



DESIGN REFERENCE GUIDE

Existing Non-Residential Building

Version 3.3

April 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.

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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 Non-Residential Buildings (referred to as “this Guideline”) is to establish environmentally friendly practices for the planning, design and construction of buildings, which would help to mitigate the environmental impact of built structures.

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
1.1	Issued for Implementation	1 st June 2013
1.2	Revised version of implementation	1 st June 2014
2.0	Revised version of implementation	1 st June 2015
3.0	Revised version of implementation	1 st October 2015
3.1	Revised version of implementation	15 th March 2018
3.2	Revised version of implementation	15 th February 2021
3.2	Revised version of implementation	1 st September 2021
3.3	Revised version for implementation	June 2023
3.3	Revised version for implementation	January 2024
3.3	Revised version for implementation	March 2024
3.3	Revised version for implementation	April 2024

4. GreenRE Assessment Stages

The GreenRE Non-Residential Building certification process is as follows:

Application

Submittal of application with relevant supporting documents for certification upon strategic inception of infrastructure project.



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 building project 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 Existing Non-Residential Building Rating System

Overview

GreenRE assessment criteria consist of six (6) environmental impact categories namely:

- (a) 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.
- (b) Part 2 – Water Efficiency: This category focuses on the selection of fittings and strategies enabling water use efficiency during construction and building operation.
- (c) Part 3 – Sustainable Operation & Management: This category focuses on the sustainability of operation and management that would reduce the environmental impacts upon building operation.
- (d) 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.
- (e) Part 5 – Other Green Features: This category focuses on the adoption of green practices and new technologies that are innovative and have potential environmental benefits.
- (f) 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 groupings 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 15 bonus credits that are obtainable under ENRB 1-10 – Renewable Energy).

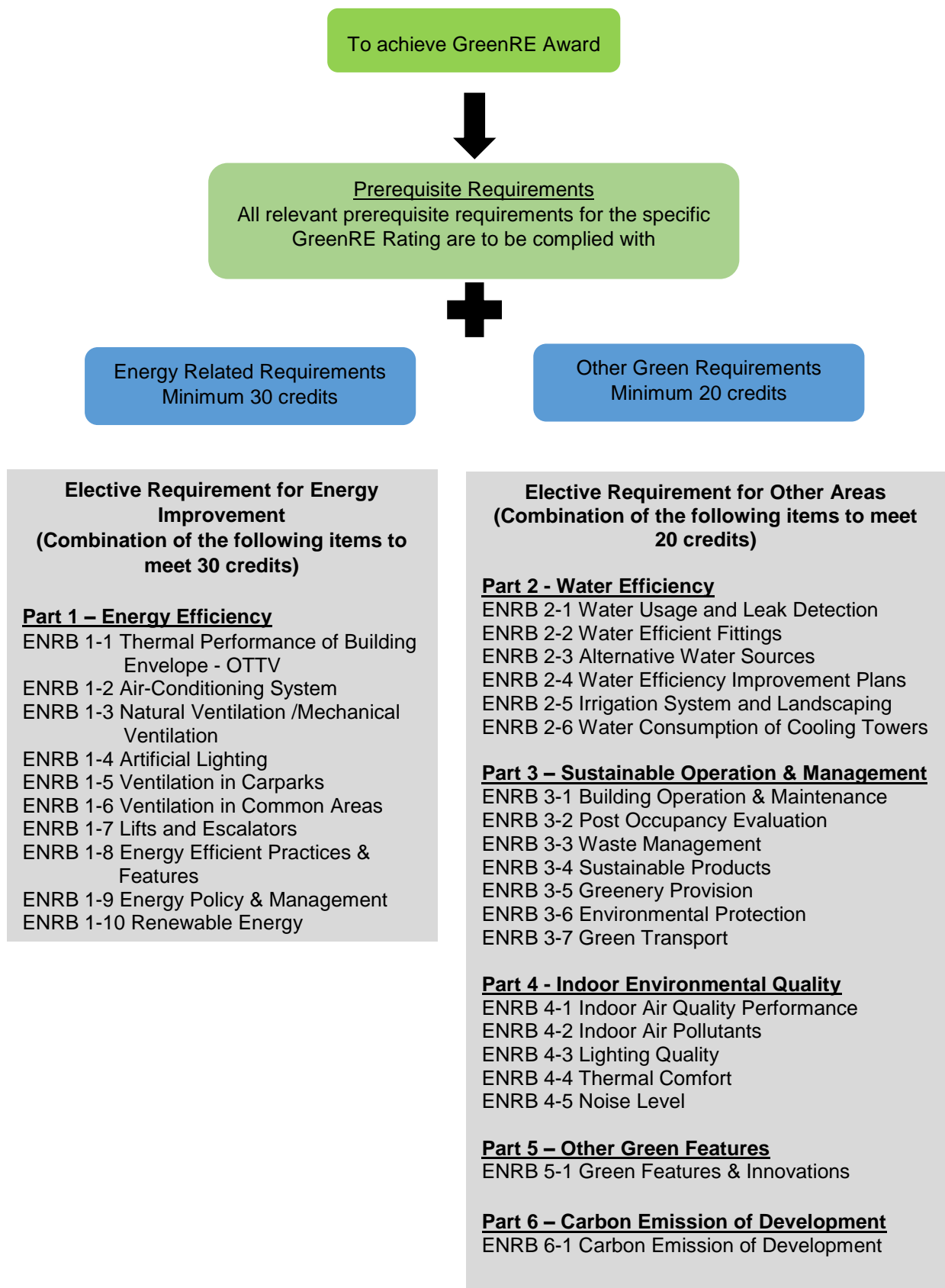
Other Green Requirements consist of Part 2 – Water Efficiency; Part 3 – Sustainable Operation & Management; Part 4 – Indoor Environmental Quality; Part 5 – Other Green Features and Part 6: Carbon Emission of Development. Credits are allocated for the water efficient features, environmentally friendly 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 15 bonus credits that are obtainable under Energy Related Requirements if a project uses renewable energy sources.

Under the non-residential building 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 500 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 car parks.

Framework



Credit Allocation

Category		Credit allocation	
(I) Energy Related Requirements			
Minimum 30 credits	Part 1: Energy Efficiency		
	ENRB 1-1 Thermal Performance of Building Envelope-OTTV	5	
	ENRB 1-2 Air-Conditioning System (applicable to air-conditioned areas)	33	
	ENRB 1-3 Natural Ventilation /Mechanical Ventilation (Applicable to non-air – conditioned areas excluding carparks and common area)	32	
	ENRB 1-4 Artificial Lighting	13	
	ENRB 1-5 Ventilation in Carparks	4	
	ENRB 1-6 Ventilation in Common Areas	5	
	ENRB 1-7 Lifts & Escalators	2	
	ENRB 1-8 Energy Efficient Practices & Features	12	
	ENRB 1-9 Energy Policy & Management	2	
	ENRB 1-10 Renewable Energy	20	
Category Score for Part 1 – Energy Efficiency		96	
(II) Other Green Requirements			
Minimum 20 credits	Part 2: Water Efficiency		
	ENRB 2-1 Water Usage and Leak Detection System	4	
	ENRB 2-2 Water Efficient Fittings	12	
	ENRB 2-3 Alternative Water Sources	3	
	ENRB 2-4 Water Efficiency Improvement Plans	1	
	ENRB 2-5 Irrigation System and Landscaping	3	
	ENRB 2-6 Water Consumption of Cooling Towers	2	
	Category Score for Part 2 – Water Efficiency		25
	Part 3: Sustainable Operation & Management		
	ENRB 3-1 Building Operation & Maintenance	5	
	ENRB 3-2 Post Occupancy Evaluation	3	
	ENRB 3-3 Waste Management	7	
	ENRB 3-4 Sustainable Products	8	
	ENRB 3-5 Greenery Provision	8	
	ENRB 3-6 Environmental Protection	3	
	ENRB 3-7 Green Transport	4	
	Category Score for Part 3 – Sustainable Operation & Management		38
	Part 4: Indoor Environmental Quality		
	ENRB 4-1 Indoor Air Quality Performance	8	
	ENRB 4-2 Indoor Air Pollutants	2	
	ENRB 4-3 Lighting Quality	5	
	ENRB 4-4 Thermal Comfort	2	
	ENRB 4-5 Internal Noise Level	1	
Category Score for Part 4: Indoor Environmental Quality		18	
Part 5: Other Green Features			
ENRB 5-1 Green Features & Innovations	10		
Category Score for Part 5: Other Green Features		10	
Part 6: Carbon Emission of Development			
ENRB 6-1 Carbon Emission of Development	2		
Category Score for Part 6: Carbon Emission of Development		2	
Category Score for Part 2 to Part 6 - Other Green Requirements		93	
GreenRE Existing Non-Residential Building Score		189	

6. GreenRE Existing Non-Residential Building Rating System Scoring

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

7. GreenRE Non-Residential Building Rating System Criteria

Pre-requisites

PART 1 – ENERGY EFFICIENCY

1. ENERGY EFFICIENCY

GreenRE Rating	Minimum credits achievement from Part 1 – Energy Efficiency
GreenRE Bronze	30 credits
GreenRE Silver	35 credits
GreenRE Gold	40 credits
GreenRE Platinum	45 credits

2. ENERGY EFFICIENCY COMPLIANCE

Projects shall demonstrate the stipulated performance through either option listed below;

Option 1 - Minimum System Efficiency (Fixed Metric)

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

(i) 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

(ii) 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 for higher GreenRE rating will be assessed on a case-by-case basis.

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

Office Building Monday to Friday: 9am to 6pm	Hotel and Hospital: 24-hour
Retail Mall: Monday to Sunday: 10am to 9pm	Industrial and Other Building Types: To be determined based on the operating hours
Institutional: Monday to Friday: 9am to 5pm	

For Gold & Platinum, the project also needs to provide the 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.

Option 2 – Energy Usage Intensity (EUI) Benchmarking

Total Building annual energy consumption over the gross floor area of the building (kWh/m²/yr). Based on:

- Energy Calculation and measured data (Retrofit)
- Measurement – In operation

The building shall demonstrate compliance to the Energy Usage Intensity (EUI) stated in the table below through 12-months measured data with a requirement of minimum occupancy of 80% for the period of measurement (projection of energy consumption necessary for lower occupancy based on prescribed EUI formula):

Building Type	Bronze (kWh/m ² /year)	Silver (kWh/m ² /year)	Gold (kWh/m ² /year)	Platinum (kWh/m ² /year)
Office Building	205	180	135	120
Hotel	375	330	240	220
Retail Mall	360	315	230	210
School, University and College	170	145	110	100
School, University and College (MOE)	60	50	38	35
Hospital (Private & General)	580	510	375	340
Community Hospitals	360	315	230	210
Polyclinics	230	205	150	135
Nursing / Youth Homes	135	120	90	80

Table 1: Energy Usage Intensity (EUI) Benchmarking

Building Type	Bronze (kWh/m ² /year)	Silver (kWh/m ² /year)	Gold (kWh/m ² /year)	Platinum (kWh/m ² /year)
Office Building	130	120	90	80
Hotel	240	220	150	135
Retail Mall	230	200	140	140
School, University and College	110	90	75	60
School, University and College (MOE)	40	30	25	20
Hospital (Private & General)	370	330	245	230
Community Hospitals	230	210	150	140
Polyclinics	150	130	95	90
Nursing / Youth Homes	90	75	55	55

Table 2: Energy Usage Intensity (EUI) Benchmarking – District Cooling System (DCS)

3. NATURAL VENTILATION AREA (only applicable to occupied areas, excluding circulation, plant rooms and transit areas):

Prerequisite requirement for Platinum - At least 75% of natural ventilated areas with effective cross ventilation with North and South facing window opening.

4. Energy Usage Intensity (EUI) Calculation

5. Provision of Building User Guide

PART 4 - INDOOR ENVIRONMENTAL QUALITY

1. IAQ Audit - to conduct a full IAQ audit three yearly that complies with Code of Practice on Indoor Air Quality, Department of Occupational Safety and Health, Ministry of Human Resources Malaysia (2005). **[4 credits]** [ENRB 4-1(a)]

Note: IAQ audit applies only to air-conditioned areas of building.

Part 1 – Energy Efficiency	GreenRE Credits								
<p><u>ENRB 1-1 THERMAL PERFORMANCE OF BUILDING ENVELOPE - OTTV</u></p> <p>Enhance the overall thermal performance of building envelope to minimize heat gain thus reducing the overall cooling load requirement.</p> <p><u>Baseline:</u> Maximum permissible OTTV = 50 W/m²</p>	<p>0.5 credits for every reduction of 1 W/m² in OTTV from the baseline of 50 W/m²</p> <p>Credit scored = 0.5 x (50 – OTTV)</p> <p>(Up to 5 credits)</p>								
<p><u>ENRB 1-2 AIR-CONDITIONING SYSTEM</u></p> <p><u>Option 1 – Fixed Metrics</u></p> <p>Applicable to Air-conditioned Building Areas (with an aggregate air-conditioned area > 1000m²) Encourage the use of better efficiency air-conditioned equipment to minimize the energy consumption. (System efficiency in kW/ton)</p> <p><u>(a) Water-Cooled Chilled-Water Plant:</u></p> <ol style="list-style-type: none"> i. Water-Cooled Chiller ii. Chilled water pump iii. Condenser water pump iv. Cooling tower <table border="1" data-bbox="209 1357 783 1711"> <thead> <tr> <th rowspan="2">Baseline</th> <th colspan="2">Building Cooling Load</th> </tr> <tr> <th>< 500 RT</th> <th>≥ 500 RT</th> </tr> </thead> <tbody> <tr> <td><u>Prerequisite Requirements</u> Minimum system efficiency of central chilled-water plant</td> <td>0.85 kW/RT</td> <td>0.75 kW/RT</td> </tr> </tbody> </table>	Baseline	Building Cooling Load		< 500 RT	≥ 500 RT	<u>Prerequisite Requirements</u> Minimum system efficiency of central chilled-water plant	0.85 kW/RT	0.75 kW/RT	<p><u>(a) Water-Cooled Chilled-Water Plant:</u></p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <p>Building cooling load < 500RT</p> </div> <p>14 credits for achieving plant efficiency of 0.85 kW/ton</p> <p>0.3 credit for every percentage improvement in the chiller plant efficiency better than 0.85 kW/ton</p> <p>Credit scored = 0.3 x (% improvement)</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <p>Building cooling load ≥ 500RT</p> </div> <p>14 credits for achieving plant efficiency of 0.75 kW/ton</p>
Baseline		Building Cooling Load							
	< 500 RT	≥ 500 RT							
<u>Prerequisite Requirements</u> Minimum system efficiency of central chilled-water plant	0.85 kW/RT	0.75 kW/RT							

0.35 credit for every percentage improvement in the chiller plant efficiency better than 0.75 kW/ton

$$\text{Credit scored} = 0.35 \times (\% \text{ improvement})$$

(up to 20 credits)

OR

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

Air cooled Chilled-Water Plant:

- Air-Cooled Chiller
- Chilled Water Pump

Unitary Air-Conditioners:

- Variable Refrigerant Flow (VRF) System
- Water-Cooled Package Unit
- Single-Split Unit
- Multi-Split Unit

Baseline	Building Cooling Load	
	< 500 RT	≥ 500 RT
<u>Prerequisite Requirements</u> Minimum system efficiency of air-cooled chilled water plant or unitary conditioners	1.1 kW/RT	1.0 kW/RT

Note

(1): Where there is a combination of centralised air-conditioned system with unitary air-conditioned system, the computation for the credits scored will be pro-rated based on the air-conditioning system aggregate capacity.

OR

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

Building cooling load < 500RT

14 credits for achieving plant efficiency of 1.1 kW/ton

0.2 credit for every percentage improvement in the chiller plant efficiency better than 1.1 kW/ton

$$\text{Credit scored} = 0.2 \times (\% \text{ improvement})$$

Building cooling load ≥ 500RT

14 credits for achieving plant efficiency of 1.0 kW/ton

0.25 credit for every percentage improvement in the chiller plant efficiency better than 1.0 kW/ton

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

(Up to 20 credits)

(c) Air Distribution system:

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

Fan System Input Power

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

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

Note (3): For buildings using district cooling system, there is no need to compute the plant efficiency under Part 1-2 (a) and (b). The credits obtained will be pro-rated based on the air distribution system efficiency under Part 1-2(c).

(d) 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. The following instrumentation and installation are also required to be complied:

- Location and installation of the measuring devices to meet the manufacturer's recommendation.
- Data acquisition system to have a minimum resolution of 16 bit.
- All data logging with capability to trend at 1minute sampling time interval.
- Dedicated digital power meters shall be provided for the following groups of equipment: chiller(s), chilled water pump(s),

(c) Air Distribution system:

0.15 credits for every percentage improvement in the air distribution system efficiency over the baseline

Credits scored = 0.15 x (% improvement)

(up to 8 credits)

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

2 credits

<p>condenser water pump(s) and cooling tower(s).</p> <ul style="list-style-type: none"> • Flow meters 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 entire measurement or calibration range. All thermo-wells shall be installed in a manner that ensures that the sensors can be in direct contact with fluid flow. Provisions shall be made for each temperature measurement location to have two spare thermo-wells located at both side of the temperature sensor for verification of measurement accuracy. <p>(e) Verification of central water cooled chilled-water plant instrumentation: Heat Balance - substantiating test for water cooled chilled-water plant to be computed in accordance with AHRI 550/590. The operating system efficiency and heat balance to be submitted to GreenRE upon commissioning.</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 carbon dioxide. Indoor carbon dioxide acceptable range ≤ 700 ppm above outdoor concentration.</p>	<p>1 credit</p> <p>1 credit</p> <p>1 credit</p>
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Option 2 – EUI Benchmarking

i. Air-conditioning System

(a) Projects with air conditioning system

Total Building annual energy consumption over the gross floor area of the building (kWh/m²/yr). Based on:

- Energy Calculation and measured data (Retrofit)
- Measurement – In operation

The project shall demonstrate the Energy Usage Intensity (EUI) and show compliance to the table below (minimum occupancy >80%)- (projection of energy consumption necessary for lower occupancy based on prescribed EUI formula):

Building Type	Bronze (kWh/m ² /year)	Silver (kWh/m ² /year)	Gold (kWh/m ² /year)	Platinum (kWh/m ² /year)
Office Building	205	180	135	120
Hotel	375	330	240	220
Retail Mall	360	315	230	210
School, University and College	170	145	110	100
School, University and College (MOE)	60	50	38	35
Hospital (Private & General)	580	510	375	340
Community Hospitals	360	315	230	210
Polyclinics	230	205	150	135
Nursing / Youth Homes	135	120	90	80

Table 1: Energy Usage Intensity (EUI) Benchmarking (kwh/m2/yr)

(b) Water-Cooled Chilled-Water Plant:

- v. Water-Cooled Chiller
- vi. Chilled water pump
- vii. Condenser water pump
- viii. Cooling tower

20 credits for achieving EUI per table shown.

(b) Water-Cooled Chilled-Water Plant:

Building cooling load < 500RT

0.3 credit for every percentage improvement in the chiller plant efficiency better than 0.85 kW/ton

Credit scored = 0.3 x (% improvement)

Baseline	Building Cooling Load	
	< 500 RT	≥ 500 RT
<u>Prerequisite Requirements</u> Minimum system efficiency of central chilled-water plant	0.85 kW/RT	0.75 kW/RT

OR

(c) Air Cooled Chilled-Water Plant / Unitary Air-Conditioners:

Air cooled Chilled-Water Plant:

- Air-Cooled Chiller
- Chilled Water Pump

Unitary Air-Conditioners:

- Variable Refrigerant Flow (VRF) System
- Water-Cooled Package Unit
- Single-Split Unit
- Multi-Split Unit

Baseline	Building Cooling Load	
	< 500 RT	≥ 500 RT
<u>Prerequisite Requirements</u> Minimum system efficiency of air-cooled chilled water plant or unitary conditioners	1.1 kW/RT	1.0 kW/RT

Note

(1): Where there is a combination of centralised air-conditioned system with unitary air-conditioned system, the computation for the credits scored will be pro-rated based on the air-conditioning system aggregate capacity.

Building cooling load ≥ 500RT

0.35 credit for every percentage improvement in the chiller plant efficiency better than 0.75 kW/ton

Credit scored = 0.35 x (% improvement)

(up to 8 credits)

OR

(c) Air Cooled Chilled-Water Plant / Unitary Air-Conditioners:

Building cooling load < 500RT

0.2 credit for every percentage improvement in the chiller plant efficiency better than 1.1 kW/ton

Credit scored = 0.2 x (% improvement)

Building cooling load ≥ 500RT

0.25 credit for every percentage improvement in the chiller plant efficiency better than 1.0 kW/ton

Credit scored = 0.25 x (% improvement)

(up to 8 credits)

<p>(d) 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. The following instrumentation and installation are also required to be complied:</p> <ul style="list-style-type: none"> • Location and installation of the measuring devices to meet the manufacturer’s recommendation. • Data acquisition system to have a minimum resolution of 16 bit. • All data logging with capability to trend at 1minute sampling time interval. • Dedicated digital power meters shall be provided for the following groups of equipment: chiller(s), chilled water pump(s), condenser water pump(s) and cooling tower(s). • Flow meters 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 entire measurement or calibration range. All thermo-wells shall be installed in a manner that ensures that the sensors can be in direct contact with fluid flow. Provisions shall be made for each temperature measurement location to have two spare thermo-wells located at both side of the temperature sensor for verification of measurement accuracy. 	<p>Applicable only to buildings with provision of water-cooled chilled water plants</p> <p>2 credits</p>
<p>(e) Verification of central water cooled chilled-water plant instrumentation: Heat Balance - substantiating test for water cooled chilled-water plant to be computed in accordance with AHRI 550/590. The operating system efficiency and heat balance to be submitted to GreenRE upon commissioning.</p>	<p>1 credit</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.

1 credit

(g) Sensors or similar automatic control devices are used to regulate outdoor air flow rate to maintain the concentration of carbon dioxide. Indoor carbon dioxide acceptable range ≤ 700 ppm above outdoor concentration.

1 credit

ii. District Cooling System

(a) Projects with district cooling system

Total Building annual energy consumption over the gross floor area of the building ($\text{kWh}/\text{m}^2/\text{yr}$). Based on:

20 credits for achieving EUI per table shown.

- Energy Calculation and measured data (Retrofit)
- Measurement – In operation

The project shall demonstrate the Energy Usage Intensity (EUI) and show compliance to the table below (minimum occupancy $>80\%$)

Building Type	Bronze ($\text{kWh}/\text{m}^2/\text{year}$)	Silver ($\text{kWh}/\text{m}^2/\text{year}$)	Gold ($\text{kWh}/\text{m}^2/\text{year}$)	Platinum ($\text{kWh}/\text{m}^2/\text{year}$)
Office Building	130	120	90	80
Hotel	240	220	150	135
Retail Mall	230	200	140	140
School, University and College	110	90	75	60
School, University and College (MOE)	40	30	25	20
Hospital (Private & General)	370	330	245	230
Community Hospitals	230	210	150	140
Polyclinics	150	130	95	90
Nursing / Youth Homes	90	75	55	55

Table 2: Energy Usage Intensity (EUI) Benchmarking – District Cooling System (DCS)

(b) Air Distribution system:

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

Fan System Input Power

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

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

Note (3): For buildings using district cooling system, there is no need to compute the plant efficiency under Part 1-2 (a) and (b). The credits obtained will be pro-rated based on the air distribution system efficiency under Part 1-2(c).

(b) Air Distribution system:

0.15 credits for every percentage improvement in the air distribution system efficiency over the baseline

$$\text{Credits scored} = 0.15 \times (\% \text{ improvement})$$

(up to 8 credits)

ENRB 1-3 NATURAL VENTILATION / MECHANICAL VENTILATION

Applicable to Non-Air-Conditioned Building Areas (with an aggregate non-air-conditioned areas > 10% of total floor area excluding carparks and common areas)

(a) Natural Ventilation

(only applicable to occupied areas, excluding circulation, plant rooms and transit areas)

Encourage building that facilitates good natural ventilation. Proper design of building layout that utilises prevailing wind conditions to achieve adequate cross ventilation.

(b) Mechanical Ventilation

Encourage energy efficient mechanical ventilation system as the preferred ventilation mode to non-air-conditioning in buildings.

Baseline: Fan power limitation in mechanical ventilation systems:

Allowable nameplate motor power	
Constant volume	Variable volume
1.7 kW/m ³ /s	2.4 kW/m ³ /s

Note (3): Where there is a combination of naturally ventilated and mechanical ventilated spaces, the credits scored will only be based on the predominant ventilation modes of normally occupied spaces.

20 based credits will be awarded for use of natural ventilation

1.2 credits for every 10% of NV areas with window openings facing north and south directions and cross ventilation

(Up to 32 credits)

0.6 credit for every subsequent 1% improvement from the baseline

(Up to 32 credits)

ENRB 1-4 ARTIFICIAL LIGHTING

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

Baseline: Luminance level stated in MS 1525:2019–Energy Efficient and use of renewable energy for non-residential building - Code of Practice

0.25 credit for every percentage improvement in lighting power budget

Credit scored = 0.25 x (% improvement)
(Up to 13 credits)

Excluding tenant lighting provision – (Up to 5 credits)

<p><u>ENRB 1-5 VENTILATION IN CARPARKS</u></p> <p>Encourage the use of energy efficient design and control of ventilation systems in carparks.</p> <p>(a) Carparks designed with natural ventilation.</p> <p>(b) CO sensors are used to regulate the demand for mechanical ventilation (MV)</p> <p>Note (4): Where there is a combination of different ventilation mode adopted for carpark design, the credits obtained will be prorated accordingly.</p>	<p>Naturally Ventilated Carparks – 4 credits</p> <p>Credits scored based on the mode of mechanical ventilation provided:</p> <p>Fume extract – 2.5 credits MV with or without supply – 2 credits</p> <p>(Up to 4 credits)</p>
<p><u>ENRB 1-6 VENTILATION IN COMMON AREAS</u></p> <p>Encourage the use of energy efficient of ventilation systems in the following common areas:</p> <ul style="list-style-type: none"> • Toilets • Staircases • Lift Lobbies • Corridors • Atriums 	<p>Extent of Coverage: At least 90% of each applicable area</p> <p>Credit scored based on the mode of ventilation provided in the applicable areas</p> <p>Natural Vent. – 1.5 credits for each area Mechanical Vent. – 0.5 credit for each area</p> <p>(Up to 5 credits)</p>
<p><u>ENRB 1-7 LIFTS AND ESCALATORS</u></p> <p>Encourage the use of energy efficient lifts and escalators.</p> <p>(a) Lifts with the following energy efficient features:</p> <ol style="list-style-type: none"> i. AC variable voltage and variable frequency (VVVF) motor drive or equivalent. ii. Sleep mode features or equivalent. <p>(b) Escalators with energy efficient features such as motion sensors.</p>	<p>Extent of Coverage: All lifts and/or escalators</p> <p>1 credit</p> <p>1 credit</p>

ENRB 1-8 ENERGY EFFICIENT PRACTICES & FEATURES

Encourage the use of energy efficient practices and features which are innovative and/or have positive environmental impact.

- (a) Computation of the energy consumption in the form of Energy Usage Index (EUI) 1 credit

- (b) Use of energy efficiency product that are certified by approved local certification body 0.5 credit for each equipment type
(Up to 2 credits)

- (c) Use of energy efficient features 2 credits for every 1% energy saving over the total building energy consumption
(Up to 9 credits)
Example:
 - Re-generative lift
 - Heat recovery system
 - Motion sensors
 - Sun pipes
 - Light shelves
 - Photocell sensors to maximize the use of Daylight
 - Heat pumps, etc.

ENRB 1-9 ENERGY POLICY AND MANAGEMENT

- (a) Energy policy, energy targets and regular review with top management's commitment as part of an environmental strategy 1 credit

- (b) To show intent, measures and implementation strategies of energy efficiency improvement plans to achieve energy target set over the next three years. Committed energy savings accrued from proposed measures should be quantified. 1 credit

ENRB 1-10 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 1% replacement of electricity (based on the total electricity consumption excluding tenant's usage) by renewable energy

OR

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

(Up to 20 credits)

**PART 1 – ENERGY EFFICIENCY
CATEGORY SCORE:**

$$\begin{aligned} & (\text{ENRB 1-2}) \times \frac{\text{Air-conditioned Building Floor Area}}{\text{Total Floor Area}} \\ & + \\ & (\text{ENRB 1-3}) \times \frac{\text{Non-Air-Conditioned Building Floor Area}}{\text{Total Floor Area}} \\ & + \\ & (\text{ENRB 1-1, ENRB 1-4 to ENRB 1-10}) \end{aligned}$$

Where:

ENRB 1-2 = Total GreenRE credits obtained under ENRB 1-2

ENRB 1-3 = Total GreenRE credits obtained under ENRB 1-3

ENRB 1-1, ENRB 1-4 to ENRB 1-10 = Total GreenRE credits obtained under ENRB 1-1, ENRB 1-4 to ENRB 1-10

Part 2 – Water Efficiency	GreenRE Credits									
<p><u>ENRB 2-1 WATER USAGE AND LEAK DETECTION</u></p> <p>Provide sub-metering and leak detection system for better control and monitoring</p> <p>(a) To monitor the water consumption on monthly basis</p> <p>(b) Provision of sub-meters for major water uses (e.g., cooling tower, water features, irrigation, swimming pools, tenants' usage)</p> <p>(c) Provision of automated / smart metering for monitoring and leaking detection</p>	<p>1 credit</p> <p>1 credit</p> <p>2 credits</p>									
<p><u>ENRB 2-2 WATER EFFICIENT FITTINGS</u></p> <p>Encourage the use of water efficient fittings under Water Efficiency Product Labelling Scheme (WEPLS)</p> <ul style="list-style-type: none"> • Basin taps and mixers • Showers • Sink/Bib taps and mixers • Urinals and Urinal Flush Valves • Dual flushing cistern for WC • Other water fittings (e.g. Ablution taps and mixers) 	<table border="1" data-bbox="940 958 1366 1312"> <tr> <td colspan="3" data-bbox="940 958 1366 1115">Weightage Based on Water Efficiency Products Labelling Scheme (WEPLS)</td> </tr> <tr> <td data-bbox="940 1115 1082 1232">Efficient *</td> <td data-bbox="1082 1115 1224 1232">Highly Efficient **</td> <td data-bbox="1224 1115 1366 1232">Most Efficient ***</td> </tr> <tr> <td data-bbox="940 1232 1082 1312">6</td> <td data-bbox="1082 1232 1224 1312">9</td> <td data-bbox="1224 1232 1366 1312">12</td> </tr> </table> <p>Credits scored based on the number and water efficiency rating of the fitting type used</p> <p>(Up to 12 credits)</p>	Weightage Based on Water Efficiency Products Labelling Scheme (WEPLS)			Efficient *	Highly Efficient **	Most Efficient ***	6	9	12
Weightage Based on Water Efficiency Products Labelling Scheme (WEPLS)										
Efficient *	Highly Efficient **	Most Efficient ***								
6	9	12								
<p><u>ENRB 2-3 ALTERNATIVE WATER SOURCES</u></p> <p>Use of suitable systems that utilize alternative water sources for non-potable uses: irrigation, washing, water features, toilet flushing, etc (excluding cooling tower make up water) to reduce use of potable water. Alternative sources can include rainwater, greywater (for toilet flushing only), AHU condensate and recycled water from approved sources.</p>	<p>Credits awarded based on % reduction in total potable water usage of the applicable uses</p> <table border="1" data-bbox="896 1771 1390 1906"> <tr> <td data-bbox="896 1771 1142 1814">> 50 %</td> <td data-bbox="1142 1771 1390 1814">3 credits</td> </tr> <tr> <td data-bbox="896 1814 1142 1859">≥ 10 % to 50 %</td> <td data-bbox="1142 1814 1390 1859">2 credits</td> </tr> <tr> <td data-bbox="896 1859 1142 1906">< 10 %</td> <td data-bbox="1142 1859 1390 1906">1 credit</td> </tr> </table> <p>(Up to 3 credits)</p>	> 50 %	3 credits	≥ 10 % to 50 %	2 credits	< 10 %	1 credit			
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≥ 10 % to 50 %	2 credits									
< 10 %	1 credit									

<p><u>ENRB 2-4 WATER EFFICIENCY IMPROVEMENT PLANS</u></p> <p>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>1 credit</p>
<p><u>ENRB 2-5 IRRIGATION SYSTEM AND LANDSCAPING</u></p> <p>Reduce potable water consumption for irrigation and landscaping.</p> <p>(a) Use of non-potable water including rainwater for landscape irrigation</p> <p>(b) Use of automatic water efficient irrigation system with rain sensor, soil moisture sensor or equivalent control system.</p> <p>(c) Use of drought tolerant plants that require minimal irrigation.</p>	<p>1 credit</p> <p>Extent of Coverage: At least 50% of the landscape areas are served by the system 1 credit</p> <p>Extent of Coverage: At least 80% of the landscape areas 1 credit</p>
<p><u>ENRB 2-6 WATER CONSUMPTION OF COOLING TOWERS</u></p> <p>Reduce potable water use for cooling purpose.</p> <p>(a) Use of cooling tower water treatment system which can achieve 6 or better cycles of concentration at acceptable water quality.</p> <p>(b) Use of recycled water from approved sources for cooling purpose.</p>	<p>1 credit</p> <p>1 credit</p>
<p>PART 2 – WATER EFFICIENCY CATEGORY SCORE:</p>	<p>Sum of GreenRE credits obtained from ENRB 2-1 to 2-6</p>

Part 3 – Sustainable Operation & Management	GreenRE Credits
<p><u>ENRB 3-1 BUILDING OPERATION & MAINTENANCE</u></p> <p>(a) The environmental policy that reflects the sustainability goals set.</p> <p>(b) Provision of a Building User Guide</p> <p>(c) In-house building management team comprises one Certified GreenRE Manager/ Green Mark Manager</p> <p>(d) Project team comprises one Certified GreenRE/Green Mark Manager (GM)</p> <p>(e) The environmental management system of the building is ISO14000 or ISO 50001 certified.</p>	<p>1 credit</p> <p>1 credit</p> <p>1 credit</p> <p>1 credit</p> <p>1 credit</p>

<p><u>ENRB 3-2 POST OCCUPANCY EVALUATION</u></p> <p>(a) Conduct post occupancy survey for occupant's satisfaction on energy and environmental performance.</p> <p>Required number of people surveyed shall be:</p> <ul style="list-style-type: none"> • 10% of total occupancy and up to 100 maximums. • Minimum 5 people shall be surveyed if total occupancy is less than 50. <p>(b) List of corrective actions taken following the post occupancy evaluation, if any.</p>	<p>2 credits</p> <p>1 credit</p>
<p><u>ENRB 3-3 WASTE MANAGEMENT</u></p> <p>(a) Provision of facilities or recycling bins for collection and storage of different recyclable waste such as paper, glass, plastic, food waste, etc.</p> <p>(b) Promote and encourage waste minimization and recycling among occupants, tenants and visitors through various avenues</p> <p>(c) Provide the proper storage area for the recyclable waste</p> <p>(d) To quantify and monitor the recycling programme for continuous improvement.</p>	<p>2 credits</p> <p>2 credits</p> <p>1 credit</p> <p>2 credits</p>

<p><u>ENRB 3-4 SUSTAINABLE PRODUCTS</u></p> <p>Promote use of environmentally friendly products that are certified by approved local certification body and are applicable to non-structural and architectural related building components.</p>	<table border="1"> <thead> <tr> <th data-bbox="823 199 1161 327">Extent of use of environmentally friendly product</th> <th data-bbox="1168 199 1382 327">Weightage for Credit Allocation</th> </tr> </thead> <tbody> <tr> <td data-bbox="823 327 1161 383">Low Impact</td> <td data-bbox="1168 327 1382 383">0.5</td> </tr> <tr> <td data-bbox="823 383 1161 439">Medium impact</td> <td data-bbox="1168 383 1382 439">1</td> </tr> <tr> <td data-bbox="823 439 1161 495">High Impact</td> <td data-bbox="1168 439 1382 495">2</td> </tr> </tbody> </table> <p>Credits scored will be based on the extent of use of environmentally friendly product.</p> <p>(Up to 8 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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Low Impact	0.5														
Medium impact	1														
High Impact	2														
<p><u>ENRB 3-5 GREENERY PROVISION</u></p> <p>Encourage greater use of greenery to reduce heat island effect.</p> <p>(a) Green Plot Ratio (GnPR) is calculated by considering the 3D volume covered by plants using the Leaf Area Index (LAI).</p> <p>(b) Restoration of trees on site, conserving or relocating of existing trees on site.</p> <p>(c) Provision of compost bins to recycle organic waste to meet at least 30% of landscape fertilizer needs.</p>	<table border="1"> <thead> <tr> <th data-bbox="823 790 1118 869">GnPR</th> <th data-bbox="1125 790 1382 869">Credits Allocation</th> </tr> </thead> <tbody> <tr> <td data-bbox="823 869 1118 909">1.0 to < 2.0</td> <td data-bbox="1125 869 1382 909">1</td> </tr> <tr> <td data-bbox="823 909 1118 949">2.0 to < 3.0</td> <td data-bbox="1125 909 1382 949">2</td> </tr> <tr> <td data-bbox="823 949 1118 990">3.0 to < 4.0</td> <td data-bbox="1125 949 1382 990">3</td> </tr> <tr> <td data-bbox="823 990 1118 1030">4.0 to < 5.0</td> <td data-bbox="1125 990 1382 1030">4</td> </tr> <tr> <td data-bbox="823 1030 1118 1070">5.0 to < 6.0</td> <td data-bbox="1125 1030 1382 1070">5</td> </tr> <tr> <td data-bbox="823 1070 1118 1111">≥ 6.0</td> <td data-bbox="1125 1070 1382 1111">6</td> </tr> </tbody> </table> <p>1 credit</p> <p>1 credit</p>	GnPR	Credits Allocation	1.0 to < 2.0	1	2.0 to < 3.0	2	3.0 to < 4.0	3	4.0 to < 5.0	4	5.0 to < 6.0	5	≥ 6.0	6
GnPR	Credits Allocation														
1.0 to < 2.0	1														
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4.0 to < 5.0	4														
5.0 to < 6.0	5														
≥ 6.0	6														
<p><u>ENRB 3-6 ENVIRONMENTAL PROTECTION</u></p> <p>(a) Green procurement policy – Adoption of sustainable and environmental-friendly procurement and purchasing policy in the operation and maintenance of the building.</p> <p>(b) 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>1 credit</p> <p>1 credit</p>														

<ul style="list-style-type: none"> • Refrigerants with ozone depletion potential (ODP) of zero or with global warming potential (GWP) of less than 100. • Use of refrigerant leak detection system at critical areas of plant rooms containing chillers and other equipment with refrigerants. 	<p>1 credit</p>
<p><u>ENRB 3-7 GREEN TRANSPORT</u></p> <p>Promote the use of public transport or bicycles to reduce pollution from individual car use with the following provision:</p> <p>(a) Good access (<800m walking distance) to public transport networks such as MRT/LRT stations or bus stops.</p> <p>(b) Provision of covered walkway to facilitate connectivity and the use of public transport.</p> <p>(c) Provision of hybrid/electric vehicle charging stations and priority parking lots within the development.</p> <p>(d) Provision of covered / sheltered bicycles parking lots with adequate shower and changing facilities.</p>	<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)</p> <p>(1 credit)</p> <p>Extent of Coverage: Bicycles parking lot: Minimum 10 number and maximum 50 numbers of bicycle parking lot.</p> <p>Shower Facilities: Minimum 1 number for every 100 regular occupant and additional 1 for every 150 occupants. (Cap at 7)</p> <p>(1 credit)</p>
<p>PART 3 – SUSTAINABLE OPERATION & MANAGEMENT CATEGORY SCORE:</p>	<p>Sum of GreenRE credits obtained from ENRB 3-1 to 3-7</p>

Part 4 – Indoor Environmental Quality	GreenRE Credits
<p><u>ENRB 4-1 INDOOR AIR QUALITY PERFORMANCE</u></p> <p>To promote a healthy indoor environment.</p> <p>(a) <i>Prerequisite Requirements:</i> To conduct full IAQ audit once in three years that complies with Code of Practice on Indoor Air Quality, Department of Occupational Safety and Health, Ministry of Human Resources Malaysia (2005).</p> <p>(b) Implement effective IAQ management plan to ensure building ventilation systems are frequently maintained to ensure clean delivery of air.</p> <p>(c) Use of high efficiency air filter (at least MERV 8) in AHU to reduce indoor contaminants and provide good protection for cooling coil and reducing frequency or eliminating duct cleaning</p> <p>(d) Room Temperature display (at least 1 unit per floor)</p> <p>(e) Additional carbon dioxide sensor displays (at least 1 unit per floor)</p>	<p>4 credits</p> <p>1 credit</p> <p>1 credit</p> <p>1 credit</p> <p>1 credit</p>
<p><u>ENRB 4-2 INDOOR AIR POLLUTANTS</u></p> <p>Minimise airborne contaminants, mainly from inside sources to promote a healthy indoor environment.</p> <p>(a) Use of low volatile organic compounds (VOC) paints certified by approved local certification body.</p> <p>(b) Use of environmentally friendly adhesives certified by approved local certification body.</p>	<p>1 credit</p> <p>1 credit</p>

<p><u>ENRB 4-3 LIGHTING QUALITY</u></p> <p>To encourage good workplace lighting quality to promote productivity and occupant's comfort</p> <p>(a) Lighting level to comply with MS1525:2019</p> <p>(b) Controllability of lighting system</p> <p>(c) High frequency ballast OR use of driver with output frequency < 200Hz and < 30% flicker for LED lighting.</p>	<p>1 credit</p> <p>At least 90% of occupants are able to adjust lighting to suit their task needs and preference</p> <table border="1" data-bbox="826 607 1386 766"> <tr> <td>Controlled by light switches</td> <td>1 credit</td> </tr> <tr> <td>Controlled by task lights</td> <td>2 credits</td> </tr> </table> <p>(Up to 2 credits)</p> <p>All applicable areas in the entire building that are served by fluorescent / LED lighting.</p> <table border="1" data-bbox="826 960 1386 1120"> <tr> <td>20% to < 40%</td> <td>0.5 credit</td> </tr> <tr> <td>40% to < 60%</td> <td>1 credit</td> </tr> <tr> <td>60% to < 80%</td> <td>1.5 credits</td> </tr> <tr> <td>80% and above</td> <td>2 credits</td> </tr> </table> <p>(Up to 2 credits)</p>	Controlled by light switches	1 credit	Controlled by task lights	2 credits	20% to < 40%	0.5 credit	40% to < 60%	1 credit	60% to < 80%	1.5 credits	80% and above	2 credits
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<p><u>ENRB 4-4 THERMAL COMFORT</u></p> <p>(a) Ensure the consistent indoor conditions for thermal comfort:</p> <ul style="list-style-type: none"> Indoor dry-bulb temperature between 23°C to 26°C Relative humidity between 50% to 70% <p>(b) Controllability of temperature.</p>	<p>1 credit</p> <p>1 credit</p>												
<p><u>ENRB 4-5 INTERNAL NOISE LEVEL</u></p> <p>Building is designed to achieve ambient internal noise level as specified:</p> <ul style="list-style-type: none"> 55 dB (6am – 10pm) L_{Aeq} 45 dB (10pm – 6am) L_{Aeq} 	<p>1 credit</p>												
<p>PART 4 – INDOOR ENVIRONMENTAL QUALITY CATEGORY SCORE:</p>	<p>Sum of GreenRE credits obtained from ENRB 4-1 to 4-5</p>												

Part 5 – Other Green Features	GreenRE Credits
<p><u>ENRB 5-1 GREEN FEATURES & INNOVATIONS</u></p> <p>To encourage the use of other green features which are innovative or/and have positive environmental impact.</p> <p>Examples:</p> <ul style="list-style-type: none"> • Vertical greening • Green Lease • Ultraviolet light-C band (UV) emitters in air handling units (AHUs) to improve indoor air quality • Provision of car park guidance system • Use of self-cleaning façade system • Use of grey water recycling system • Titanium Dioxide coating to remove odour in toilets • Use of pneumatic waste collection system • Use of double refuse chutes for separating recyclable from non-recyclable waste • Stormwater management 	<p>2 credits for high impact item</p> <p>1 credit for medium impact item</p> <p>0.5 credit for low impact item</p> <p>(Up to 10 credits)</p>
<p>PART 5 – OTHER GREEN FEATURES CATEGORY SCORE:</p>	<p>Sum of GreenRE credits obtained from ENRB 5-1</p>

Part 6 – Carbon Emission of Development	GreenRE Credits
<p><u>ENRB 6-1 CARBON FOOTPRINT OF DEVELOPMENT</u></p> <p>a) Recognise the carbon emission based on operational carbon footprint computation of the building comprising energy [B6] and water consumption [B7].</p> <p>b) Calculation of product stage embodied carbon based on following building materials [A1-A3]:</p> <ul style="list-style-type: none"> - concrete - steel - bricks - cement - steel and metal 	<p style="text-align: center;">1 credit</p> <p style="text-align: center;">. 1 credit</p>
<p style="text-align: center;">PART 6 – CARBON EMISSION OF DEVELOPMENT CATEGORY SCORE:</p>	<p style="text-align: center;">Sum of GreenRE credits obtained from ENRB 6-1</p>
<p>GreenRE Score (Existing Non-Residential Building)</p> <p>GreenRE Score (ENRB) = \sumCategory score [(Part 1-Energy Efficiency) + (Part 2-Water Efficiency) + (Part 3-Sustainable Operation & Management)+ (Part 4-Indoor Environmental Quality) + (Part 5-Other Green Features) + (Part 6-Carbon Emission of Development)]</p> <p>Where: Category Score for Part 1 \geq 30 credits and \sumCategory score for Part 2, 3, 4, 5 & 6 \geq 20 credits</p>	

(I) Energy Efficiency Compliance

Option 1– Minimum Design System Efficiency (Fixed Metric)

Requirements	Minimum Design System Efficiency/Operating System Efficiency (DSE/OSE)																																					
	<p>(i) For buildings using Water-Cooled Chilled Water Plant</p> <table border="1" style="margin-left: 20px; border-collapse: collapse; width: 80%;"> <thead> <tr> <th rowspan="3" style="width: 25%;">GreenRE Rating</th> <th colspan="2" style="text-align: center;">Building Cooling Load (RT)</th> </tr> <tr> <th style="width: 25%; text-align: center;">< 500</th> <th style="width: 25%; text-align: center;">≥ 500</th> </tr> <tr> <th colspan="2" style="text-align: center;">Efficiency (kW/RT)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Bronze</td> <td style="text-align: center;">0.85</td> <td style="text-align: center;">0.75</td> </tr> <tr> <td style="text-align: center;">Silver</td> <td style="text-align: center;">0.80</td> <td style="text-align: center;">0.70</td> </tr> <tr> <td style="text-align: center;">Gold</td> <td style="text-align: center;">0.75</td> <td style="text-align: center;">0.68</td> </tr> <tr> <td style="text-align: center;">Platinum</td> <td style="text-align: center;">0.70</td> <td style="text-align: center;">0.65</td> </tr> </tbody> </table> <p style="margin-left: 20px;">(ii) For buildings using Air-Cooled Chilled Water Plant or Unitary Air-Conditioner</p> <table border="1" style="margin-left: 20px; border-collapse: collapse; width: 80%;"> <thead> <tr> <th rowspan="3" style="width: 25%;">GreenRE Rating</th> <th colspan="2" style="text-align: center;">Building Cooling Load (RT)</th> </tr> <tr> <th style="width: 25%; text-align: center;">< 500</th> <th style="width: 25%; text-align: center;">≥ 500</th> </tr> <tr> <th colspan="2" style="text-align: center;">Efficiency (kW/RT)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Bronze</td> <td style="text-align: center;">1.1</td> <td style="text-align: center;">1.0</td> </tr> <tr> <td style="text-align: center;">Silver</td> <td style="text-align: center;">1.0</td> <td style="text-align: center;">1.0</td> </tr> <tr> <td style="text-align: center;">Gold</td> <td style="text-align: center;">0.85</td> <td rowspan="2" style="text-align: center; vertical-align: middle;">Case by case(i)</td> </tr> <tr> <td style="text-align: center;">Platinum</td> <td style="text-align: center;">0.78</td> </tr> </tbody> </table> <p style="margin-left: 20px;">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 for higher GreenRE rating will be assessed on a case-by-case basis.</p> <p style="margin-left: 20px;">For Gold & Platinum, the project also needs to provide the 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</p>	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	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
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	<p>is required for verification of the accuracy of the Measurement and Verification (M&V) instrumentation</p>
<p>Documentary Evidences</p>	<p><u>Actual Assessment:</u></p> <ul style="list-style-type: none"> • Details report from simulation software <p><u>Site Verification Assessment</u></p> <ul style="list-style-type: none"> • Scenario 1), based on utility bill, if the occupancy rate is low, e.g. only 20% occupancy rate, it needs to be projected to 80% to get the EUI which reflects the actual operation situation; • Scenario 2), based on the utility bills, If the actual operation hours are the same as what were used during the design stage, no adjustment required for operational hours; If fixed operational hours were used during design and they are different from actual operation hours, adjustment needs to be done based on actual operational hours

Option 2– Energy Usage Intensity (EUI)

Requirements	<p>Total Building annual energy consumption over the gross floor area of the building (kWh/m²/yr.). Based on:</p> <ul style="list-style-type: none"> • Energy Calculation and measured data (Retrofit) • Measurement – In operation <p>The project shall demonstrate the Energy Usage Intensity (EUI) and show compliance to the table below (minimum occupancy >80%):</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="padding: 5px;">Building Type</th> <th style="padding: 5px;">Bronze (kWh/m²/year)</th> <th style="padding: 5px;">Silver (kWh/m²/year)</th> <th style="padding: 5px;">Gold (kWh/m²/year)</th> <th style="padding: 5px;">Platinum (kWh/m²/year)</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">Office Building</td> <td style="padding: 5px;">205</td> <td style="padding: 5px;">180</td> <td style="padding: 5px;">135</td> <td style="padding: 5px;">120</td> </tr> <tr> <td style="padding: 5px;">Hotel</td> <td style="padding: 5px;">375</td> <td style="padding: 5px;">330</td> <td style="padding: 5px;">240</td> <td style="padding: 5px;">220</td> </tr> <tr> <td style="padding: 5px;">Retail Mall</td> <td style="padding: 5px;">360</td> <td style="padding: 5px;">315</td> <td style="padding: 5px;">230</td> <td style="padding: 5px;">210</td> </tr> <tr> <td style="padding: 5px;">School, University and College</td> <td style="padding: 5px;">170</td> <td style="padding: 5px;">145</td> <td style="padding: 5px;">110</td> <td style="padding: 5px;">100</td> </tr> <tr> <td style="padding: 5px;">School, University and College (MOE)</td> <td style="padding: 5px;">60</td> <td style="padding: 5px;">50</td> <td style="padding: 5px;">38</td> <td style="padding: 5px;">35</td> </tr> <tr> <td style="padding: 5px;">Hospital (Private & General)</td> <td style="padding: 5px;">580</td> <td style="padding: 5px;">510</td> <td style="padding: 5px;">375</td> <td style="padding: 5px;">340</td> </tr> <tr> <td style="padding: 5px;">Community Hospitals</td> <td style="padding: 5px;">360</td> <td style="padding: 5px;">315</td> <td style="padding: 5px;">230</td> <td style="padding: 5px;">210</td> </tr> <tr> <td style="padding: 5px;">Polyclinics</td> <td style="padding: 5px;">230</td> <td style="padding: 5px;">205</td> <td style="padding: 5px;">150</td> <td style="padding: 5px;">135</td> </tr> <tr> <td style="padding: 5px;">Nursing / Youth Homes</td> <td style="padding: 5px;">135</td> <td style="padding: 5px;">120</td> <td style="padding: 5px;">90</td> <td style="padding: 5px;">80</td> </tr> </tbody> </table> <p style="text-align: center; margin-top: 10px;"><i>Table 2: Energy Usage Intensity (EUI) Benchmarking</i></p>	Building Type	Bronze (kWh/m ² /year)	Silver (kWh/m ² /year)	Gold (kWh/m ² /year)	Platinum (kWh/m ² /year)	Office Building	205	180	135	120	Hotel	375	330	240	220	Retail Mall	360	315	230	210	School, University and College	170	145	110	100	School, University and College (MOE)	60	50	38	35	Hospital (Private & General)	580	510	375	340	Community Hospitals	360	315	230	210	Polyclinics	230	205	150	135	Nursing / Youth Homes	135	120	90	80
Building Type	Bronze (kWh/m ² /year)	Silver (kWh/m ² /year)	Gold (kWh/m ² /year)	Platinum (kWh/m ² /year)																																															
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Building Type	Bronze (kWh/m ² /year)	Silver (kWh/m ² /year)	Gold (kWh/m ² /year)	Platinum (kWh/m ² /year)
Office Building	130	120	90	80
Hotel	240	220	150	135
Retail Mall	230	200	140	140
School, University and College	110	90	75	60
School, University and College (MOE)	40	30	25	20
Hospital (Private & General)	370	330	245	230
Community Hospitals	230	210	150	140
Polyclinics	150	130	95	90
Nursing / Youth Homes	90	75	55	55

Table 3: Energy Usage Intensity (EUI) Benchmarking – District Cooling System (DCS)

Documentary Evidences

Actual Assessment:

- Details report from simulation software

Site Verification Assessment

- Scenario 1), based on utility bill, if the occupancy rate is low, e.g. only 20% occupancy rate, it needs to be projected to 80% to get the EUI which reflects the actual operation situation;
- Scenario 2), based on the utility bills, If the actual operation hours are the same as what were used during the design stage, no adjustment required for operational hours; If fixed operational hours were used during design and they are different from actual operation hours, adjustment needs to be done based on actual operational hour

Worked Example

Example 1

Office building	Result based on projected data for existing building undergoing retrofit)	
TBEC (Total Annual Building Energy Consumption):	250,500	kWh/year
GFA	2,584	m ²
EUI	96.9	kWh/m ² /year

Based on the requirement, it meets the Platinum EUI <120 requirement.

Example 2:

During verification stage, which is one year after operation, if the occupancy rate is only 30%:

A small office building	Results based on projected data for existing building undergoing retrofit)	
Annual Total Building Energy Consumption: At 30% occupancy	100,000	kWh/year
GFA	2,584	m ²
EUI	38.77	kWh/m ² /year
TBEC Adjusted to 80% occupancy	=100,000 ÷ 0.3 × 0.8 = 266667	kWh/year
EUI after adjustment	103.2	kWh/m ² /year

With adjusted EUI of 103.2 the project can pass the verification requirement for Platinum.

(I) Energy Related Requirements

Part 1- Energy Efficiency

ENRB 1-1 Thermal Performance of Building Envelope-OTTV

ENRB 1-2 Air-Conditioning System

ENRB 1-3 Natural Ventilation /Mechanical Ventilation

ENRB 1-4 Artificial Lighting

ENRB 1-5 Ventilation in Carparks

ENRB 1-6 Ventilation in Common Areas

ENRB 1-7 Lifts and Escalators

ENRB 1-8 Energy Efficient Practices & Feature

ENRB 1-9 Energy Policy & Management

ENRB 1-10 Renewable Energy

ENRB 1-1 THERMAL PERFORMANCE OF BUILDING ENVELOPE - OTTV

Objectives	Enhance overall thermal performance of building envelope to minimise heat gain thus reducing the overall cooling load requirement.
Applicability	Applicable to air-conditioned building spaces with aggregate areas > 1000m ² .
Baseline Standard	<p>Maximum permissible OTTV = 50 W/m²</p> <p>OTTV stands for Overall Thermal Transfer Value.</p> <p>Maximum permissible RTTV = 25 W/m²</p> <p>RTTV stands for Roof Thermal Transfer Value.</p> <p>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.</p> <p>The computation of OTTV & RTTV shall be based on the methodology specified in the MS 1525:2019.</p>
Requirements	<p>Up to 5 credits can be scored for building envelope with better thermal performance than the baseline standard:</p> <p>0.5 credits for every reduction of 1 W/m² in OTTV from the baseline.</p> <p>Credits scored = 0.5 x [50 – OTTV] where OTTV ≤ 50 W/m²</p> <p>For developments consisting of more than one building, the weighted average of the OTTVs based on the façade areas of these buildings shall be used as the basis for credit allocation.</p> <p>That is,</p> $\text{OTTV}_{\text{weighted average}} = \sum (\text{OTTV}_{\text{bldg}} \times A_{\text{bldg}}) / A_{\text{devt}}$ <p>where OTTV_{bldg} = OTTV for building (W/m²) A_{bldg} = Summation of all façade areas (m²) in a building A_{devt} = Summation of total applicable façade areas of all buildings within the development (m²) (i.e., $\sum A_{\text{bldg}}$)</p>

<p>Documentary Evidences</p>	<ul style="list-style-type: none"> • Site plan with clearly demarcated the orientation of the building. • Architectural elevation drawings showing the composition of the different façade or wall systems that are relevant for the computation of OTTV. • Glazing specification showing the U Value and SC Value. • Window and door schedule. • Detailed area (m2) tabulation of fenestration and wall for every façade. • Calculation of U Value for all type of external walls. • Calculation of the Shading Coefficient for external shading device. • OTTV calculation for each facing wall. • A drawing showing the cross-sections of typical parts of the roof construction, giving details of the type and thickness of basic construction materials, insulation, and air space. • The U-value of the roof assembly and technical specification of the roof insulation (if any) <p><i>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.</i></p> <ul style="list-style-type: none"> • RTTV Calculation (if applicable) • Skylight specification showing the U Value and SC Value.
<p>References</p>	<p>MS 1525:2019 - Energy Efficiency and use of renewable energy for non-residential building – Code of Practice</p>

ENRB 1-2 AIR-CONDITIONING SYSTEM

Objectives	Encourage the use of better efficient air-conditioned equipment to minimise energy consumption.																	
Applicability	<p>Applicable to air-conditioned building areas where its aggregate air-conditioned areas > 1000m².</p> <p>Scope covers on below air-conditioned equipment installed for the buildings:</p> <ul style="list-style-type: none"> <li style="display: inline-block; width: 45%;">• Chillers <li style="display: inline-block; width: 45%;">• Air Handling Units (AHU) <li style="display: inline-block; width: 45%;">• Chilled water pumps <li style="display: inline-block; width: 45%;">• Fan Coil Units (FCU) <li style="display: inline-block; width: 45%;">• Condenser water pumps <li style="display: inline-block; width: 45%;">• Unitary Air-Conditioners/ Condensing Units which include single-split units, multi-split units and variable refrigerant flow (VRF) system <li style="display: inline-block; width: 45%;">• Cooling Towers 																	
Baseline Standard	<p>Minimum efficiency requirement of the air-conditioning system stated in MS 1525:2019 or SS 530 & SS CP 13.</p> <ul style="list-style-type: none"> • <u>Water-Cooled Chilled Water Plant</u> <table border="1" style="margin-left: 40px; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2" style="padding: 5px;">Baseline</th> <th colspan="2" style="padding: 5px;">Building Cooling Load</th> </tr> <tr> <th style="padding: 5px;">< 500 RT</th> <th style="padding: 5px;">≥ 500 RT</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;"><i>Prerequisite Requirements</i></td> <td style="padding: 5px;">0.85</td> <td style="padding: 5px;">0.75</td> </tr> <tr> <td style="padding: 5px;">Minimum system efficiency of central chilled-water plant</td> <td style="padding: 5px;">kW/RT</td> <td style="padding: 5px;">kW/RT</td> </tr> </tbody> </table> <ul style="list-style-type: none"> i. Water-Cooled Chiller – Refer Table 25 of MS 1525:2019 to calculate Its Coefficient of Performance (COP) ii & iii. Chilled-water pump and condenser water pump efficiency – Refer to Clause 8.2.5 in MS 1525:2019 which states that for chilled water or condenser water pumping system operating for more than 750 hours a year, the pump efficiency shall be: <p style="margin-left: 40px;">Table 21. Maximum power consumption for pumping system</p> <table border="1" style="margin-left: 40px; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="padding: 5px;">Type of pumping system</th> <th style="padding: 5px;">Maximum Power consumption [W/(m³/h)]</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">Condenser water pump</td> <td style="padding: 5px;">84</td> </tr> <tr> <td style="padding: 5px;">Chilled water pump</td> <td style="padding: 5px;">97</td> </tr> </tbody> </table> <ul style="list-style-type: none"> • Cooling tower performance at the rating condition states in Table 3 SS 530. <p style="margin-left: 40px;"><u>Rating condition is as follows:</u> 35°C Entering water 29°C Leaving water 24°C Wet Bulb Outdoor air</p> 	Baseline	Building Cooling Load		< 500 RT	≥ 500 RT	<i>Prerequisite Requirements</i>	0.85	0.75	Minimum system efficiency of central chilled-water plant	kW/RT	kW/RT	Type of pumping system	Maximum Power consumption [W/(m ³ /h)]	Condenser water pump	84	Chilled water pump	97
Baseline	Building Cooling Load																	
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Minimum system efficiency of central chilled-water plant	kW/RT	kW/RT																
Type of pumping system	Maximum Power consumption [W/(m ³ /h)]																	
Condenser water pump	84																	
Chilled water pump	97																	

Propeller and axial fan cooling tower:

With heat rejected from every 3.23 L/s of condenser water per 1 kW of fan power rating:

$$\begin{aligned} \text{Cooling tower performance} &\leq 1\text{kW} / 3.23 \text{ L/s} \\ &\leq 0.310 \text{ kW/ L/s} \end{aligned}$$

Centrifugal fan cooling tower:

With heat rejected from every 1.7L/s of condenser water per 1kW of fan power rating:

$$\begin{aligned} \text{Cooling tower performance} &\leq 1\text{kW} / 1.7 \text{ L/s} \\ &\leq 0.588 \text{ kW / L/s} \end{aligned}$$

OR

- Air-Cooled Chilled-Water Plant / Unitary Air-Conditioners

Baseline	Building Cooling Load	
	< 500 RT	≥ 500 RT
<u>Prerequisite Requirements</u> Minimum system efficiency of air-cooled chilled water plant or unitary conditioners	1.1 kW/RT	1.0 kW/RT

- Air-cooled chilled water plant - Refer Table 25 of MS 1525:2019 to calculate its Coefficient of Performance (COP).
- Unitary Air-Conditioners / Condensing Units – Refer Table 23 of MS 1525:2014

Note: If the specific type of air conditioned is not found in MS 1525:2019, please refer to SS 530 to make the calculation on COP. Priority given to MS 1525:2019.

- Air Distribution System – Refer ASHRAE 90.1:2010 Clause 6.5.3.1 as prescribed below:

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

- Provision of permanent measuring instruments to monitor water-cooled and air-cooled chilled water plant
 - The instrumentation installed in the system shall have capability to calculate resultant plant efficiency within ± 5% of its true value – Refer ASHRAE Guide 22 and AHRI 550/590.
 - The following instrumentation accuracy as follow can be considered for monitoring central water-cooled chilled plant efficiency.

Description	Measurement error
<u>Temperature sensors</u> - 10K/30K Thermistor - Platinum Resistance Thermometers	± 0.03 – 0.05 °C at 0°C
<u>Floor Sensor Meter</u> - Ultrasonic - Full bore magnetic	± 0.5 – 1.0 % over entire measurement range
Power meter	ANSI C12.1-2008, Class 1 ±1%

	<ul style="list-style-type: none"> • <u>Verification of central chilled water plant instrumentation – Heat Balance substantiating test</u> • Substantiating test shall be conducted as accordance to AHRI 550/590 • The heat balance shall be conducted over entire normal operating hours with more than 80% of the computed balance within $\pm 5\%$ over the audit period <p>Heat balance is denoted by below equation:</p> $q_{\text{condenser}} = q_{\text{evaporator}} + W_{\text{input}}$ <p>Where;</p> <p>$q_{\text{condenser}}$ = heat rejected (in kW or RT) $q_{\text{evaporator}}$ = cooling load (in kW or RT) W_{input} = measured electrical power input to compressor</p> <p>1-2(f) Provisioning of variable speed controls for chiller plant equipment</p> <p>1-2(g) Provisioning of automatic control devices or sensors to regulate outdoor air flow rate to maintain the concentration of Carbon Dioxide at acceptable range ≤ 700 ppm above outdoor concentration.</p>
Requirements	<p><u>1-2 Option 1: Fixed Metric</u></p> <p>(a) <u>Water-Cooled Chilled-Water Plant (Up to 20 credits)</u></p> <ul style="list-style-type: none"> • Building cooling load $\geq 500\text{RT}$: <p>14 credits for achieving plant efficiency of 0.75 kW/ton</p> <p>0.35 credit for every percentage improvement in the chiller plant efficiency better than 0.75 kW/ton</p> <p>Credit scored = $0.35 \times (\% \text{ improvement})$</p> <ul style="list-style-type: none"> • Building cooling load $< 500\text{RT}$: <p>14 credits for achieving plant efficiency of 0.85 kW/ton</p> <p>0.3 credit for every percentage improvement in the chiller plant efficiency better than 0.85 kW/ton</p> <p>Credit scored = $0.3 \times (\% \text{ improvement})$</p> <p style="text-align: center;">(up to 20 credits)</p>

OR

(b) Air Cooled Chilled-Water Plant / Unitary Air-Conditioners (Up to 20 credits)

• **Building cooling load \geq 500RT:**

14 credits for achieving plant efficiency of 1.0 kW/ton

0.25 credit for every percentage improvement in the chiller plant efficiency better than 1.0 kW/ton

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

• **Building cooling load $<$ 500RT:**

14 credits for achieving plant efficiency of 1.1 kW/ton

0.2 credit for every percentage improvement in the chiller plant efficiency better than 1.1 kW/ton

Credit scored = $0.2 \times (\% \text{ improvement})$

(up to 20 credits)

(c) Air Distribution System (Up to 8 credits)

0.15 credits for every percentage improvement in the air distribution system efficiency above the baseline.

Credits scored = $0.15 \times (\% \text{ improvement})$

(d) 2 credits can be scored for the provision of permanent measuring instruments for monitoring of water cooled chilled-water plant and air-cooled chilled water plant efficiency

(e) 1 credit can be scored for verification of central water cooled chilled-water plant instrumentation: Heat Balance – substantiating test for water cooled chilled-water plant to be computed in accordance with AHRI 550/590. The operating system efficiency and heat balance to be submitted to GreenRE upon commissioning.

(f) 1 credit can be scored if variable speed controls for chiller plant equipment such as chilled-water pumps and cooling tower fans are provided to ensure better part-load plant efficiency.

(g) 1 credit can be scored if sensors or similar automatic control devices are used to regulate outdoor air flow rate to maintain the concentration of carbon dioxide (CO_2) \leq 700 ppm above outdoor.

1-2 Option 2: EUI Benchmarking

i. Projects with air conditioning system

(a) 20 credits for achieving EUI per table shown.

Building Type	Bronze (kWh/m ² /year)	Silver (kWh/m ² /year)	Gold (kWh/m ² /year)	Platinum (kWh/m ² /year)
Office Building	205	180	135	120
Hotel	375	330	240	220
Retail Mall	360	315	230	210
School, University and College	170	145	110	100
School, University and College (MOE)	60	50	38	35
Hospital (Private & General)	580	510	375	340
Community Hospitals	360	315	230	210
Polyclinics	230	205	150	135
Nursing / Youth Homes	135	120	90	80

Table 2: Energy Usage Intensity (EUI) Benchmarking (kwh/m²/yr)

(b) Water-Cooled Chilled-Water Plant (Up to 8 credits)

- **Building cooling load ≥ 500RT:**

0.35 credit for every percentage improvement in the chiller plant efficiency better than 0.75 kW/ton
 Credit scored = 0.35 x (% improvement)

- **Building cooling load < 500RT:**

0.3 credit for every percentage improvement in the chiller plant efficiency better than 0.85 kW/ton

Credit scored = 0.3 x (% improvement)

(c) Air Cooled Chilled-Water Plant / Unitary Air-Conditioners (Up to 8 credits)

- **Building cooling load \geq 500RT:**

0.25 credit for every percentage improvement in the chiller plant efficiency better than 1.0 kW/ton

Credit scored = 0.25 x (% improvement)

- **Building cooling load $<$ 500RT:**

0.2 credit for every percentage improvement in the chiller plant efficiency better than 1.1 kW/ton

Credit scored = 0.2 x (% improvement)

(up to 8 credits)

(d) 2 credits can be scored for the provision of permanent measuring instruments for monitoring of water cooled chilled-water plant and air-cooled chilled water plant efficiency

(e) 1 credit can be scored for verification of central water cooled chilled-water plant instrumentation: Heat Balance – substantiating test for water cooled chilled-water plant to be computed in accordance with AHRI 550/590. The operating system efficiency and heat balance to be submitted to GreenRE upon commissioning.

(f) 1 credit can be scored if variable speed controls for chiller plant equipment such as chilled-water pumps and cooling tower fans are provided to ensure better part-load plant efficiency.

(g) 1 credit can be scored if sensors or similar automatic control devices are used to regulate outdoor air flow rate to maintain the concentration of carbon dioxide (CO_2) \leq 700 ppm above outdoor.

ii. Project with District Cooling System

(a) 20 credits for achieving EUI per table shown

Building Type	Bronze (kWh/m ² /year)	Silver (kWh/m ² /year)	Gold (kWh/m ² /year)	Platinum (kWh/m ² /year)
Office Building	130	120	90	80
Hotel	240	220	150	135
Retail Mall	230	200	140	140
School, University and College	110	90	75	60
School, University and College (MOE)	40	30	25	20
Hospital (Private & General)	370	330	245	230
Community Hospitals	230	210	150	140
Polyclinics	150	130	95	90
Nursing / Youth Homes	90	75	55	55

(b) Air Distribution System (Up to 8 credits)

0.15 credits for every percentage improvement in the air distribution system efficiency above the baseline.

Credits scored = 0.15 x (% improvement)

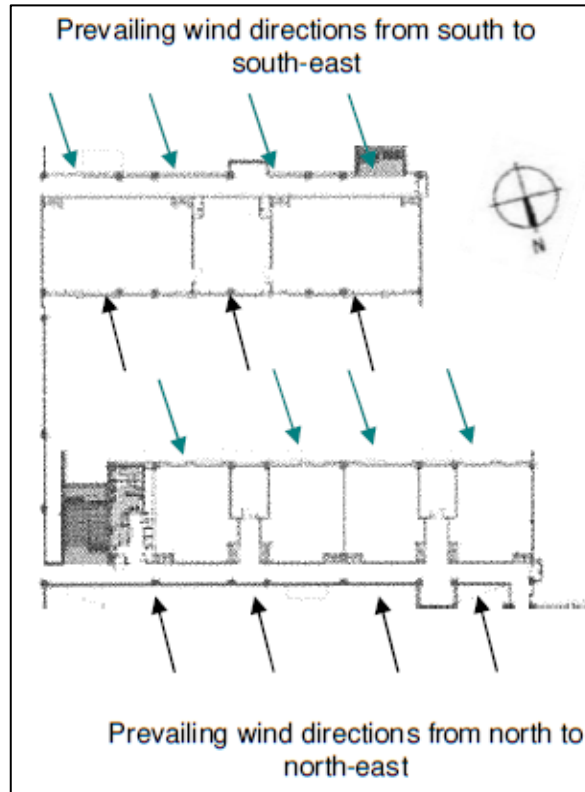
<p>Documentary Evidences</p>	<p><u>For 1-2 Option 1 (a) & (b) and Option 2 (b) & (c)</u></p> <ul style="list-style-type: none"> • Detailed calculations of the overall improvement in equipment/system efficiency of the air-conditioning plants/ showing the design cooling system capacity and the system efficiency (including individual equipment efficiency). • Calculation and technical data of the designed system efficiency of chillers at part load condition. • Technical product information of all air-conditioning and system which included chillers, chilled water pumps, condenser water pumps, cooling towers. • Schematic drawings showing the air-conditioning system • Schedules of the air-conditioning system. <p><u>For 1-2 Option 1 (c) and Option 2(ii) District Cooling (b)</u></p> <ul style="list-style-type: none"> • Detailed calculations of the overall improvement for air distribution system. • Technical product information of all AHUs, FCUs, and etc. • AHUs and FCUs schedule and schematic drawing <p><u>For 1-2 Option 1 and Option 2 (d)</u></p> <ul style="list-style-type: none"> • Instrument's calibration certificates from accredited laboratory or batch calibration certificates from manufacturer. • Summary of instruments, standard and measurement accuracy to be presented in the prescribed format. • Technical specification of the digital power meters, flow meters and temperature sensors. <p><u>For 1-2 Option 1 and Option 2 (e)</u></p> <ul style="list-style-type: none"> • Computation of the percent heat balance that is the total heat gain and total heat rejected must be within $\pm 5\%$ for 80% of the sampled credits over the normal building operations hours accordance with AHRI550/590. • Detailed calculations of the overall uncertainty of measurement of the resultant chiller plant efficiency in kW/RT to be within $\pm 5\%$ of the true value based on instrumentation specification. <p><u>For 1-2 Option 1 and Option 2 (f) and (g)</u></p> <ul style="list-style-type: none"> • Extracts of the tender specification showing the requirements to incorporate these control devices. • Plan layouts showing the locations and the types of control devices used to regulate fresh air intake. • Technical product specification of the control devices. <p><u>For Option 2 (i) Air Conditioning System (a) and (ii) District Cooling system (a)</u></p> <ul style="list-style-type: none"> • Tabulation data for the energy consumption of the building for the 1 year. • EUI calculation
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References	<ul style="list-style-type: none">(a) MS 1525:2019 – Energy efficient and use of renewable energy for non-residential building – Code of Practice(b) SS 530 – Code of Practice for Energy Efficiency Standard for Building Services and Equipment.(c) SS CP 13 – Code of Practice for Mechanical Ventilation and Air-Conditioning in Buildings.
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ENRB 1-3 NATURAL VENTILATION/ MECHANICAL VENTILATION

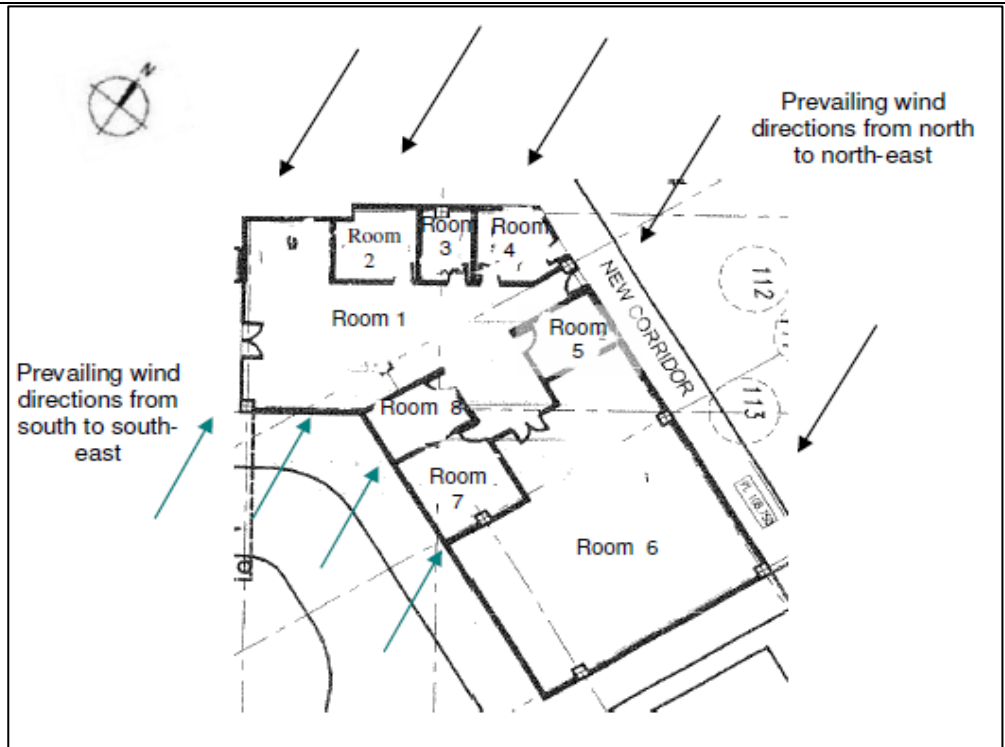
Objectives	Encourage building that facilitates good natural ventilation. Encourage energy efficient mechanical ventilation system as the preferred ventilation mode to air-conditioning in buildings.						
Applicability	Applicable to Non-Air-Conditioned Building Areas (with an aggregate non air-conditioned areas > 10% of total floor area excluding carparks and common areas) for Natural Ventilation.						
Baseline Standard	<p>Fan power limitation in mechanical ventilation systems:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2" style="text-align: center;">Allowable nameplate motor power</th> </tr> <tr> <th style="text-align: center;">Constant volume</th> <th style="text-align: center;">Variable volume</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1.7 kW/m³/s</td> <td style="text-align: center;">2.4 kW/m³/s</td> </tr> </tbody> </table>	Allowable nameplate motor power		Constant volume	Variable volume	1.7 kW/m ³ /s	2.4 kW/m ³ /s
Allowable nameplate motor power							
Constant volume	Variable volume						
1.7 kW/m ³ /s	2.4 kW/m ³ /s						
Requirements	<p><u>1-3(a) Natural Ventilation</u></p> <p>Up to 32 credits will be awarded for natural ventilation in the building.</p> <p>20 base credits will be awarded for use of natural ventilation,</p> <p>Up to 12 credits can be scored for building design that utilises prevailing wind conditions to achieve adequate cross ventilation.</p> <p>1.2 credits for every (10% of units/ rooms with window openings facing north and south directions)</p> <p style="text-align: center;">Credits scored = 1.2 x (% of units / 10)</p> <p>Note: In Malaysia, the prevailing wind comes from two predominant directions; that is the north to north-east during the Northeast monsoon season and south to south-east during the South-west monsoon season. Hence, buildings designed with window openings facing the north and south directions have the advantages of the prevailing wind conditions which would enhance indoor thermal comfort. Meteorological data on the more precise wind direction and velocity of the site location can also be used as the basis for the design.</p> <p>It is not necessary for the window openings to be located perpendicularly to the prevailing wind direction. Only window adjoining the habitable to be considered. Window adjoining toilets/ bathroom and store room will not be considered An oblique angle is considered acceptable (see illustrations as shown in the next page).</p>						

Illustration 1-3.1: Orientation of facade facing North and South



Building layout shows all rooms with window openings facing the North and South directions.

Illustration 1-3.2: Orientation of facade facing North and South



Building layout shows not all rooms with window facing the north and south directions. Room 2 to Room 5 would only have prevailing wind in one direction. Only Room 1 and 6 can be considered meeting requirement 1-3(a).

1-3(b) Mechanical Ventilation

Up to 32 credits for the use of mechanical system in order to promote adequate ventilation between indoor and outdoor air.

0.6 credits for every subsequent 1% improvement in the baseline.

Documentary Evidences	<p>1-3(a) Natural Ventilation</p> <ul style="list-style-type: none"> Architectural plan layouts showing the units / rooms of all blocks with highlights of those with north and south window openings. Calculation showing the percentage of units or rooms with window openings facing north and south directions in the prescribed formats as shown in Table 1-3(a). <p>Table 1-3(a) – Percentage of units with window opening in N-S direction</p> <table border="1" data-bbox="399 504 1388 996"> <thead> <tr> <th>Ref</th> <th>Description</th> <th>Units/Rooms with window opening in the N-S direction (a)</th> <th>Total no. of naturally ventilated units/room (b)</th> <th>% of units/rooms with window opening in N-S direction</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Classroom Blk A & A1</td> <td></td> <td></td> <td rowspan="4">$\sum (a) / \sum(b) \times 100$</td> </tr> <tr> <td>2</td> <td>Classroom Blk B</td> <td></td> <td></td> </tr> <tr> <td>3</td> <td>Offices, meeting rooms and computer rooms with air-conditioning</td> <td></td> <td></td> </tr> <tr> <td colspan="2">Total:</td> <td></td> <td></td> </tr> </tbody> </table> <p style="text-align: center;"> Credits scored = $1.2 \times (\% \text{ of units} / 10)$ = $1.2 \times [(\sum (a) / \sum(b) \times 100) / 10] + 20$ (for use of NV) </p> <p>1-3(b) Mechanical Ventilation</p> <ul style="list-style-type: none"> Plan layout demarcate the area with mechanical ventilation system. The overall design and drawings for mechanical ventilation system to make up the required outdoor air quantity into the building at desire fan power limit. Detailed calculations showing the fan power improvement. Product catalogue of the fan power used. 	Ref	Description	Units/Rooms with window opening in the N-S direction (a)	Total no. of naturally ventilated units/room (b)	% of units/rooms with window opening in N-S direction	1	Classroom Blk A & A1			$\sum (a) / \sum(b) \times 100$	2	Classroom Blk B			3	Offices, meeting rooms and computer rooms with air-conditioning			Total:			
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2	Classroom Blk B																						
3	Offices, meeting rooms and computer rooms with air-conditioning																						
Total:																							
References	SS CP 13 – Code of Practice for Mechanical Ventilation and Air-Conditioning in Buildings																						

ENRB 1-4 ARTIFICIAL LIGHTING

Objectives	Encourage the use of energy efficient lighting to minimize energy consumption from lighting usage while maintaining proper lighting level
Applicability	Applicable to lighting provisions that designed in accordance to the luminance level as recommended in MS 1525: 2019.
Baseline Standard	Luminance level stated in MS 1525:2019 – Energy Efficient and use of renewable energy for non-residential building – Code of Practice.
Requirements	<p>Up to 13 credits if tenants' light is provided OR up to 5 credits if tenants' light is excluded for the improvement in the lighting power consumption.</p> <p>0.25 credit for every percentage improvement in the lighting provisions over the baseline standard. That is:</p> <p>Credits scored = 0.25 x (% improvement)</p> <p>Display lighting and specialised lighting are to be included in the calculation of lighting power budget.</p> <p>The design service illuminance, lamp efficiencies and the light output ratios of luminaries shall be in accordance with in MS 1525:2019 – Energy Efficiency and use of renewable energy for non-residential building – Code of Practice.</p>
Documentary Evidences	<ul style="list-style-type: none"> • Lighting layout plan. • Lighting schedules showing the numbers, locations and types of luminaries used. • Calculation of the installed lighting power budget and the percentage, improvement in the prescribed tabulated format. • Technical product information of the lighting luminaries used.
References	MS 1525:2019 – Energy Efficiency and use of renewable energy for non-residential building – Code of Practice.

ENRB 1-5 VENTILATION IN CARPARKS

Objectives	Encourage the use of energy efficiency design and control of ventilation systems in carparks.
Applicability	Applicable to all carpark spaces in the development.
Baseline Standard	-
Requirements	<p>1-5(a) 4 credits can be scored if the carparks spaces that are fully naturally</p> <p>1-5(b) For carparks that have to be mechanically ventilated, credits can be scored for the use of carbon monoxide (CO) sensors in regulating such demand based on the mode of mechanical ventilation (MV) used; 2.5 credits for carparks using fume extract system and 2 credits for those with MV with or without supply.</p> <p>Note: Where there is a combination of different ventilation mode adopted for carpark design, the credits scored under this requirement will be prorated accordingly.</p>
Documentary Evidences	<p><u>For 1-5 (a)</u></p> <ul style="list-style-type: none"> • Plan layouts showing all car park provision for the development with highlights of the car park spaces that are designed to be naturally ventilated. • Calculation showing the openings at the carpark level to meet the UBBL requirement. <p><u>For 1-5 (b)</u></p> <ul style="list-style-type: none"> • Plan layouts showing all car park provision for the development with highlights of the car park spaces that are designed to be mechanical ventilated. • Plan layout indicating the location of CO sensors and the mode of ventilation adopted for the design. • Calculation showing the credits allocation if there is a combination of different ventilation mode adopted for the car park design. • Technical product information of CO sensors and mechanical ventilation.
References	-

ENRB 1-6 VENTILATION IN COMMON AREAS

Objectives	Encourage the use of energy efficient of ventilation systems in common areas
Applicability	Applicable to the following common areas of the development. <ul style="list-style-type: none"> <li style="display: inline-block; width: 45%;">• Toilets <li style="display: inline-block; width: 45%;">• Lift Lobbies <li style="display: inline-block; width: 45%;">• Staircases <li style="display: inline-block; width: 45%;">• Atriums <li style="display: inline-block; width: 45%;">• Corridors
Baseline Standard	-
Requirements	<p>Up to 5 credits can be scored for the use of natural ventilation as an effective passive cooling design strategy to reduce the energy used by air-conditioning systems in these common areas.</p> <p>Credits are scored based on the mode of ventilation provided in these applicable areas.</p> <p>Natural ventilation – 1.5 credits for each area</p> <p>Mechanical ventilation – 0.5 credit for each area</p>
Documentary Evidences	<ul style="list-style-type: none"> • Plan layouts showing the applicable areas and the respective modes of ventilation with proper demarcation of the opening. • Schedules showing the numbers, locations of the applicable areas and the mode of ventilation used. • Technical product information of mechanical ventilation system. (if applicable) • Schematic drawing of the mechanical ventilation system. • Calculation showing the credits allocation if there is a combination of different ventilation modes adopted for the applicable areas.
References	-

ENRB 1-7 LIFTS AND ESCALATORS

Objectives	Encourage the use of energy efficient lifts and escalator.
Applicability	Applicable to <u>ALL</u> lifts and/or escalators in the development.
Baseline Standard	-
Requirements	<p>1 credit can be scored for the use of lifts with energy efficient features such as AC variable voltage and variable frequency (VVVF) motor drive or equivalent.</p> <p>1 credit can be scored for the use if lifts with sleep mode features.</p> <p>1 credit can be scored for the use of escalators with motion sensors to regulate usage.</p>
Documentary Evidences	<ul style="list-style-type: none"> • Extracts of the tender specification indicating the types of lifts & escalators and related features used. • Plan layout showing the location of the lifts and escalators. • Schedules showing the total number of lifts & escalators and its power consumption. • Technical information of the lifts & escalators.
References	-
Worked Example 1-7	<p>Proposed development has the following provision:</p> <p>Two lift types: Type L1 with VVVF motor drive and sleep mode features Type L2 with VVVF motor drive and sleep mode features</p> <p>Two escalator types: Type E1 with VVVF motor drive and motion sensors Type E2 without VVVF motor drive and motion sensors</p> <p>1 credit for the use of lifts with VVVF motor drive; and</p> <p>1 credit for the use of lifts with sleep mode features</p> <p>No credits for escalators as not all escalators are designed with motion sensors</p> <p>Credits scored for 1-7 = 2 credits (out of 3 credits)</p>

ENRB 1-8 ENERGY EFFICIENT PRACTICES & FEATURES

Objectives	Encourage the use of energy efficient practices and features which are innovative and/or have positive environmental impact.
Applicability	Applicable to practices and features that are not listed in the requirements under Part 1 – Energy Efficiency.
Baseline Standard	-
Requirements	<p>1-8(a) 1 credit can be scored for the practice of using Energy Usage Index (EUI) as a building performance indicator to measure the building’s unit area energy consumption for future monitoring and improvements.</p> <p style="padding-left: 40px;">EUI is derived using the following equation:</p> $\text{EUI} = [(\text{TBEC} - \text{CPEC}) / (\text{GFA excluding carpark})] * \text{FVR}$ <p style="padding-left: 40px;">Where:</p> <p style="padding-left: 40px;">(a) TBEC = Total building energy consumption (kWh/year)</p> <p style="padding-left: 40px;">(b) CPEC = Car Park Energy Consumption in (kWh/year)</p> <p style="padding-left: 40px;">(c) GFA = Gross Floor Area (exclude car park area) (m²)</p> <p style="padding-left: 40px;">(d) FVR = Floor Vacancy Rate (NLA) (m²)</p> <p style="padding-left: 40px;">Note:</p> <ol style="list-style-type: none"> Design EUI 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 EUI which reflects the actual operation situation <p>1-8(b) 0.5 credits can be scored for each equipment type used up to 2 credits.</p> <p>1.8(c) Up to 9 credits can be scored for this section. 2 credits for every 1% energy saving over the total building energy consumption.</p> <p style="padding-left: 40px;">Examples include:</p> <ul style="list-style-type: none"> • Re-generative lift • Heat recovery system • Motion sensors • Sun pipes • Light shelves • Photocell sensors to maximize the use of Daylight • Heat pumps, etc. <p>Notes: For features that are not listed ENRB 1-8(b) above, the QP is required to submit the details showing the positive environmental impacts and potential energy savings of the proposed features to GreenRE assessment.</p>

<p>Documentary Evidences</p>	<p><u>For 1-8(a)</u></p> <ul style="list-style-type: none"> • Calculation of the Energy Usage Index (EUI) using the pre-determined daily usage pattern. • Detail calculation including operation hours for the estimated energy load for each component in the building etc.: lighting, air conditioning system, pump, receptacle load. • Technical product information and related drawing on the energy efficient features. • List of the assumption for the EUI calculation <p><u>For 1-8(b)</u></p> <ul style="list-style-type: none"> • Extracts of the tender specification showing the provision of the proposed energy efficient products and the extent of implementation where applicable. • Technical product information and certificate. <p><u>For 1-8(c)</u></p> <ul style="list-style-type: none"> • Extracts of the tender specification showing the provision of the proposed energy efficient features and the extent of implementation where applicable. • Technical product information and related drawing on the energy efficient features used. • Calculation of the percentage energy saving that could be reaped from the use of these features.
<p>References</p>	<p>-</p>

ENRB 1-9 ENERGY POLICY & MANAGEMENT

Objectives	Encourage new strategies and plans in the future save and minimise the use of energy.
Applicability	Applicable to building that uses energy
Baseline Standard	-
Requirements	<p>1-9(a) 0.5 credits for energy policy, energy targets and regular review with top management's commitment as part of an environmental strategy.</p> <p>1-9(b) 0.5 credits to show intent, measures and implementation strategies of energy efficiency improvement plans to achieve energy target set over the next three years. Committed energy savings accrued from proposed measures should be quantified</p>
Documentary Evidences	<p><u>For 1-9 (a)</u></p> <ul style="list-style-type: none"> • Energy policy showing energy saving commitments or energy targets from the top management. <p><u>For 1-9 (b)</u></p> <ul style="list-style-type: none"> • Improvement plans showing the calculation of energy saving that can be achieved over the next three years.
References	-

ENRB 1-10 RENEWABLE ENERGY

Objectives	Encourage the application of renewable energy sources in buildings.
Applicability	Includes all renewable energy sources.
Baseline Standard	-
Requirements	<p>Up to 20 credits can be scored for the use of renewable energy. Credit scored based on % replacement of electricity by renewable energy source</p> <p>5 credits for every 1% replacement of electricity (based on total electricity consumption) by renewable energy</p> <p style="text-align: center;">OR</p> <p>3 credits for every 1% replacement of electricity (based on the total electricity consumption excluding tenant's usage) by renewable energy</p> <p style="text-align: center;">OR</p> <p>3 credits for every 10% of roof area used for solar panels</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>
Documentary Evidences	<ul style="list-style-type: none"> • Plan layout showing the location of proposed renewable energy system. • Technical product information on the salient features of the renewable energy system and the expected renewable energy generated. • Calculation of the percentage replacement of electricity and the total annual electricity consumption of the development.
References	-

(II) Other Green Requirements

Part 2 – Water Efficiency

ENRB 2-1 Water Usage and Leak Detection

ENRB 2-2 Water Efficient Fittings

ENRB 2-3 Alternative Water Sources

ENRB 2-4 Water Efficiency Improvement Plans

ENRB 2-5 Irrigation System and Landscaping

ENRB 2-6 Water Consumption of Cooling Towers

ENRB 2-1 WATER USAGE AND LEAK DETECTION SYSTEM

Objectives	Promote the use of sub-metering and leak detection system for better control and monitoring of water usage
Applicability	Applicable to sub-metering provisions for major water uses of the building developments.
Baseline Standard	-
Requirements	<p>(a) 1 credit can be scored by monitoring the water consumption on a monthly basis.</p> <p>(b) 1 credit can be scored for the provision of private-meters for major water uses (e.g., Cooling tower, water features, irrigation, swimming pools and tenant usage)</p> <p>(c) Up to 2 credits can be scored for the provision of automated/smart metering for monitoring and leakage detection.</p>
Documentary Evidences	<p><u>For 2-1 (a)</u></p> <ul style="list-style-type: none"> • Monitoring plan of water consumptions. <p><u>For 2-1 (b)</u></p> <ul style="list-style-type: none"> • Schematic drawings of cold-water distribution system showing the location of the sub meters provided. • List of sub metering and its location. <p><u>For 2-1 (c)</u></p> <ul style="list-style-type: none"> • Schematic drawing showing the location of sub-metering and its linkage to the Building Management System (BMS). • List of input and output point of the Building Management System (BMS) with highlighted the submeter point. • Printouts of smart metering results data log for each sub-meter.
References	-

ENRB 2-2 WATER EFFICIENT FITTINGS

Objectives	Encourage the use of water efficient fittings under Water Efficient Product Labelling Scheme (WELPS) or Water Efficiency Labelling Scheme (WELS)									
Applicability	Applicable to all water fittings covered by the WEPLS or WELS as follows: <ul style="list-style-type: none"> • Basin taps and mixers • Sink/taps and mixers • Dual Flush Low-Capacity Flushing Cisterns • Showerheads • Shower taps and mixers • Urinals and Flush Valves 									
Baseline Standard	As specified under Water Efficiency Products Labelling Scheme (WEPLS)									
Requirements	Up to 12 credits can be scored based on the number and water efficiency rating of the fitting type used. <table border="1" style="margin: 10px auto;"> <thead> <tr> <th colspan="3">Weightage Based on Water Efficiency Products Labelling Scheme (WEPLS)</th> </tr> <tr> <th>Efficient *</th> <th>Highly Efficient **</th> <th>Most Efficient ***</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">6</td> <td style="text-align: center;">9</td> <td style="text-align: center;">12</td> </tr> </tbody> </table>	Weightage Based on Water Efficiency Products Labelling Scheme (WEPLS)			Efficient *	Highly Efficient **	Most Efficient ***	6	9	12
Weightage Based on Water Efficiency Products Labelling Scheme (WEPLS)										
Efficient *	Highly Efficient **	Most Efficient ***								
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Documentary Evidences	<ul style="list-style-type: none"> • Extracts of the tender specification showing all the water fitting provisions for the development. • Water fitting schedules showing the numbers, types and the approved rating of the proposed fittings in the prescribed tabulated format shown in the Table 2.1-1. • Schematic drawing of cold water and sanitary plumbing. • WEPLS or WELS product specification or certificate. In the event no product recognition from WEPLS or WELS, product catalogue and test report from local or international body that equivalent to the SIRIM standard of testing is required. 									
References	For more information about WEPLS, refer to http://www.span.gov.my/index.php?option=com_content&view=article&id=580%3AAbout-us1&catid=175%3Awepls&Itemid=457&lang=en									
Worked Example 2-2	Example of a water fitting schedule showing the numbers, types and the approved rating of the proposed fitting for a residential development (including common facilities such as clubhouse toilets).									

Table 2-2.1 – Computation of the percentage of water fittings under WEPLS

Ref.	Water Fitting Type	WEPLS rating			Not Rated	Total
		Efficient	Highly Efficient	Most Efficient		
1	Shower taps and mixers	0	45	0	0	45
2	Basin taps and mixers	0	0	55	0	55
3	Sink/bib taps and mixers	0	70	0	0	70
4	Flushing cisterns	0	0	50	0	50
5	Others - Urinals for club house	0	0	0	5	5
Total no. based on rating (A)		0	115	105	5	$\sum A = 225$
Weightage (B)		6	9	12	0	
Total (AxB)		0	1035	1260	0	$\sum(AxB) = 2295$

$$\begin{aligned}
 \text{Credits scored} &= \sum(AxB) / \sum A \\
 &= 2295 / 225 \\
 &= 10.2 \text{ credits}
 \end{aligned}$$

ENRB 2-3 ALTERNATIVE WATER SOURCES

Objectives	Encourage the use of suitable systems that utilize alternative water sources for non-potable uses : irrigation, washing, water features, toilet flushing, etc						
Applicability	Generally applicable to building that uses alternative water sources.						
Baseline Standard	-						
Requirements	<p>Up to 3 credits will be awarded based on the % reduction in total potable water usage of the applicable uses</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">> 50 %</td> <td style="text-align: center;">3 credits</td> </tr> <tr> <td style="text-align: center;">≥ 10 % to 50 %</td> <td style="text-align: center;">2 credits</td> </tr> <tr> <td style="text-align: center;">< 10 %</td> <td style="text-align: center;">1 credit</td> </tr> </table>	> 50 %	3 credits	≥ 10 % to 50 %	2 credits	< 10 %	1 credit
> 50 %	3 credits						
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< 10 %	1 credit						
Documentary Evidences	<ul style="list-style-type: none"> • Drawings showing the location and design of non-potable water source. • Product information or related catalogue on the alternative water source used. • Calculation of potable water usage of the building • Calculation on the percentage of water reduction that can be achieved by using this alternative source. 						
References	-						

ENRB 2-4 WATER EFFICIENCY IMPROVEMENT PLANS

Objectives	To show intent, measures and implementation strategies of water efficiency improvement plans over the next three years
Applicability	Generally applicable for water consumption and its cycle for non-domestic used
Baseline Standard	-
Requirements	1 credit can be scored for the commitment to plan water savings accrued from proposed measures
Documentary Evidences	<ul style="list-style-type: none">• Improvement plans showing the calculation of water saving that can be achieved.• Water efficiency management plan report
References	-

ENRB 2-5 IRRIGATION SYSTEM AND LANDSCAPING

Objectives	Reduce potable water consumption by provision of suitable systems that utilise rainwater or recycled water for landscape irrigation.																																											
Applicability	Applicable to development with landscaping provision.																																											
Baseline Standard	-																																											
Requirements	<p>2-5(a) 1 credit can be scored for the use of non-potable water including rainwater for landscape irrigation.</p> <p>For rainwater harvesting tank provision, RWHT to be sized in accordance to Guideline for Rainwater Harvesting and Utilisation System (SPAH) and MSMA guidelines. The rainwater tanks are to be optimally sized to cater for outdoor water use only</p> <p>Summary calculation of % replacement of outdoor water requirements from rainwater harvesting to be provided as part of claim for this credit</p> <p>2-5(b) 1 credit can be scored if more than 50% of the landscape areas are served by water efficient irrigation system with features such as automatic sub-soil drip irrigation system with rain sensor control.</p> <p>2-5(c) 1 credit can be scored if at least 80% of the landscape areas consist of drought tolerant plants or plants that require minimal irrigation.</p>																																											
Worked Example 2-5 (a)	<p>Landscape Consumption</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: black; color: white;"> <th style="width: 15%;">Location</th> <th style="width: 20%;">Landscape type</th> <th style="width: 15%;">Water Required (L/day)</th> <th style="width: 10%;">Quantity</th> <th style="width: 10%;">Total watering requirement (L/Day)</th> </tr> </thead> <tbody> <tr> <td>GF</td> <td>Tree</td> <td style="text-align: center;">24</td> <td style="text-align: center;">200 Nos</td> <td style="text-align: center;">4800</td> </tr> <tr> <td></td> <td>Shrub</td> <td style="text-align: center;">6.3</td> <td style="text-align: center;">5660 m2</td> <td style="text-align: center;">35658</td> </tr> <tr> <td></td> <td>Turf</td> <td style="text-align: center;">3.1</td> <td style="text-align: center;">1415 m2</td> <td style="text-align: center;">4386.5</td> </tr> <tr> <td colspan="4"></td> <td style="text-align: center; background-color: #90EE90;">44844.5</td> </tr> </tbody> </table> <p style="margin-left: 40px;">Irrigation water requirement (Litre/Day) 44844.5</p> <p>Roof Catchment</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #cccccc;"> <th style="width: 60%;">Type</th> <th style="width: 20%;">m²</th> <th style="width: 20%;">Run-off coefficient</th> </tr> </thead> <tbody> <tr> <td>Pitched Tile</td> <td></td> <td style="text-align: center;">0.8</td> </tr> <tr> <td>Steel Roof</td> <td style="text-align: center;">1239</td> <td style="text-align: center;">0.9</td> </tr> <tr> <td>RC Roof</td> <td style="text-align: center;">1110</td> <td style="text-align: center;">0.5</td> </tr> <tr> <td>Block Pavement</td> <td></td> <td style="text-align: center;">0.7</td> </tr> <tr> <td>Gravel Roadway</td> <td></td> <td style="text-align: center;">0.3</td> </tr> </tbody> </table>	Location	Landscape type	Water Required (L/day)	Quantity	Total watering requirement (L/Day)	GF	Tree	24	200 Nos	4800		Shrub	6.3	5660 m2	35658		Turf	3.1	1415 m2	4386.5					44844.5	Type	m ²	Run-off coefficient	Pitched Tile		0.8	Steel Roof	1239	0.9	RC Roof	1110	0.5	Block Pavement		0.7	Gravel Roadway		0.3
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Documentary Evidences	<p><u>For 2-5(a)</u></p> <ul style="list-style-type: none"> • Calculation showing the percentage of potable water saving for irrigation. • Drawings showing the location and design of non-potable water source. • Extracts of the tender specification showing how the non-potable water source is to be provided. <p><u>For 2-5(b)</u></p> <ul style="list-style-type: none"> • Drawings showing the overall landscape areas and the areas that would be served using the system. • Calculation showing the percentage of the landscape areas that would be served using the system (at least 50%). • Extracts of the tender specification showing the provision and details of water efficient irrigation system. • Product technical information of the irrigation system. <p><u>For 2-5(c)</u></p> <ul style="list-style-type: none"> • Drawings showing the overall landscape areas and the areas that use drought tolerant plants or plants that require minimal irrigation. • Calculation showing the percentage of the landscape areas that use drought tolerant plants or plants that require minimal irrigation (at least 80%). • Plant species showing the minimum water requirement. 																				
References	-																				

ENRB 2-6 WATER CONSUMPTION OF COOLING TOWERS

Objectives	Reduce potable water consumption for cooling purpose.
Applicability	Applicable to building development with water-cooled central chillers systems and water-cooled package units.
Baseline Standard	-
Requirements	<p>2-6(a) 1 credit can be scored for the use of cooling tower water treatment system which can achieve 6 or better cycles of concentration at acceptable water quality.</p> <p>2-6(b) 1 credit can be scored for the use of recycled water from approved sources to meet the water demand for cooling purpose.</p>
Documentary Evidences	<p><u>For 2-6(a)</u></p> <ul style="list-style-type: none"> • Extracts of the tender specification showing the requirements to incorporate with the cooling tower designs to achieve six cycles of concentration. • Details showing how the cooling towers have been designed to achieve at least six cycles of concentration. • Relevant drawings showing the location of the cooling towers and other supporting systems that are required to achieve the designed concentration. <p><u>For 2-6(b)</u></p> <ul style="list-style-type: none"> • Extracts of the tender specification showing how the recycled water source is to be provided. • Details of the recycled water system. • Schematic system showing the recycling system
References	-

(II) Other Green Requirements

Part 3 – Sustainable Operation
& Management

ENRB 3-1 Building Operation & Maintenance

ENRB 3-2 Post Occupancy Evaluation

ENRB 3-3 Waste Management

ENRB 3-4 Sustainable Products

ENRB 3-5 Greenery Provision

ENRB 3-6 Environmental Protection

ENRB 3-7 Green Transport

ENRB 3-1 BUILDING OPERATION & MAINTENANCE

Objectives	Encourage the adoption of environmentally friendly practices during construction and building operation.
Applicability	Generally applicable to all building developments.
Baseline Standard	-
Requirements	<p>3-1(a) 1 credit can be scored if the environmental policy that reflects the sustainable goals set.</p> <p>3-1(b) 1 credit can be scored for the provision of building users' guide with details of the environmental friendly facilities and features within the building and their uses in achieving the intended environment performance during building operation. The minimum requirement of the Green Building User Guide as follows;</p> <ul style="list-style-type: none"> • Details of green building certification i.e rating tier, scorecard, certificate, validity etc. • Summary of green building features (ideally with photographs and diagrams) • Recommended practices for enhanced environmental performance of the building • Green fit out guidelines to details recommended minimum environmental standards to assist building users in making sustainable fit- out decisions • GreenRE renewal guideline <p>3-1(c) 1 credit can be scored if the building maintenance team comprises of 1 GreenRE manager / Green Mark manager</p> <p>3-1(d) 1 credit can be scored if the project team comprises 1 GreenRE Manager / Green Mark manager</p> <p>3-1(e) Up to 1 credit if the environmental management system of the building is ISO 14000 or ISO 50001 certified.</p>
Documentary Evidences	<p><u>For 3-1(a)</u></p> <ul style="list-style-type: none"> • Documentation related to the building environmental policy. <p><u>For 3-1(b)</u></p> <ul style="list-style-type: none"> • A copy of the building users' guide containing the details of the environmentally friendly facilities and features within the building and their uses in achieving the intended environment performance during building operation.

	<p><u>For 3-1(c)</u></p> <ul style="list-style-type: none"> • A certified true copy of certificate of GreenRE Manager/Green Mark Manager where applicable and a copy of organization chart of the building management team. <p><u>For 3-1(d)</u></p> <ul style="list-style-type: none"> • A certified true copy of certificate of GreenRE Manager/Green Mark Manager where applicable and a confirmation of their involvement in the project. <p><u>For 3-1(e)</u></p> <ul style="list-style-type: none"> • A certified true copy of the ISO 14000 and ISO 50001 certificate from the facilities management team.
References	-

ENRB 3-2 POST OCCUPANCY EVALUATION

Objectives	To receive feedback from occupants of the building
Applicability	Generally applicable to all building developments.
Baseline Standard	-
Requirements	<p>3-2(a) 2 credits for the conduct of post occupancy survey for occupants satisfaction on energy and environmental practices.</p> <p>Required number of people surveyed shall be:</p> <ul style="list-style-type: none"> • 10% of total occupancy and up to 100 maximums. • Minimum 5 people shall be surveyed if total occupancy is less than 50. <p>3-2(b) 1 credit can be scored for the list of corrective actions taken following the post evaluation.</p>
Documentary Evidences	<p><u>For 3-2(a)</u></p> <ul style="list-style-type: none"> • Draft of survey form. • Letter of commitment to conduct the survey. <p><u>For 3-2(b)</u></p> <ul style="list-style-type: none"> • List of corrective action will be taken if the feedback of the survey is not satisfying. • Evidence from past feedback that improvements were implemented or justification of measures to be taken to improve the current situation.
References	-

ENRB 3-3 WASTE MANAGEMENT

Objectives	To promote and encourage recycling and waste minimisation within the occupants of the building.
Applicability	Generally applicable to all building developments.
Baseline Standard	-
Requirements	<p>3-3(a) 2 credits for the provision of facilities or recycling bins for collection and storage for different recyclable waste such as paper, glass, plastic, food waste, etc.</p> <p>For commercial building, waste separation bins to be provided at each floor in a convenient location and suitable strategy should be available to manage the waste collection centrally</p> <p>3-3(b) 2 credits for promoting and encouraging minimization and recycling among occupants, tenants and visitors through various avenues.</p> <p>3-3(c) 1 credit for providing proper storage area for recyclable waste.</p> <p>3-3(d) 2 credit for quantifying and monitoring the recycling programme for continuous improvement.</p>
Documentary Evidences	<p><u>For 3-3(a)</u></p> <ul style="list-style-type: none"> • Layout plan showing the collection and storage for the different recyclable waste. <p><u>For 3-3(b)</u></p> <ul style="list-style-type: none"> • Draft of promotion and encouragement plan for minimization and recycling among occupants. <p><u>For 3-3(c)</u></p> <ul style="list-style-type: none"> • Layout plan showing the location of the storage area for recyclable waste. <p><u>For 3-3(d)</u></p> <ul style="list-style-type: none"> • Waste management plan
References	-

ENRB 3-4 SUSTAINABLE PRODUCTS









Objectives	To promote use of environmentally friendly products that are certified by approved local certification body and are applicable to non-structural and architectural related building components.								
Applicability	Generally applicable to all building developments.								
Baseline Standard	-								
Requirements	<p>Up to 8 credits are allocated to encourage the use of environmentally friendly products that are certified by approved local/international certification body. The criterion is only applicable for non-structural building components and construction. Credits scored will be based on the extent of use of environmentally friendly product.</p> <p>The environmentally friendly product proposed must be approved by a valid international or local certification body and is subject to GreenRE's evaluation.</p> <p style="text-align: center;">Table 3-2.1 : Weightage for credits allocation</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Extent of use of environmentally friendly product</th> <th style="text-align: center;">Weightage for Credits Allocation</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Low impact</td> <td style="text-align: center;">0.5</td> </tr> <tr> <td style="text-align: center;">Medium impact</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;">High Impact</td> <td style="text-align: center;">2</td> </tr> </tbody> </table> <p>The use of environmentally friendly products or recycled materials used for all main building elements or functional spaces of the development will be considered as <u>high impact</u> (2 credits) on condition that quantities used by percentage are more than 50% (i.e extent of coverage as compared to total quantities used for same intended purpose. If not met, it will be classified as <u>medium impact</u> (1 credit).</p> <p>Items that are used for all common areas, external works and communal facilities are considered as <u>medium impact</u> (1 credit) if quantities used by percentage are more than 80% (i.e extent of coverage as compared to total quantities used for same intended purpose in common areas If not met, it will be classified as <u>low impact</u> (0.5 credit).</p> <p>Notes:</p> <ol style="list-style-type: none"> (1) The impact categories listed above generally apply to main building elements – i.e internal / external wall, floor, ceiling, roof, doors, etc. Singular products – i.e termite treatment system, playground equipment, gym flooring etc will be classed as <u>low impact</u>. All applications will be subject to GreenRE's evaluation. (2) Same type of the product not allowed to be double claimed for different area of application. 	Extent of use of environmentally friendly product	Weightage for Credits Allocation	Low impact	0.5	Medium impact	1	High Impact	2
Extent of use of environmentally friendly product	Weightage for Credits Allocation								
Low impact	0.5								
Medium impact	1								
High Impact	2								

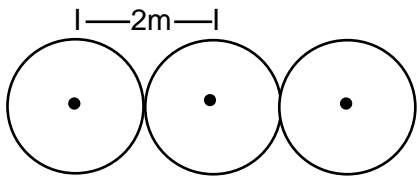
	<p>(3) The credit allocated for low volatile organic compound (VOC) paints and adhesives certified by approved local certification body can be found in NRB 4-3 and hence shall not be included in the scoring for NRB 3-2.</p>
Documentary Evidences	<ul style="list-style-type: none"> • Extracts from the tender specification and drawings showing the requirements to incorporate the environmentally friendly products that are certified and approved by local/international certification body. • Certification details from approved local/international certification body such as the material certification standards and rating within validity period. • Technical product information on the sustainable products. • Calculation of products and extent of coverage.
References	<p>For more info on product certification, refer to;</p> <ol style="list-style-type: none"> 1. http://www.sirim-gas.com.my/index.php/zh/our-services/product-certification/eco-labelling-scheme 2. http://www.sec.org.sg/sqsls/
Worked Example 3-4	<p>Determine if the environmentally friendly products selected are certified with approved local/international certification body. Check if the products used are meant for main building elements or functional spaces and can be considered <u>high impact or medium impact</u>. Products that are meant for common areas and external works such as toilets, lobbies and landscaping areas are considered as <u>medium impact or low impact</u>.</p> <p>Note: Certain products can have more environmentally friendly features than others. Other than recycled materials, they may have features like low VOC assembly or manufactured with resource efficient processes, durability etc that will render the products more environmental friendly than others. If the certified products selected are more environmental friendly and are given a better rating by the approved local/international certification body, a higher weightage can be considered in credit scoring.</p> <p>Example of a proposed development with the following provisions:</p> <ol style="list-style-type: none"> (a) Use of carpets for all office spaces. Product is not certified. (b) Use of panel boards as internal partitions for more than 50% of the office spaces and the product is rated by an approved certification body. (c) Precast concrete road kerbs. Product is rated by approved local certification body. – (Singular product) (d) Use of roof waterproofing coating. Product is rated by approved local certification body. (e) Use of wooden doors for all areas. Product is rated by approved local certification body.

Products and Extent of coverage		With approved certification	Extent of use category	Credits scored
(a)	Carpets for all office spaces	No	N/A	0
(b)	Panel boards as internal partition for more than 50% of office spaces	Yes	2	2
(c)	Precast road kerbs	Yes	0.5	0.5
(d)	Roof waterproofing	Yes	1	1
(e)	Wooden doors for all areas	Yes	2	2

Therefore, credits scored for 3-2 = 2 + 0.5 + 1 + 2 = 5.5 credits

ENRB 3-5 GREENERY PROVISION

Objectives	Encourage greater use of greenery and restoration of existing trees reduce heat island effect.																													
Applicability	Applicable to building developments with landscaping areas.																													
Baseline Standard	-																													
Requirements	<p>3-5(a) Up to 6 credits can be scored for the provision of greenery within the developments including roof top/ sky garden and green roof.</p> <p>Greenery Plot Ratio (GnPR) is calculated by considering the 3D volume covered by plants using the following Leaf Area Index(LAI) :</p> <table border="1" style="width: 100%; border-collapse: collapse; margin: 10px 0;"> <thead> <tr> <th style="width: 10%;">Plant group</th> <th style="width: 30%;">Trees</th> <th style="width: 20%;">Palms</th> <th style="width: 20%;">Shrubs & Groundcover</th> <th style="width: 10%;">Turf</th> </tr> </thead> <tbody> <tr> <td>LAI</td> <td>Canopy: Open = 2.5 Intermediate = 3.0 Dense = 4.0</td> <td>Solitary = 2.5 Cluster = 4.0</td> <td>Monocot = 3.5 Dicot = 4.5</td> <td>Turf = 2.0</td> </tr> <tr> <td>Area</td> <td>All = 60 m²</td> <td>Solitary = 20m² Cluster = 17m²</td> <td>Planted area</td> <td>Planted area</td> </tr> </tbody> </table> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>TREES</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <small>Santanea saman</small> <small>open canopy</small> </div> <div style="text-align: center;">  <small>Stryglum polyanthum</small> <small>intermediate canopy</small> </div> <div style="text-align: center;">  <small>Mimusops elengi</small> <small>dense canopy</small> </div> </div> </div> <div style="text-align: center;"> <p>PALMS</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <small>Archontophoenix alexandrae</small> <small>solitary</small> </div> <div style="text-align: center;">  <small>Ptychosperma macarthurii</small> <small>cluster</small> </div> </div> </div> <div style="text-align: center; margin-top: 20px;"> <p>SHRUBS & GROUNDCOVER</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <small>Cordylifera fructicosa 'Firebrand'</small> <small>monocot</small> </div> <div style="text-align: center;">  <small>Ixora 'Super pink'</small> <small>dicot</small> </div> </div> </div> <div style="text-align: center; margin-top: 20px;"> <p>TURF</p> <div style="text-align: center;">  <small>Zoyisia matrella</small> </div> </div> </div> <table border="1" style="width: 100%; border-collapse: collapse; margin: 10px 0;"> <thead> <tr> <th style="width: 50%;">GnPR</th> <th style="width: 50%;">Credits Allocation</th> </tr> </thead> <tbody> <tr> <td>1.0 to < 2.0</td> <td style="text-align: center;">1</td> </tr> <tr> <td>2.0 to < 3.0</td> <td style="text-align: center;">2</td> </tr> <tr> <td>3.0 to < 4.0</td> <td style="text-align: center;">3</td> </tr> <tr> <td>4.0 to < 5.0</td> <td style="text-align: center;">4</td> </tr> <tr> <td>5.0 to < 6.0</td> <td style="text-align: center;">5</td> </tr> <tr> <td>≥ 6.0</td> <td style="text-align: center;">6</td> </tr> </tbody> </table> <p style="text-align: center; margin: 10px 0;">Green Plot Ratio (GnPR) = Total leaf area index / site area</p> <p>3-5 (b) 1 credit for restoration of trees on-site, conservation or relocation of existing trees on site.</p> <p>3-5 (c) 1 credit for provision of compost bins to recycle organic waste to meet at least 30% of landscape fertilizer needs.</p>	Plant group	Trees	Palms	Shrubs & Groundcover	Turf	LAI	Canopy: Open = 2.5 Intermediate = 3.0 Dense = 4.0	Solitary = 2.5 Cluster = 4.0	Monocot = 3.5 Dicot = 4.5	Turf = 2.0	Area	All = 60 m ²	Solitary = 20m ² Cluster = 17m ²	Planted area	Planted area	GnPR	Credits Allocation	1.0 to < 2.0	1	2.0 to < 3.0	2	3.0 to < 4.0	3	4.0 to < 5.0	4	5.0 to < 6.0	5	≥ 6.0	6
Plant group	Trees	Palms	Shrubs & Groundcover	Turf																										
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1.0 to < 2.0	1																													
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<p>Documentary Evidences</p>	<p><u>For 3-5(a)</u></p> <ul style="list-style-type: none"> • Plan layouts showing the site area as well as the greenery that is provided within the development (including a listing of the number of trees, palms, shrubs, turf and the respective sub category and LAI values). • Calculation showing the extent of the greenery provision in the prescribed tabulated formats. • The plant species sub categories and its LAI values obtained from the online website: http://florafauweb.nparks.gov.sg/. <p><u>For 3-5 (b)</u></p> <ul style="list-style-type: none"> • Site layouts showing the existing and final locations (where applicable) and number of the trees to be restored or conserved or relocated. • Documentary evidence showing the relocation or restoration activities. <p><u>For 3-5 (c)</u></p> <ul style="list-style-type: none"> • Extracts of the tender specification showing the requirements to provide compost bin • Product specifications. • Method statement with details steps of composting process (if applicable). <p>The calculation of the 30% of fertilizer replacement with the composting</p>
<p>Exceptions</p>	<p>TREES AND PALMS SPACING (CENTRE-TO-CENTRE)</p> <p>(a) If the selected trees and palms are to be planted at $\leq 2\text{m}$ from trunk-to-trunk as illustrated below, the leaf area shall be calculated as the product of LAI value and planted area (in m^2).</p>  <p>OLUMNAR TREES</p> <p>(b) For trees that have tight, columnar crowns, the canopy area of 12m^2 is to be adopted for calculation of leaf area. These species include, but not limited to the following:</p> <ul style="list-style-type: none"> • Garciniacymosa forma pendula • Garciniasubelliptica • Polyalthialongifolia • Carallia brachiate • Gnetumgnemon
<p>References</p>	<p>The plant species, its sub categories and LAI values may be obtained from the online website: http://florafauweb.nparks.gov.sg</p>

Worked Example 3-5(a)

- (1) Determine the number of trees, palms and the trees for shrubs and turfs and other greenery area.
- (2) The Leaf Area Index (LAI) of the individual plant species and its canopy area are predetermined design parameters applicable for all developments.
- (3) The plant species sub categories and its LAI values can be obtained from the online website: <http://florafaunaweb.nparks.gov.sg/> (see example below) by searching the common / scientific names of the plants.
- (4) Compute the green areas as shown in the Table 3-5 (a) below

Table 3-5(a) – Calculation of the Green Plot Ratio

Category	Sub category	(A)	(B)	(C)	(A)x(B)x(C)
		LAI value	Canopy area	Qty/Planted Area	Leaf Area
Trees (no.)	Open Canopy	2.5	60 m ²	0 no.	0
	Intermediate Canopy	3.0	60 m ²	8 no.	1440
	Dense Canopy	4.0	60 m ²	12 no.	2880
	Intermediate columnar canopy*	3.0	12 m ²	4 no.	144
Palms (no.)	Solitary	2.5	30 m ²	10 no.	750
	Solitary (trunk-to-trunk)	2.5	NA	20 m ²	50
	Cluster	4.0	17 m ²	10 no.	680
Shrubs (m ²)	Monocot	3.5	NA	0 m ²	0
	Dicot	4.5	NA	20 m ²	90
Turf(m ²)	Turf	2.0	NA	90 m ²	180
Vertical Greenery (m ²)	-	2.0	NA	10 m ²	20
Total Leaf Area:					6234

Note: Green roof landscaping would be calculated as per illustrated above

Assume site area is 2000 m²

$$\begin{aligned} \text{Green Plot Ratio (GnPR)} &= \text{total leaf area} / \text{site area} \\ &= 6234 / 2000 = 3.117 < 4.0 \end{aligned}$$

Where GnPR = 3.0 to < 4.0

Therefore, credits scored for 3-5(a) = 3 credit

ENRB 3-6 ENVIRONMENTAL PROTECTION

Objectives	To adopt a sustainable and environmental-friendly procurement and purchasing policy in the operation and maintenance of the building. To reduce the potential damage to the ozone layer and the increase in global warming.
Applicability	Generally applicable to all building developments.
Baseline Standard	-
Requirements	<p><u>For 3-6(a)</u></p> <ul style="list-style-type: none"> • 1 credit can be allocated for the adoption of sustainable and environmental-friendly procurement and purchasing policy in the operation and maintenance of the building. <p><u>For 3-6(b)</u></p> <ul style="list-style-type: none"> • 1 credit can be scored for the use of refrigerants with ozone depleting potential (ODP) of zero or with global warming potential (GWP) of less than 100. • 1 credit can be scored for the use of refrigerant leak detection system at critical areas of plant rooms containing chillers and other equipment with refrigerants.
Documentary Evidences	<p><u>For 3-6(a)</u></p> <ul style="list-style-type: none"> • Draft green procurement policy documents to demonstrate environmental preferable services (operation and maintenance). <p><u>For 3-6(b)</u></p> <ul style="list-style-type: none"> • Schematic drawing showing the location of the refrigerant leak detection system at critical areas of plant room containing chillers and others equipment with refrigerants. • Product catalogue of the installed refrigerant leak detection system.
References	-

ENRB 3-7 GREEN TRANSPORT

Objectives	Promote environmentally friendly transport options and facilities to reduce pollution from individual car use.
Applicability	Generally applicable to all building developments.
Baseline Standard	-
Requirements	<p>3-7(a) 1 credit can be scored for design that provides good access (<800m walking distance) to public transport networks such as MRT/LRT stations or bus stops.</p> <p>3-7(b) 1 credit can be scored for provision of covered walkway to facilitate connectivity and the use of public transport.</p> <p>3-7(c) 1 credit can be scored for provision of electric vehicle charging stations and priority parking lots within the development. Provision of minimum of isolator with 7kWp charger</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>3-7(d) Up to 1 credit can be scored for the provision of covered/sheltered bicycles parking lots with rack / locking bar.</p> <p>Extent of Coverage: Bicycles parking lot : Minimum 10 number and maximum 50 numbers of bicycle parking lot.</p> <p>Shower Facilities: Minimum 1 number for every 100 regular occupant and additional 1 for every 150 occupants. (Cap at 7)</p>
Documentary Evidences	<p><u>For 3-7(a)</u></p> <ul style="list-style-type: none"> • Site layout plan in the context of the surrounding area showing the location of the development site and walking path to the location of the MRT/LRT stations and bus stops not more than 800m. • Proposed bus-stop details drawing. <p><u>For 3-7(b)</u></p> <ul style="list-style-type: none"> • Site layout plan showing the connection of covered walkway from the development to the MRT/LRT stations or bus stops. • Extracts of the tender specification showing the requirement to provide covered walkway.

	<p><u>For 3-7(c)</u></p> <ul style="list-style-type: none">• Extracts of the tender specification showing the requirement to provide hybrid/electric vehicle refuelling/recharge stations and priority parking bays.• Plan layout showing the location of the electric vehicle charging station in the development.• Calculation showing numbers of priority parking and charging station to the ratio of overall parking provided.• Product technical information. <p><u>For 3-7(d)</u></p> <ul style="list-style-type: none">• Extracts of the tender specification showing the requirement to provide covered/sheltered bicycles parking lots for the development and the total quantity of bicycles lots provided.• Plan layout showing the location of the covered/sheltered bicycle parking lots and rack/locking bar.
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(II) Other Green Requirements

Part 4 – Indoor Environment Quality

ENRB 4-1 Indoor Air Quality Performance

ENRB 4-2 Indoor Air Pollutants

ENRB 4-3 Lighting Quality

ENRB 4-4 Thermal Comfort

ENRB 4-5 Internal Noise Level

ENRB 4-1 INDOOR AIR QUALITY PERFORMANCE

Objectives	To promote a healthy indoor environment for occupant																																																																								
Applicability	Generally applicable to all building developments (air-conditioned areas only)																																																																								
Baseline Standard	<p>Indoor Air Contaminants Parameters:</p> <p>Notes:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Physical Parameters</th> <th colspan="3" style="text-align: center;">Acceptable Range</th> </tr> </thead> <tbody> <tr> <td>Air Temperature</td> <td colspan="3" style="text-align: center;">23-26 °C</td> </tr> <tr> <td>Relative Humidity</td> <td colspan="3" style="text-align: center;">50-70%</td> </tr> <tr> <td>Air Movement</td> <td colspan="3" style="text-align: center;">0.15-0.5 m/s</td> </tr> <tr> <th style="text-align: left;">Chemical Contaminants</th> <th colspan="3" style="text-align: center;">Acceptable Limits</th> </tr> <tr> <td></td> <td style="text-align: center;">ppm</td> <td style="text-align: center;">mg/m³</td> <td style="text-align: center;">Cfu/m³</td> </tr> <tr> <td>Carbon Monoxide</td> <td style="text-align: center;">10</td> <td style="text-align: center;">-</td> <td style="text-align: center;">-</td> </tr> <tr> <td>Formaldehyde</td> <td style="text-align: center;">0.1</td> <td style="text-align: center;">-</td> <td style="text-align: center;">-</td> </tr> <tr> <td>Ozone</td> <td style="text-align: center;">0.05</td> <td style="text-align: center;">-</td> <td style="text-align: center;">-</td> </tr> <tr> <td>Respirable particulates</td> <td style="text-align: center;">-</td> <td style="text-align: center;">0.15</td> <td style="text-align: center;">-</td> </tr> <tr> <td>Total volatile organic compounds (TVOC)</td> <td style="text-align: center;">3</td> <td style="text-align: center;">-</td> <td style="text-align: center;">-</td> </tr> <tr> <th style="text-align: left;">Biological Contaminants</th> <th colspan="3" style="text-align: center;">Acceptable Limits</th> </tr> <tr> <td></td> <td style="text-align: center;">ppm</td> <td style="text-align: center;">mg/m³</td> <td style="text-align: center;">Cfu/m³</td> </tr> <tr> <td>Total Bacteria Counts</td> <td style="text-align: center;">-</td> <td style="text-align: center;">-</td> <td style="text-align: center;">500</td> </tr> <tr> <td>Total Fungal Counts</td> <td style="text-align: center;">-</td> <td style="text-align: center;">-</td> <td style="text-align: center;">1000</td> </tr> <tr> <th style="text-align: left;">Ventilation Performance Indicator</th> <th colspan="3" style="text-align: center;">Acceptable Limits</th> </tr> <tr> <td></td> <td style="text-align: center;">ppm</td> <td style="text-align: center;">mg/m³</td> <td style="text-align: center;">Cfu/m³</td> </tr> <tr> <td>Carbon Dioxide</td> <td style="text-align: center;">C1000</td> <td style="text-align: center;">-</td> <td style="text-align: center;">-</td> </tr> </tbody> </table> <ul style="list-style-type: none"> • For chemical contaminants, the limits are eight-hour time-weighted average airborne concentrations. • mg/m³ is milligrams per cubic meter of air at 25° Celsius and one atmosphere pressure. • ppm is parts of vapour or gas per million parts of contaminated air by volume. • cfu/m³ is colony forming units per cubic meter. • C is the ceiling limit that shall not be exceeded at any time. Readings above 1000ppm are indication of inadequate ventilation. • Excess of bacterial counts does not necessarily imply health risk but serve as an indicator for further investigation. 	Physical Parameters	Acceptable Range			Air Temperature	23-26 °C			Relative Humidity	50-70%			Air Movement	0.15-0.5 m/s			Chemical Contaminants	Acceptable Limits				ppm	mg/m ³	Cfu/m ³	Carbon Monoxide	10	-	-	Formaldehyde	0.1	-	-	Ozone	0.05	-	-	Respirable particulates	-	0.15	-	Total volatile organic compounds (TVOC)	3	-	-	Biological Contaminants	Acceptable Limits				ppm	mg/m ³	Cfu/m ³	Total Bacteria Counts	-	-	500	Total Fungal Counts	-	-	1000	Ventilation Performance Indicator	Acceptable Limits				ppm	mg/m ³	Cfu/m ³	Carbon Dioxide	C1000	-	-
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Carbon Dioxide	C1000	-	-																																																																						
Requirements	<p>4-1(a) Up to 4 credits will be given for conducting a full IAQ audit once every 3 years to comply with the Code of Practice on Indoor Air Quality Department of Occupational Safety and Health, Ministry of Human Resources Malaysia (2005).</p> <p>4-1(b) 1 credit for the implementation of effective IAQ management plan to ensure building ventilation systems are frequently maintained.</p> <p>4-1(c) 1 credit for the use of high efficient filter (at least MERV 8) in AHU to reduce indoor contaminations and provide good protection for cooling coil and reducing frequency or eliminating duct cleaning</p> <p>4-1(d) 1 credit for providing room temperature display (at least 1 unit per floor)</p> <p>4-1(e) 1 credit for additional carbon dioxide sensor display (at least 1 unit per Floor)</p>																																																																								

Prerequisite	To conduct a full IAQ audit once every 3 years to comply with the Code of Practice on Indoor Air Quality Department of Occupational Safety and Health, Ministry of Human Resources Malaysia (2005).
Documentary Evidences	<p><u>For 4-1(a):</u></p> <ul style="list-style-type: none"> • Most recent IAQ audit report highlighting the parameters that contribute to indoor air quality performance. • Most recent IAQ assessment report with the results of the building air quality. • Letter of commitment to conduct IAQ assessment IF the assessment not conduct previously. <p><u>For 4-1(b):</u></p> <ul style="list-style-type: none"> • Provision of IAQ Management Plan which evaluates overall building ventilation system using checklist and any comparable methods. <p><u>For 4-1(c):</u></p> <ul style="list-style-type: none"> • Technical product specification of the filter that is implemented in the AHU. • Layout plan showing the location of the AHU in the building. <p><u>For 4-1(d):</u></p> <ul style="list-style-type: none"> • Layout plan for every floor showing the location of the room temperature displays. • Technical specification of the temperature displays. <p><u>For 4-1(e):</u></p> <ul style="list-style-type: none"> • Layout plan for every floor showing the location of the carbon dioxide sensor display of the building. • Technical product specification of carbon dioxide sensor.
References	Code of Practice on Indoor Air Quality Department of Occupational Safety and Health, Ministry of Human Resources Malaysia

ENRB 4-2 INDOOR AIR POLLUTANTS

Objectives	Minimise airborne contaminants, mainly from inside sources to promote a healthy indoor environment.
Applicability	Generally applicable to all building developments.
Baseline Standard	-
Requirements	<p>4-2(a) 1 credit can be scored for the use of low volatile organic compounds (VOC) paints certified under local/international certification body for at least 90% of the internal wall areas.</p> <p>4-2(b) 1 credit can be scored for the use adhesives certified under local/international certification body in all composite wood products used for the development.</p>
Documentary Evidences	<p><u>For 4-2(a)</u></p> <ul style="list-style-type: none"> • Extracts of the tender specification showing the requirement to use low VOC paints that are certified by approved local/ international certification body or equivalent. • Product catalogue. • Product certificate with validity expiry. <p><u>For 4-2(b)</u></p> <ul style="list-style-type: none"> • Extracts of the tender specification showing the requirement to use adhesive with low emission formaldehyde and are certified by approved local/ international certification body. • Product catalogue. • Product certificate with validity expiry.
References	-

ENRB 4-3 LIGHTING QUALITY

Objectives	To encourage good workplace lighting quality to promote productivity and occupants' comfort												
Applicability	Generally applicable to all building developments.												
Baseline Standard	Luminance level stated in MS 1525:2019 – Energy Efficient and use of renewable energy for non-residential buildings – Code of Practice.												
Requirements	<p><u>4-3(a) Lighting level to comply with MS 1525:2019</u></p> <ul style="list-style-type: none"> • 1 credit will be provided if the lighting level comply with MS 1525:2019. <p><u>4-3(b) Controllability of the lighting system</u></p> <ul style="list-style-type: none"> • Up to 2 credits will be given if at least 90% of the occupants are able to adjust lighting to suit their need and preference. <table border="1" data-bbox="528 797 1098 936" style="margin-left: auto; margin-right: auto;"> <tr> <td>Controlled by light switches</td> <td>1 credit</td> </tr> <tr> <td>Controlled by task lights</td> <td>2 credits</td> </tr> </table> <p><u>4-3(c) High Frequency Ballast</u></p> <p>Up to 2 credits will be given if all applicable areas in the entire building are served with fluorescent tubes using high frequency ballast.</p> <table border="1" data-bbox="528 1115 1106 1274" style="margin-left: auto; margin-right: auto;"> <tr> <td>20% to < 40%</td> <td>0.5 credit</td> </tr> <tr> <td>40% to < 60%</td> <td>1 credit</td> </tr> <tr> <td>60% to < 80%</td> <td>1.5 credits</td> </tr> <tr> <td>80% and above</td> <td>2 credits</td> </tr> </table>	Controlled by light switches	1 credit	Controlled by task lights	2 credits	20% to < 40%	0.5 credit	40% to < 60%	1 credit	60% to < 80%	1.5 credits	80% and above	2 credits
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60% to < 80%	1.5 credits												
80% and above	2 credits												
Documentary Evidences	<p><u>For 4-3(a):</u></p> <ul style="list-style-type: none"> • Current lighting schedule showing lighting levels in various building areas. • Lighting layout plan. • Lux simulation showing the lighting level comply with MS1525:2019. • Technical product information of the lighting luminaries used. <p><u>For 4-3(b):</u></p> <ul style="list-style-type: none"> • Schematic drawing showing the location of controllable switches / task lights. • Layout plan showing the coverage of each switches. <p><u>For 4-3(c):</u></p> <ul style="list-style-type: none"> • A summary sheet listing all fluorescent luminaries/LED lighting used for the developments and those with high frequency ballasts/LED driver. • Technical product information of high frequency ballasts/LED driver in all lighting luminaries used. • Product catalogue of the light fittings used. 												

	<ul style="list-style-type: none">• Electrical lighting layout indicating all the fittings with high frequency ballast/LED driver.
References	Luminance level stated in MS 1525:2019 - Energy Efficient and use of renewable energy for non-residential buildings – Code of Practice.

ENRB 4-4 THERMAL COMFORT

Objectives	Recognise buildings that are designed with good thermal comfort.
Applicability	Generally applicable to all building developments with air-conditioning systems.
Baseline Standard	<ul style="list-style-type: none"> • Indoor dry-bulb temperature within 23°C to 26°C • Relative humidity between 50% to 70%
Requirements	<p>4-4(a) 1 credit can be scored by ensuring the consistent indoor conditions for thermal comfort:</p> <p>4-4(b) 1 credit can be scored by giving the flexibility of temperature controllability.</p>
Documentary Evidences	<p><u>For 4-4(a)</u></p> <ul style="list-style-type: none"> • Commissioning report of indoor dry-bulb temperature and relative humidity achieved consistent indoor thermal comfort for at least 48 hours. • Demonstrate compliance with the committed design specifications. <p><u>For 4-4(b)</u></p> <ul style="list-style-type: none"> • Layout plan showing the location of the temperature control equipment. • Product catalogue of temperature control device installed.
References	“Code of Practice on Indoor Air Quality” (2005), Department of Occupational Safety and Health, Ministry of Human Resources Malaysia

ENRB 4-5 INTERNAL NOISE LEVEL

Objectives	Recognise buildings that are designed to consider the potential noise levels within the dwelling units are maintained at an appropriate level. All building partitions to shall be in accordance with required STC ratings.								
Applicability	Generally applicable to building developments.								
Baseline Standard	ASTEM E413 or equivalent								
Requirements	<p>1 credit can be scored if the building is designed to achieve ambient internal noise level as specified:</p> <ul style="list-style-type: none"> • 55dB (6am – 10pm) L_{Aeq} • 45dB (10pm – 6 am) L_{Aeq} <p>This can be achieved by adhering to the following STC values for residential building partitions</p> <table border="1" data-bbox="446 884 1340 1220" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Description</th> <th>Sound Transmission Class (STC)</th> </tr> </thead> <tbody> <tr> <td>Separation between functional spaces within dwelling units and in-between adjacent dwelling units.</td> <td>40 - 50</td> </tr> <tr> <td>Spaces between mechanical and equipment spaces and occupied spaces</td> <td>50 - 60</td> </tr> </tbody> </table> <p>For developments that are in close proximity to road with heavy traffic, flyover or highway, it is necessary to have a detailed analysis conducted by the acoustic consultant. Credits can only be scored if the recommendations from the acoustic consultant are implemented.</p>	Description	Sound Transmission Class (STC)	Separation between functional spaces within dwelling units and in-between adjacent dwelling units.	40 - 50	Spaces between mechanical and equipment spaces and occupied spaces	50 - 60		
Description	Sound Transmission Class (STC)								
Separation between functional spaces within dwelling units and in-between adjacent dwelling units.	40 - 50								
Spaces between mechanical and equipment spaces and occupied spaces	50 - 60								
Documentary Evidences	<ul style="list-style-type: none"> • Architectural & structural plan layout, elevation and sectional plans showing types of wall system used, dimensions and size of all building and structural elements with STC ratings as per table below: <table border="1" data-bbox="438 1568 1348 1881" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Location</th> <th>STC rating of partitions</th> </tr> </thead> <tbody> <tr> <td>Between General Office Space</td> <td>40 - 50</td> </tr> <tr> <td>Hotel Rooms, Classrooms, Lecture Theatres, Meeting Rooms, Conference Rooms and spaces where confidential speech is required</td> <td>50 - 60</td> </tr> <tr> <td>Between Mechanical / Equipment spaces and occupied spaces</td> <td>50 - 60</td> </tr> </tbody> </table>	Location	STC rating of partitions	Between General Office Space	40 - 50	Hotel Rooms, Classrooms, Lecture Theatres, Meeting Rooms, Conference Rooms and spaces where confidential speech is required	50 - 60	Between Mechanical / Equipment spaces and occupied spaces	50 - 60
Location	STC rating of partitions								
Between General Office Space	40 - 50								
Hotel Rooms, Classrooms, Lecture Theatres, Meeting Rooms, Conference Rooms and spaces where confidential speech is required	50 - 60								
Between Mechanical / Equipment spaces and occupied spaces	50 - 60								

	<ul style="list-style-type: none">• Architectural & structural plan layout, elevation and sectional plans showing types of wall system used, dimensions and size of all building and structural elements with STC ratings. <p>OR</p> <ul style="list-style-type: none">• A report of detail analysis and recommendations from acoustic consultant (if applicable).
References	-

(II) Other Green Requirement

Part 5 – Other Green Features

ENRB 5-1 GREEN FEATURES & INNOVATIONS

Objectives	Encourage the use of green features which are innovative and have positive environmental impact on water efficiency, environmental protection and indoor environmental quality of the buildings.
Applicability	Generally applicable to all building developments.
Baseline Standard	-
Requirements	<p>Up to 10 credits are awarded for the use of the following green features depending on their potential environmental benefits or reduced environmental impacts.</p> <p><u>Water efficiency</u></p> <ol style="list-style-type: none"> i. Use of self-cleaning façade system <ul style="list-style-type: none"> • 2 credits for more than 75% of the external walls. • 1 credit for more than 50% of the external walls. • 0.5 credit for at least 25% of the external walls. ii. Use of grey water recycling system <ul style="list-style-type: none"> • 2 credits for all blocks of the development. • 1 credit for at least one block of the development. iii. Recycling of AHU condensate <ul style="list-style-type: none"> • 1 credit for more than 75% of the AHU condensate • 0.5 credit for at least of 50% of the AHU condensate iv. 0.5 credit for the use of non-chemical water treatment for cooling tower. <p><u>Environmental Protection</u></p> <ol style="list-style-type: none"> i. Provision of green roof and roof top garden <ul style="list-style-type: none"> • 1 credit for more than 50% of the roof areas • 0.5 credit for at least 25% of the roof areas ii. Provision of vertical greening <ul style="list-style-type: none"> • 1 credit for more than 50% of the external wall areas • 0.5 credit for at least 25% of the roof areas iii. 1 credit for the provision of double refuse shuts for separating recyclable from non-recyclable waste iv. 0.5 credit for the use of non-chemical treatment system such as termite baiting system, anti-termite mesh. <p><u>Indoor Air Quality</u></p> <ol style="list-style-type: none"> i. Use of Titanium Dioxide solutions to remove odour in toilets: <ul style="list-style-type: none"> • 1 credit for more than 50% of all toilets

	<ul style="list-style-type: none"> • 0.5 credit for at least 25% of all toilets <p>ii. 1 credit for the use of pneumatic waste collection system.</p> <p>iii. 0.5 credit for the use of Ultraviolet light-C band (UV) emitters in all air handling units (AHUs) to improve indoor air quality.</p> <p>iv. Demonstrating the external view in the net lettable area (NLA). The submission must be showing the furniture plan layout.</p> <ul style="list-style-type: none"> • 1 credit for more than 60% of the NLA having the external view • 2 credit for more than 75% of the NLA having the external view. <p><u>Others</u></p> <p>i. Provision of landscape drainage and infiltration trenches:</p> <ul style="list-style-type: none"> • 1 credit for at least 25% of the green areas • 0.5 credit for less than 25% of the green areas <p>ii. Provision of system to recycle surface runoff from the vertical green wall and sky garden:</p> <ul style="list-style-type: none"> • 1 credit for at least 25% of green areas • 0.5 credit for less than 25% green areas <p>iii. 0.5 credit for the use of siphonic rainwater discharge system at roof.</p> <p>iv. 0.5 credit for the provision of eco-pond.</p> <p>v. 0.5 credit for the provision of carpark guidance system.</p> <p>Note: For features that are not listed above, the QP is required to submit the details showing the positive environmental impacts, possible savings and benefits of the proposed features to GreenRE for assessment.</p>
Documentary Evidences	<ul style="list-style-type: none"> • As-built drawings showing the installed green features. • Product catalogue of the installed green features and its delivery order. A summary sheet listing the breakdown and the extent of implementation as well as the total requirements for the same intended purpose for the specific green features used. • A summary sheet listing the breakdown and the extent of implementation as well as the total requirements for the same intended purpose for the specific green features used. • Quantified evidence on the potential environmental benefits that the features can bring to the development.

	<ul style="list-style-type: none">• Demolition audit showing the summary of the total and actual quantity of concrete waste and delivery records or receipts from approved recycling firm.
References	-

(II) Other Green Requirement

Part 6 – Carbon Emission of Development

ENRB 6-1 CARBON EMISSION OF DEVELOPMENT

Objectives	To calculate the carbon emission resulted from the associated energy used during construction and operational phase of a development.															
Applicability	Generally applicable to all building development.															
Baseline Standard	-															
Requirements	<p>a) 1 credit for recognise the carbon emission based on operational carbon footprint computation of the building comprising energy [B6] and water consumption [B7].</p> <p>b) 1 credit for calculation of product stage embodied carbon based on following building materials [A1-A3]:</p> <ul style="list-style-type: none"> - concrete - steel - bricks - cement - steel and metal 															
Documentary Evidences	<p><u>For 6-1 (a)</u></p> <ul style="list-style-type: none"> • Detail calculation for the estimated energy load for each component in the building e.g.: lighting, air-conditioning system, pump, receptacle load. • Details calculation for estimated water consumption of the building e.g.: water fittings, landscape, water features. • Technical product information on the energy efficient features and water efficient features used. • Summary tabulation of estimated total energy savings and total water savings of the development for the year. • Carbon emission calculation. <p><u>For 6-1 (b)</u></p> <ul style="list-style-type: none"> • Embodied carbon footprint calculation 															
References	-															
Worked Example 6-1	<p>Energy Consumption</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Type of usage</th> <th style="text-align: center;">Design (kWh/yr)</th> <th style="text-align: center;">Baseline (kWh/yr)</th> </tr> </thead> <tbody> <tr> <td>Lighting</td> <td style="text-align: center;">819,498</td> <td style="text-align: center;">1,151,575</td> </tr> <tr> <td>Air-Conditioning</td> <td style="text-align: center;">860,589</td> <td style="text-align: center;">1,406,899</td> </tr> <tr> <td>M/V System</td> <td style="text-align: center;">25,550</td> <td style="text-align: center;">25,550</td> </tr> <tr> <td>Total Energy Usage</td> <td style="text-align: center;">1,705,637</td> <td style="text-align: center;">2,584,024</td> </tr> </tbody> </table>	Type of usage	Design (kWh/yr)	Baseline (kWh/yr)	Lighting	819,498	1,151,575	Air-Conditioning	860,589	1,406,899	M/V System	25,550	25,550	Total Energy Usage	1,705,637	2,584,024
Type of usage	Design (kWh/yr)	Baseline (kWh/yr)														
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Air-Conditioning	860,589	1,406,899														
M/V System	25,550	25,550														
Total Energy Usage	1,705,637	2,584,024														

Water Consumption
(Please refer GreenRE Water Calculator)

Type of fixtures	Design	Baseline
	(m ³ /yr)	(m ³ /yr)
Flow Fixtures	2,402	6,899
Flush Fixtures	5,366	5,161
Total Water Usage	7,768	12,060

Carbon Footprint

Type of usage	Design	Baseline
	kgCO ₂ e/yr	kgCO ₂ e/yr
Energy	1,226,619	1,860,497
Water	155,344	241,192
Total Annual Carbon Footprint	1,381,963	2,101,689

Energy CO₂ Emission Reduction (ktCO₂e/annum, based on electricity energy reduction only @ 1kWh =

- 0.694 kg CO₂- Peninsular
- 0.699 kg CO₂- Sarawak
- 0.536 kg CO₂- Sabah)

Water CO₂ Emission Reduction = 0.02

Percentage savings = (2,101,689 - 1,381,963) / 2,101,689 = 34.25%

Credits scored for 6-1 (a) = 1 credit

Embodied carbon calculation

No	Material	Description	tCO ₂ e		Quantity	Total tCO ₂ e
			Value	Unit		
1	Concrete (G30)	Slab	0.309	m ³	9876.19	3051.74
2	Glass	10mm of Glass (Single Glass excluding Frame)	0.035	m ²	4500.00	157.50
3	Steel	Rebar	1.2	kg	5000.00	6000.00
	Total					9209.24

Credits scored for 6-1 (b) = 1 credit

The project entitled for Part 6 = 2 credits

8. Documentation Requirements

All documents submitted for the REHDA GreenRE Assessment should be duly verified and signed by the Qualified Person (QP) and appropriate practitioners where applicable.

The documentation required for ventilation simulation and energy modelling should also be endorsed by the QP and appropriate practitioners as part of the documentary evidences for certification.

Table: Summary Checklist and the Corresponding Signatories for GreenRE Existing Non-Residential Criteria

GreenRE Criteria	Required Signatories
Part 1 – Energy Efficiency	
ENRB 1-1 Thermal Performance of Building Envelope-OTTV	PA
ENRB 1-2 Air-Conditioning System	PE
ENRB 1-3 Natural Ventilation/ Mechanical Ventilation	PA/PE
ENRB 1-4 Artificial Lighting	PE
ENRB 1-5 Ventilation in Carparks	PA
ENRB 1-6 Ventilation in Common Areas	PA
ENRB 1-7 Lifts and Escalators	PE
ENRB 1-8 Energy Efficient Practices & Features <ul style="list-style-type: none"> • Heat Recovery Devices • Motion Sensors/ Photo Sensors • Others 	PE PE S
ENRB 1-9 Energy Policy & Management	FM
ENRB 1-10 Renewable Energy	S
Part 2 – Water Efficiency	
ENRB 2-1 Water Usage and Leak Detection	PE/FM
ENRB 2-2 Water Efficient Fittings	PA/FM
ENRB 2-3 Alternative Water Sources	PE
ENRB 2-4 Water Efficiency Improvement Plans	FM
ENRB 2-5 Irrigation System and Landscaping	PE
ENRB 2-6 Water Consumption of Cooling towers	PE
Part 3 – Sustainable Operation & Management	
ENRB 3-1 Building Operation & Maintenance	FM
ENRB 3-2 Post Occupancy Evaluation	FM
ENRB 3-3 Waste Management	FM
ENRB 3-4 Sustainable Products	PA/FM
ENRB 3-5 Greenery Provision	PA
ENRB 3-6 Environmental Protection	PE
ENRB 3-7 Green Transport	PA
Part 4 – Indoor Environmental Quality	
ENRB 4-1 Indoor Air Quality Performance	S
ENRB 4-2 Indoor Air Pollutants	S
ENRB 4-3 Lighting Quality	PE
ENRB 4-4 Thermal Comfort	S
ENRB 4-5 Internal Noise Level	S
Part 5 – Other Green Features	
ENRB 5-1 Green Features & Innovations	S
Part 6 – Carbon Emission of Development	
ENRB 6-1 Carbon Emission of Development	S

1. PA refers to Professional Architect, Landscape Architect
2. PE refers to Professional Engineer, Planner and Quantity Surveyor (QS)
3. FM refers to Facility Manager.
4. S refers to Specialist which includes Facilitator, Project Manager, Energy or Sustainable consultant and Commissioning Specialist.