m}^2$)

NHC 1-1 THERMAL PERFORMANCE OF BUILDING ENVELOPE - OTTV

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

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

Prerequisite Requirement:

GreenRE Gold - OTTV of 42W/m^2 or lower

GreenRE Platinum - OTTV of 40W/m^2 or lower

GREENRE CREDITS

With reference to the maximum permissible OTTV value of 50W/m^2 as a baseline.

Credits scored = $1.2 \times [50 - (\text{OTTV})]$

where $\text{OTTV} \leq 50\text{W/m}^2$

(Maximum 12 credits)

NHC 1-2 AIR-CONDITIONING SYSTEM

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

Baseline	Peak Building Cooling Load	
	$\geq 500\text{RT}$	$<500\text{RT}$
<u>Prerequisite Requirements</u> Minimum Design System Efficiency (DSE) for central chilled-water plant	0.75 kW/RT	0.85 kW/RT

GREENRE CREDITS

a. Water-Cooled Chilled-Water Plant:

Peak building cooling load $\geq 500\text{RT}$

15 credits for meeting the prescribed chilled-water plant efficiency of 0.75 kW/ton

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

Credit scored = $0.25 \times (\% \text{ improvement})$



Pre-requisite requirements for higher GreenRE ratings:
 GreenRE Gold & Platinum: Minimum Design System (DSE) of 0.65 kW/RT for peak building cooling load \geq 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

Baseline	Peak Building Cooling Load	
	\geq 500 RT	< 500 RT
<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 (1): 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)

Peak building cooling load < 500 RT

12 credits for meeting the prescribed chilled-water plant efficiency of 0.85 kW/ton

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

Credit scored = 0.45 x (% improvement)

(Up to 20 credits can be scored for NHC 1-2(a))

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

Peak building cooling load \geq 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

Credit 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

Credit scored = 0.6 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 NHC 1-2(c))



Option 1 – Fan System Motor Nameplate Power

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



Option 2 – Fan System Motor Nameplate Power

Baseline Air Distribution System Type	Allowable Fan System Input Power	
	(kW/m ³ /s)	(W/CMH)
AHUs / FCUs ≥ 4kW (Constant Volume)	1.5	0.42
AHUs ≥ 4kW (Variable Volume)	2.1	0.58
Fan systems with nameplate motor power < 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 NHC 1-2 (a) and (b) will be prorated based on the air distribution system efficiency under NHC 1-2 (c).

d. Pre-requisite requirements:

Provision of permanent measuring instruments for monitoring of water-cooled chilled water plant and air-cooled chilled water plant efficiency. The installed instrumentation shall have the capability to calculate resultant plant efficiency (i.e. kW/RT) within 5% of its true value and in accordance with ASHRAE Guide 22 and AHRI 550/590. Compliance of the following instrumentation and installation is also required.

- Location and installation of the measuring devices to meet the manufacturer’s and engineer’s recommendation.
- Data acquisition system to have a minimum resolution of 16 bit.
- All data logging capable of trending at a sampling interval of 1 min.
- Flow meters are to be provided for chilled-water and condenser water loop and shall be of ultrasonic/full bore magnetic type or equivalent.
- 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 measurement location to have two spare thermo-wells located at both sides of the temperature sensor for verification of reading accuracy.
- 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.

2 credits

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

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 credit

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 credit



g. Sensors or similar automatic control devices are used to regulate outdoor air flow rate to maintain the concentration of CO ₂ . Indoor CO ₂ acceptable range ≤ 700ppm above outdoor concentration.	1 credit
SUB-TOTAL (A):	Sum of GreenRE credits obtained from NHC 1-1 to 1-2



(B) Applicable to non-air-conditioned building areas (with aggregate non-air-conditioned areas ≥ 10% of total floor area excluding carparks and common areas)

NHC 1-3 BUILDING ENVELOPE – DESIGN/THERMAL PARAMETERS

GREENRE CREDITS

Enhance the overall thermal performance of building envelope to minimize 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.

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

(Up to 15 credits for NHC 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.

b. i. Minimum west facing window openings.

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

ii. Effective sun shading provision for windows on the west façade with minimum shading of 30%.

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

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

c. Better thermal transmittance (U-value) of external west facing walls, which should be equal or less than 2 W/m²K.

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 NHC 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.

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

Credits scored = 1 credit for every 0.1 W/m²K reduction from baseline roof U-value

(Up to 5 credits for NHC 1-3 (d))

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

NHC 1-4 NATURAL VENTILATION	GREENRE CREDITS
<p>a. Natural Ventilation – prescriptive approach</p> <p>i. In Occupied Spaces where building design facilitates <i>optimum</i> natural ventilation through proper design of building layout that utilizes prevailing wind conditions to achieve adequate cross ventilation;</p> <p>ii. In Transient Spaces such as: -</p> <ul style="list-style-type: none"> • lift lobbies and atrium • toilets <p>iii. In Circulation Areas such as:</p> <ul style="list-style-type: none"> • Staircases (including BOMBA staircase) and corridors <p>where reverse airflow in transient and circulation areas is unlikely to affect the immediate adjacent rooms or department with controlled ventilation.</p>	<p>1 credit for every 10% of NV areas with window openings facing north and south directions and cross ventilation</p> <p>Credits scored = $1 \times (\% \text{ units}/10)$</p> <p>(Up to 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>b. Natural Ventilation – performance approach</p> <p>i. Use of CFD modelling or wind tunnel testing to optimize the effective building layout that maximizes natural ventilation in the occupied spaces</p> <p><u><i>Pre-requisite requirement for GreenRE Platinum ratings</i></u></p>	<p>5 credits</p>
<p>ii. In conjunction with Wind-driven rain (WDR) simulation that minimizes that impact of wind-driven rain into naturally-ventilated occupied spaces.</p>	<p>5 credits</p>
<p>SUB-TOTAL (B):</p>	<p>Sum of GreenRE credits obtained from NHC 1-3 to 1-4</p>

(C) GENERAL

NHC 1-5 ELECTRICAL SERVICES

GREENRE CREDITS

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

a. Energy Use and Sub-metering

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

i. Separately meter either

- Substantial energy uses such as space cooling, domestic hot water, ventilation, lighting and plug loads

OR

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

ii. And link all energy sub-meters to BMS, EMS or other automated system

2 credits

b. Provision of low-loss service transformers

Efficiency of service transformers to meet the requirements of MS1525.

2 credits

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%	90.0%	91.0%	91.5%	93.0%
50% load	91.5%	93.0%	93.5%	94.0%	95.5%
75% load	92.5%	93.5%	94.0%	94.5%	96.0%
100% load	92.5%	93.5%	94.0%	94.5%	96.0%

iii. Stand-by mode

	UPS Range (kVA)				
	≥5 to <10	10 to <20	20 - <40	40 - <200	≥200
25% load	90.0%	94.0%	94.5%	95.0%	95.5%
50% load	93.0%	96.0%	96.5%	97.0%	97.5%
75% load	94.0%	96.5%	97.0%	97.5%	98.0%
100% load	94.0%	96.5%	97.0%	97.5%	98.0%

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

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



NHC 1-6 ARTIFICIAL LIGHTING	GREENRE CREDITS
<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 MS1525:2019 as a baseline:</p> <p>Credits scored = 0.25 x (% improvement)</p> <p>*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>
NHC 1-7 VENTILATION IN CARPARKS	GREENRE CREDITS
<p>Encourage the use energy efficient design and control of ventilation systems on 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"> • Fume extract 	<p>2.5 credits</p>
<ul style="list-style-type: none"> • MV with or without supply 	<p>2 credits</p> <p>Note: Where there is a combination of different ventilation modes adopted for carpark design, the credits obtained under NHC 1-7 will be prorated accordingly</p> <p>(Up to 4 credits for NHC 1-7)</p>
NHC 1-8 LIFTS AND ESCALATORS	GREENRE CREDITS
<p>a. Encourage the use of lift with energy efficient features such as sleep mode or regenerative features and motorless lift.</p>	<p>Extent of Coverage: All lifts and/or escalators</p> <p>1 credit</p>
<p>b. Escalators with energy efficient features such as motion sensors.</p>	<p>1 credit</p>

<p>NHC 1-9 AIRSIDE ENERGY RECOVERY</p>	<p>GREENRE CREDITS</p>
<p>Promote airside energy recovery to all healthcare ventilation systems.</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 pre-requisite requirement for GreenRE Platinum rating</u></p>
<p>a. Provision of run-around coil that could achieve the minimum 45% energy transfer efficiencies</p>	<p>2 credits</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>2 credits</p>
<p>c. Provision of any other energy-recovery device of minimum 50% energy transfer efficiency</p>	<p>2 credits</p>
<p>NHC 1-10 LOCAL ENERGY GENERATION FOR CENTRALIZED SERVICE HOT WATER HEATING</p>	<p>GREENRE CREDITS</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><u>NHC 1-10 is a Pre-requisite requirement for GreenRE Platinum rating</u></p>
<p>Centralized Hot Water Heating Systems</p> <p>a. Solar Thermal Hot Water System</p> <p>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</p> <p>The heat pump meeting minimum heating COP of 3.5 under the standard testing conditions as follows: -</p> <ul style="list-style-type: none"> • Heating water from 15°C to 55°C • Air source heat of 20°C dry bulb/15°C wet bulb for air-to-water heat pump • Water source heat of 15°C for water-to- water heat pump 	<p>1 credit for meeting the minimum efficiency for each category of centralized 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 NHC1-10)</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:

Type of CHP	Effective Electrical Efficiency
Combustion turbine-based CHP	0.50
Reciprocating engine-based CHP	0.70

d. Photovoltaic Thermal (PV/T) or other low and zero carbon technology hot water systems

Computation of Service Hot Water Demand

To capture the actual service water heat load for New Healthcare Facilities for domestic and service hot water demand and steam sterilisation.

- a. Service hot water demand for patients' wards, 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
Sterilizing	2.869

Up to 2 credits for computation of total hotwater service demand.

NHC 1-11 RENEWABLE ENERGY	GREENRE CREDITS
<p>Encourage the application of renewable energy sources in buildings</p>	<p>5 credits for every 1% replacement of electricity (based on total electricity consumption) by renewable energy</p> <p>OR</p> <p>3 credits for every 10% of roof area used for solar panels.</p> <p>OR</p> <p>1 credit for the solar ready roof.</p> <p>Note: The credit scored for renewable energy provision shall not result in a double grade jump in GreenRE rating (i.e. from GreenRE Bronze or Silver to Gold or Platinum)</p> <p>(Up to 20 credits)</p>
NHC 1-12 ENERGY EFFICIENT PRACTICES & FEATURES	GREENRE CREDITS
<p>Encourage the implementation of energy-efficient features and practices that are innovative and reduce building energy consumption.</p>	
<p>a. Daylighting in common areas</p> <p>To use Photocell sensors for maximizing the use of daylighting in the following common areas:</p>	
<ul style="list-style-type: none"> • Circulation areas (staircases and corridors) 	<p>0.5 credit</p>
<ul style="list-style-type: none"> • Transient spaces (lift lobbies, atrium and toilets) 	<p>0.5 credit</p>
<ul style="list-style-type: none"> • Carparks 	<p>0.5 credit</p>
<p>b. Use of energy-efficient features</p> <ul style="list-style-type: none"> • Sun pipes • Light shelves 	<p>2 credits for the use of any item in NHC 1-12 (b)</p>

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:

TBEC = Total building energy consumption excluding renewable energy replacement (kWh/year)

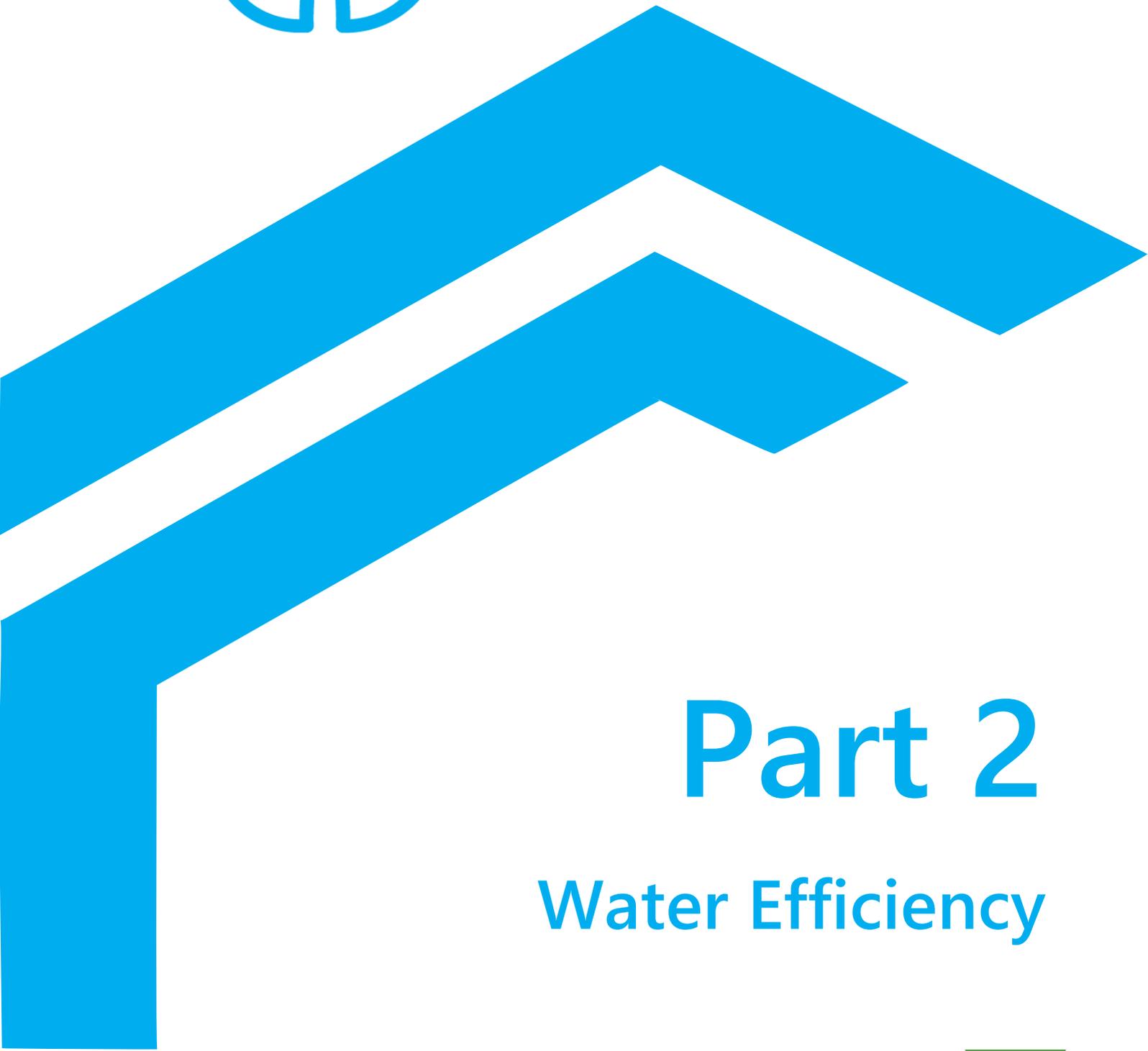
CPEC = Car Park Energy Consumption in (kWh/year)

GFA = Gross Floor Area (exclude car park area) (m²)

FVR = Floor Vacancy Rate (NLA) (m²)

0.5 credits

Sub-total (C):	Sum of GreenRE credits obtained from NHC 1-5 to 1-12
<p>PART 1 – ENERGY EFFICIENCY CATEGORY SCORE:</p> $\text{Subtotal (A)} \times \frac{\text{Air-conditioned Floor Area}}{\text{Total Floor Area}} +$ $\text{Subtotal (B)} \times \frac{\text{Non Air-conditioned Floor Area}}{\text{Total Floor Area}} +$ <p style="text-align: right;">Subtotal (C)</p>	Sum of GreenRE credits obtained from NHC 1-1 to 1-12



Part 2

Water Efficiency



Part 2 – Water Efficiency

(II) OTHER GREEN REQUIREMENTS

NHC 2-1 WATER EFFICIENCY FITTINGS

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

GREENRE CREDITS

Weightage Based on Water Efficiency Products Labelling Scheme (WEPLS)

Efficient*	Highly Efficient**	Most Efficient***
2 credits	4 credits	6 credits

Credits can be scored based on the number and water efficiency rating of the fitting type used.
(Up to 6 credits)

NHC 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.

GREENRE CREDITS

1 credit

1 credit

NHC 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 with provision of submetering for monitoring during the operation.

GREENRE CREDITS

1 credit

<p>b. Use of water efficient irrigation system with rain sensor.</p>	<p>1 credit Extent of Coverage: At least 50% of the landscape areas are served by the system</p>
<p>c. Use of drought tolerant plants that require minimal irrigation.</p>	<p>1 credit Extent of Coverage: At least 50% of the landscape areas</p>
<p>NHC 2-4 WATER CONSUMPTION OF COOLING TOWER</p>	<p>GREENRE CREDITS</p>
<p>To minimise water loss in cooling tower and seek alternate water sources to reduce potable water use for cooling purposes.</p>	
<p>a. Use of cooling tower water treatment system that can achieve 7 or better cycles of concentration at acceptable water quality.</p>	<p>1 credit</p>
<p>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:</p> <p style="text-align: center;">Water saving at cooling tower = $\frac{\text{Heat diverted} / \text{Latent heat of evaporation}}{\text{Density of water}}$</p>	<p>1 credit</p>
<p>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.</p>	<p>1 credit</p>
<p>PART 2 – WATER EFFICIENCY CATEGORY SCORE:</p>	<p>Sum of GreenRE credits obtained from NHC 2-1 to 2-4</p>



Part 3

Environmental Protection



Part 3 – Environmental Protection

NHC 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;

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).

GREENRE CREDITS

% Replacement of OPC by approved industrial by-products	Credits Allocation
10	1
20	1.5
30	2
40	2.5
>50	3

(Up to 3 credits)

b. Concrete Usage Index (CUI)

Encourage more efficient concrete usage for building components.

Project CUI (m ³ /m ²)	Credits Allocation
≤ 0.70	1
≤ 0.60	1.5
≤ 0.50	2
≤ 0.40	2.5
≤ 0.35	3

(Up to 3 credits)

Prerequisite Requirement:

Minimum score under NHC 3-1:

GreenRE Gold ≥ 3 credits

GreenRE Platinum ≥ 5 credits

NHC 3-2 SUSTAINABLE PRODUCTS

Encourage the use of products that are environmentally friendly and sustainable as follow:

- Eco Label products
- Wood products certified by the Forest Stewardship council (FSC) or the Malaysia Certification Council (MTCC)
- Agreement of the manufacturer or suppliers for the buyback programmes within the life cycle or at the end of materials life for recycling reuse purpose

Prerequisite Requirement:

Minimum score under NHC 3-1:

GreenRE Gold \geq 3 credits

GreenRE Platinum \geq 5 credits

GREENRE CREDITS

Extent of use of environmentally friendly product	Weightage for Credit Allocation
Low Impact	0.5
Medium impact	1
High Impact	2

Credits scored will be based on the extent of use of environmentally friendly product.

(Up to 6 credits)

NHC 3-3 AIRBORNE CONTAMINANT PREVENTION

Prevent air-borne contaminant releases and NO_x emissions from fuel burning processes.

The emission limits of Carbon Monoxide (CO), Oxides of Nitrogen (NO_x) 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 (kWm)	Oxides of Nitrogen (NO _x) (g/kW hr)	Hydrocarbon (HC) (g/kW hr)	Carbon Monoxide (CO) (g/kW hr)
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

GREENRE CREDITS

2 credits

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

Genset Power (kWm)	Oxides of Nitrogen (NO _x) (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

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

Note:

For generator sets ≥750kWm, it shall be installed, operated and maintained in calibration a NO_x Continuous Emission System (CEMS) with data gathering and retrieval capability

NHC 3-4 GREENERY PROVISION AND HEALING ENVIRONMENT

GREENRE CREDITS

Encourage greater use of greenery and restoration of existing trees to reduce heat island effect.

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

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

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

OR

1 credit

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

0.5 credit

<p>iv. Space for programs such as horticultural therapy, group and physical therapy</p>	<p>0.5 credit</p>
<p>NHC 3-5 STORMWATER MANAGEMENT</p>	<p>GREENRE CREDITS</p>
<p>Encourage the treatment of stormwater runoff through provision of infiltration or design features before discharge to public drains.</p> <p>Provision of infiltration features or design features for new development and redevelopment in accordance with MSMA.</p>	<p>Reduce post development stormwater peak discharge rate and quantity from exceeding pre-development peak discharge rate and quantity:</p> <p>10 - 25% - 1 credit > 25% - 2 credits (Up to 2 credits)</p>
<p>NHC 3-6 REFRIGERANTS</p>	<p>GREENRE CREDITS</p>
<p>Reduce the potential damage to the ozone layer and the increase in global warming through the release of ozone depleting substances and greenhouse gases.</p>	
<p>a. Refrigerants with ozone depleting potential (ODP) of zero or with global warming potential (GWP) of less than 100.</p>	<p>0.5 credit</p>
<p>b. Use of refrigerant leak detection system at critical areas of plant rooms containing chillers and other equipment with refrigerants.</p>	<p>0.5 credit</p>
<p>NHC 3-7 GREEN TRANSPORT</p>	<p>GREENRE CREDITS</p>
<p>Promote environmentally friendly transport options and facilities to reduce pollution from individual car use.</p>	
<p>a. Good access (<800m walking distance) to public transport networks such as MRT/LRT/BRT stations or bus stops.</p>	<p>1 credit</p>
<p>b. Provision of infrastructure for electric charging stations to at least 10% of available parking spaces.</p>	<p>1 credit</p>

<p>c. Provision of hybrid/electric vehicle charging stations and priority parking lots within the development.</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)</p> <p>1 credit</p>
<p>d. Provision of covered/sheltered bicycles parking lots (i.e. with rack / bar) and adequate shower and changing facilities.</p>	<p>Extent of Coverage: Minimum 10 number and maximum 50 numbers of bicycle parking lots</p> <p>1 credit</p>
<p>PART 3–ENVIRONMENTAL PROTECTION CATEGORY SCORE:</p>	<p>Sum of GreenRE credits obtained from NHC 3-1 to 3-7</p>



Part 4

Indoor Environmental
Quality



Part 4 – Indoor Environmental Quality

NHC 4-1 THERMAL COMFORT AND CONTROL FOR A/C SPACES	GREENRE CREDITS
<p>Air-conditioning system is designed to ensure consistent indoor thermal comfort such that</p>	
<p>a. <u>Public areas</u></p> <p>The indoor operative temperature should be maintained between 23°C to 26°C, with relative humidity between 50 – 70%.</p>	0.5 credit
<p>b. <u>Patient and General Clinical Areas</u></p> <p>The indoor operative temperature should be maintained at 23+2°C, with relative humidity <65% or in accordance with ASHRAE guidelines.</p>	0.5 credit
<p>c. <u>Clinical areas with Specialized Ventilation Systems</u></p> <p>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>	0.5 credit
<p>d. <u>Operating Theatre and Surgery</u></p> <p>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>	0.5 credit
<p>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</p> <p><u>Pre-requisite requirement for GreenRE Platinum ratings</u></p>	1 credit

NHC 4-2 THERMAL COMFORT FOR N/V SPACES	GREENRE CREDITS				
<p>Mixed-mode or assisted form of natural ventilation to achieve thermal comfort for naturally ventilated occupied spaces, while maximizing natural ventilation effects.</p>					
<p>Design Stage</p>					
<p>a. Perform thermal comfort modelling based on the following PMV equation: -</p> $PMV = -11.7853 + 0.4232T - 0.57889V$ <p>and meeting the thermal comfort criteria for naturally- ventilated spaces in tropical climate as set out below: -</p> <table border="1"> <thead> <tr> <th>PMV Range</th> <th>PPD</th> </tr> </thead> <tbody> <tr> <td>- 0.5 < PMV < + 0.5</td> <td>< 10</td> </tr> </tbody> </table>	PMV Range	PPD	- 0.5 < PMV < + 0.5	< 10	<p>4 credits</p>
PMV Range	PPD				
- 0.5 < PMV < + 0.5	< 10				
<p>b. Perform further indoor air quality evaluation in at least two of the following target levels: -</p> <ul style="list-style-type: none"> • Draft rate • Air diffusion performance index • Mean age of air • Air change effectiveness 	<p>2 credits</p> <p>N.B: one credit each of the above target levels for (b), capped at max 2 credits.</p>				
<p>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 84m² or less.</p>	<p>1 credit</p>				
<p>Post Occupancy Stage</p>					
<p>a. Conduct post-occupancy thermal comfort survey six months after operation</p>	<p>1 credit</p>				
<p>b. Implement corrective measures to improve thermal comfort of staff and patients following the post-occupancy survey.</p>	<p>1 credit</p>				

NHC 4-3 NOISE LEVEL	GREENRE CREDITS
<p>Occupied spaces in New Healthcare Facilities are designed to meet the acoustic performance of the appropriate standards</p> <p>a. <u>Public Spaces</u></p> <ul style="list-style-type: none"> • 55dB (6am – 10pm) L_{Aeq} • 45dB (10pm – 6am) L_{Aeq} <p>AND</p> <p>b. <u>Patient Wards and Clinical Areas</u></p> <ul style="list-style-type: none"> • 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. • 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. • 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>1 credit for compliance with both (a) and (b)</p>
NHC 4-4 INDOOR AIR POLLUTANTS	GREENRE CREDITS
<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) environmentally 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 style="text-align: center;">1 credit</p> <p style="text-align: center;">1 credit</p>

NHC 4-5 INDOOR AIR QUALITY	GREENRE CREDITS
<p>Indoor mechanically-ventilated spaces are designed to achieve good indoor air quality performance to ensure comfort and well-being of the staff and patients.</p>	
<p>a. Provision of filtration media and pressure monitoring and/or fault-indicator alarms in Air Handling Units (AHUs) for:</p>	
<ul style="list-style-type: none"> Public areas at least MERV 13 filters. 	0.5 credit
<ul style="list-style-type: none"> Patient and General Clinical Areas according to HTM 03-01, Clause 4.130, 4.131 and 4.145 	0.5 credit
<ul style="list-style-type: none"> 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
<p>b. Maintaining pressure differentials between various zones within the building to minimize unwanted movement of contaminants between zones such as through</p>	
<ul style="list-style-type: none"> 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
<ul style="list-style-type: none"> the building envelope is designed to minimize the introduction of pollutants due to air leakage in accordance with MS 1525:2019. 	0.5 credit

c. Provision of Infection Control Measures in ventilation systems and interior contact surfaces such as:

- install Ultraviolet Germicidal Irradiation (UVGI) in AHUs
- apply germicidal coating in ventilation systems and interior contact surfaces or
- apply self-cleaning Titanium Dioxide for interior contact surfaces

1 credit

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:

- 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.
- 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 DOSH requirements and certified by a competent person as stated in the Industry Code of Practice on Indoor Air Quality 2010.

2 credits

For compliance with NHC 4-5 (d) (i, ii, iii)

- iv. Carry out half-yearly IAQ audit and monitoring using portable IAQ monitoring equipment which is capable of measuring temperature, RH, CO, CO₂, particles, TVOC, O₃, and 40 parameters pertaining to identification of molds and pollen.

1 credit

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 is to be included.

1 credit

NHC 4-6 HIGH FREQUENCY BALLASTS & PBT-REDUCED LAMPS

Careful selection of lamps to reduce flickering and minimize persistent bio-cumulative toxins to ensure staffs 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.

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

Pre-requisite requirements for GreenRE Platinum rating.

GREENRE CREDITS

1 credit

1 credit

NHC 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 MS1525:2019.

GREENRE CREDITS

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)

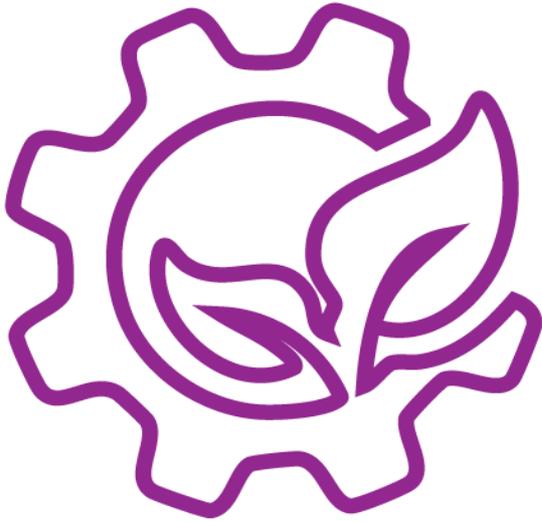
NHC 4-8 VIEW OUT & ACCESS TO INDOOR PLACES OF RESPITE

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

Provision of indoor places of respite such as:

GREENRE CREDITS

<p>a. <u>Internal courtyard</u></p> <ul style="list-style-type: none"> • Interior atria and greenhouse gardens • Wide corridors that offer seating with views of nature. • Places to pause with seating adjacent to destination • Display areas of flora and fauna 	<p>1 credit</p>
<p>b. <u>Interaction and recreation areas</u></p> <ul style="list-style-type: none"> • Family consultation spaces with views • Meditation spaces, religious or grieving rooms • Resource areas and libraries with seating • Exercise and therapy spaces 	<p>1 credit</p>
<p>PART 4 – INDOOR ENVIRONMENTAL QUALITY CATEGORY SCORE:</p>	<p>Sum of GreenRE credits obtained from NHC 4-1 to 4-8</p>



Part 5

**Sustainable Practices
and Green Innovation**

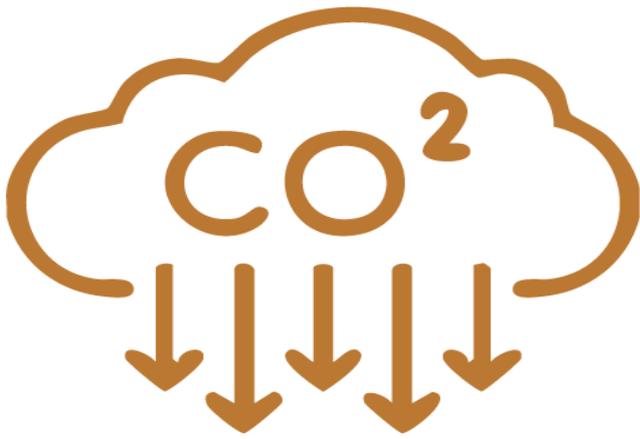


Part 5 – Sustainable Practices and Green Innovation

NHC 5-1 ENVIRONMENTAL MANAGEMENT PRACTICE	GREENRE CREDITS
Encourage the adoption of environmentally friendly practices during construction and building operation.	
a. Implement effective environmentally friendly programmes including monitoring and setting targets to minimize energy use, water use and construction waste during construction.	1 credit
b. Main builder has good track record in the adoption of sustainable, environmentally friendly and considerate practices during construction.	1 credit
c. Building quality is assessed under the Quality Assessment System in Construction (QLASSIC) or Construction Quality Assessment System (CONQUAS).	1 credit
d. To performs IBS content scoring based on CIDB IBS scoring scheme.	1 credit
e. Developer, main builder, M&E consultant and architect are ISO 14000 certified.	0.25 credit for each firm (Up to 1 credit)
f. Project team comprises one Certified GreenRE Accredited Professional (GREAP) / Green Mark Manager (GM)	1 credit for certified GREAP/GMM
g. Provision of facilities or recycling bins for collection and storage of different recyclable waste such as paper, glass, plastic etc.	0.5 credit
h. Energy policy, energy targets and regular review with top management's commitment as part of an environmental strategy	0.5 credit

<p>i. 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.</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>NHC 5-2 CONSERVATION OF EXISTING STRUCTURES AND ADOPTION OF DEMOLITION PROTOCOL</p>	<p>GREENRE CREDITS</p>
<p>Encourage conservation of existing building structures and adoption of demolition protocol to maximize resource recovery.</p>	
<p>a. Conservation of existing building structure or building envelopes (by area)</p>	
<ul style="list-style-type: none"> conserving >50% of the existing structure or building envelope 	<p>2 credit</p>
<ul style="list-style-type: none"> conserving at least 25% of the existing structure or building envelope 	<p>1 credit (Up to 2 credits for 5-2(a))</p>
<p>b. Adoption of demolition protocol to maximize resource recovery of demolition materials for reuse or recycling</p>	
<ul style="list-style-type: none"> recovery rate of >35% crushed concrete waste to be sent to the approved recyclers with proper facilities 	<p>2 credit</p>
<ul style="list-style-type: none"> recovery rate of at least 20% crushed concrete waste to be sent to the approved recyclers with proper facilities. 	<p>1 credit (Up to 2 credits for 5-2(b))</p>

NHC 5-3 OTHER GREEN PRACTICES AND INNOVATIVE FEATURES	GREENRE CREDITS
<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"> • Pneumatic waste collection system • Dual chute system • Self-cleaning façade system • Infiltration trenches • Integrated storm water retention/treatment into landscaping • Etc 	<p>0.5 credits for each item in the green and innovative features</p> <p>(Up to 3 credits for NHC 5-3)</p>
<p>PART 5 – SUSTAINABLE PRACTICES AND GREEN INNOVATION CATEGORY SCORE:</p>	<p>Sum of GreenRE credits obtained from NHC 5-1 to 5-3</p>



Part 6

Carbon Emission
of Development



Part 6 – Carbon Emission of Development

NHC 6-1 CARBON EMISSION OF DEVELOPMENT	GREENRE CREDITS
a. Recognise the carbon emission based on operational carbon footprint computation of the building comprising energy [B6] and water consumption [B7].	1 credit
b. Calculation of product stage embodied carbon based on following building materials [A1-A3]: <ul style="list-style-type: none"> • concrete • steel • bricks • cement • metal / aluminium 	0.5 credit
c. Calculation of construction stage embodied carbon [A4-A5]	0.5 credit
d. Reduction from reference embodied carbon (for Ready Mix Concrete, Cement, Steel Reinforcement, Bricks, Metal & Aluminium)	>10% 0.5 credit >30% 1 credit
Part 6 – CARBON EMISSION OF DEVELOPMENT CATEGORY SCORE:	Sum of GreenRE credits obtained from NHC 6-1

GreenRE Score (New Healthcare Facilities)

GreenRE Score (New Healthcare Facilities) = \sum 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 Emission of Development)]

Where:

Category Score for Part 1 \geq 30 credits and
 \sum Category score for Part 2, 3, 4, 5 & 6 \geq 20 credits