DESIGN REFERENCE GUIDE

Existing Non-Residential Building

Version 3.1

15th March 2018

Contents

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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GreenRE Sdn Bhd
Wisma Rehda,
No.2C, Jalan SS5/6D,
47301 Petaling Jaya,
Selangor, Malaysia

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.

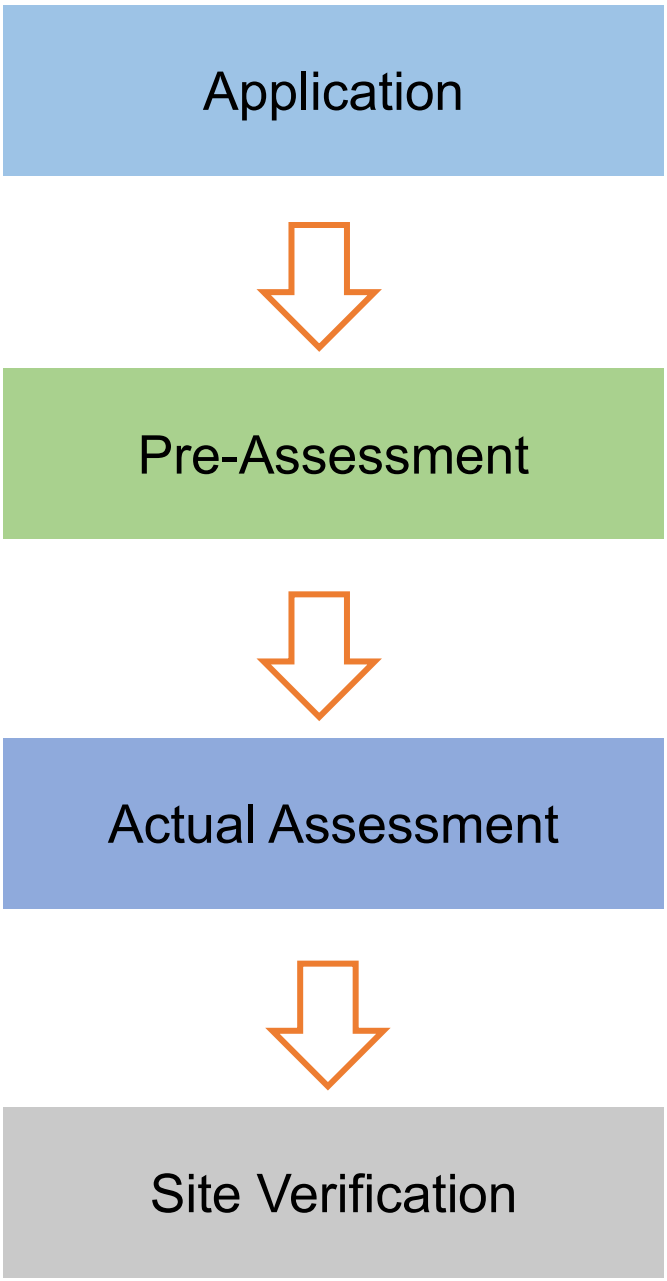
This Guideline is not intended to abridge safety, health, environmental or related requirements contained in other applicable laws, codes or policies administered by relevant authorities. Where there is a conflict between a requirement of this Guideline and such other regulations affecting the design,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

3. Revision Log

Revision	Description	Date Effective
1.1	Issued for Implementation	1st June 2013
1.2	Revised version of implementation	1st June 2014
2.0	Revised version of implementation	1st June 2015
3.0	Revised version of implementation	1st October 2015
3.1	Revised version of implementation	15th March 2018

4. GreenRE Assessment Stages

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



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

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 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 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).

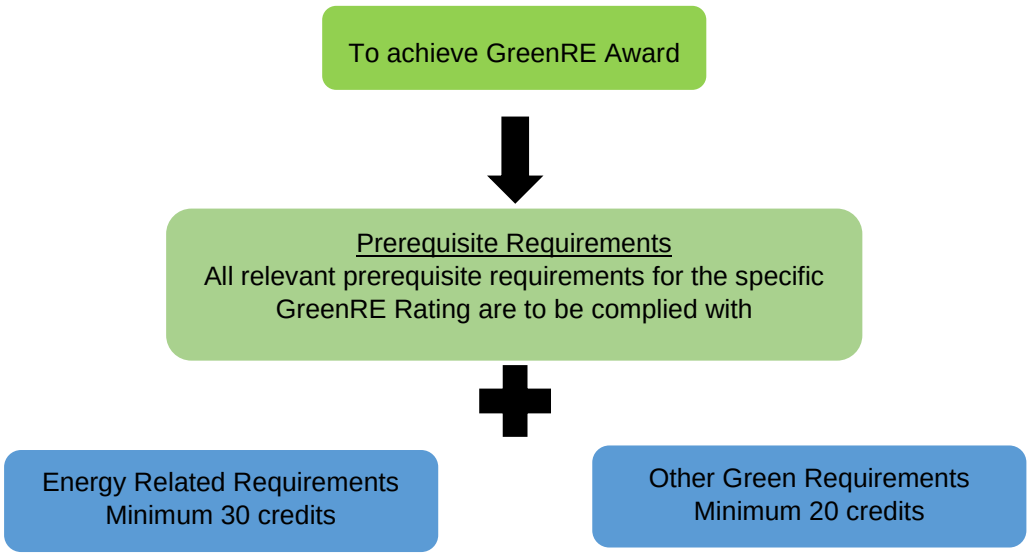
Other Green Requirements consist of Part 2 – Water Efficiency; Part 3 – Sustainable Operation & Management; Part 4 – Indoor Environmental Quality; Part 5 – Other Green Features and Part 6: Carbon Emission of Development. Credits are allocated for the water efficient features, environmentally friendly 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 carparks.

Framework



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

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 & Features
ENRB 1-9 Energy Policy & Management
ENRB 1-10 Renewable Energy

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

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

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

Part 4 - Indoor Environmental 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 Noise Level

Part 5 – Other Green Features
ENRB 5-1 Green Features & Innovations

Part 6 – Carbon Emission of Development
ENRB 6-1 Carbon Emission of Development

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 areas)**	32 13
	ENRB 1-4 Artificial Lighting	4
	ENRB 1-5 Ventilation in Carparks	5
	ENRB 1-6 Ventilation in Common Areas	3
	ENRB 1-7 Lifts & Escalators	12
	ENRB 1-8 Energy Efficient Practices & Features	1
	ENRB 1-9 Energy Policy & Management	15
	ENRB 1-10 Renewable Energy	
	Category Score for Part 1 – Energy Efficiency	**91**
(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	3
	Category Score for Part 6: Carbon Emission of Development	**3**
	Category Score for Part 2 to Part 6 - Other Green Requirements	**94**
	GreenRE Existing Non-Residential Building Score	**185**

6. GreenRE Existing Non-Residential Building Rating System Scoring

Score	Rating
90 and above	GreenRE Platinum
85 to < 90	GreenRE Gold
75 to < 85	GreenRE Silver
50 to < 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. MINIMUM SYSTEMS' EFFICIENCY

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	Not applicable
Gold	0.85	
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 applicable for Silver and higher ratings.

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

3. CHILLER PLANT M&V INSTRUMENTATION

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

4. 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

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.

<table>
<tr><th>Part 1 – Energy Efficiency</th><th>GreenRE Credits</th></tr>
<tr><td><u>ENRB 1-1 THERMAL PERFORMANCE OF BUILDING ENVELOPE - OTTV</u>

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

<u>Baseline:</u>
Maximum permissible OTTV = 50 W/m^2</td><td>0.5 credits for every reduction of 1 W/m^2 in OTTV from the baseline of 50 W/m^2

Credit scored = 0.5 x (50 – OTTV)

(Up to 5 credits)</td></tr>
<tr><td><u>ENRB 1-2 AIR-CONDITIONING SYSTEM</u>

Applicable to Air-conditioned Building Areas (with an aggregate air-conditioned areas > 1000m^2)

Encourage the use of better efficiency air-conditioned equipment to minimize the energy consumption.
(System efficiency in kW/ton)

<u>(a) Water-Cooled Chilled-Water Plant:</u>
i. Water-Cooled Chiller
ii. Chilled water pump
iii. Condenser water pump
iv. Cooling tower

<table><tr><td rowspan="2">Baseline</td><td colspan="2">Building Cooling Load</td></tr><tr><td>< 500 RT</td><td>≥ 500 RT</td></tr><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></table>
OR</td><td><u>(a) Water-Cooled Chilled-Water Plant:</u>

Building cooling load < 500RT

14 credits for achieving plant efficiency of 0.85 kW/ton

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

Credit scored = 0.3 x (% improvement)

Building cooling load ≥ 500RT

14 credits for achieving plant efficiency of 0.75 kW/ton

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 20 credits)

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

(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
Prerequisite Requirements 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-con system with unitary air-conditioned system, the computation for the credits scored will only be based on the air-conditioning system with a larger aggregate capacity.

(c) Air Distribution system:

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

Baseline – Fan power limitation in air conditioning system

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

Note (2): 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 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

Credit scored = 0.2 x (% 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/tom

Credit scored = 0.25 x (% improvement)

(up to 20 credits)

(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)

(d) *Prerequisite requirements:* Provision of permanent measuring instruments for monitoring of water-cooled chilled water plant and air-cooled chilled water plant efficiency. The installed instrumentation shall have the capability to calculate resultant plant efficiency (i.e. kW/RT) within 5% of its true value and in accordance with ASHRAE Guide 22 and AHRI 550/590. 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), 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 ± 0.05°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. • 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	2 credits

balance to be submitted to GreenRE upon commissioning. (e) *Prerequisite requirements*: 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) 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. (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 1 credit 1 credit
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:	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)

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.	
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 1525:2014–Energy Efficient and use of renewable energy for non-residential building - Code of Practice	0.3 credit for every percentage improvement in lighting power budget Credit scored = 0.3 x (% improvement) (Up to 13 credits) Excluding tenant lighting provision – (Up to 5 credits)
ENRB 1-5 VENTILATION IN CARPARKS Encourage the use of energy efficient design and control of ventilation systems in carparks. (a) Carparks designed with natural ventilation. (b) CO sensors are used to regulate the demand for mechanical ventilation (MV) Note (4): Where there is a combination of different ventilation mode adopted for carpark design, the credits obtained will be prorated accordingly.	Naturally Ventilated Carparks – 4 credits Credits scored based on the mode of mechanical ventilation provided: Fume extract – 2.5 credits MV with or without supply – 2 credits (Up to 4 credits)
ENRB 1-6 VENTILATION IN COMMON AREAS Encourage the use of energy efficient of ventilation systems in the following common areas: • Toilets • Corridors • Staircases • Atriums	Extent of Coverage: At least 90% of each applicable area Credit scored based on the mode of ventilation provided in the applicable areas Natural Vent. – 1.5 credits for each area

• Lift Lobbies	Mechanical Vent. – 0.5 credit for each area (Up to 5 credits)
ENRB 1-7 LIFTS AND ESCALATORS Encourage the use of energy efficient lifts and escalators. (a) Lifts with the following energy efficient features: i. AC variable voltage and variable frequency (VVVF) motor drive or equivalent. ii. Sleep mode features or equivalent. (b) Escalators with energy efficient features such as motion sensors.	Extent of Coverage: All lifts and/or escalators 1 credit 1 credit 1 credit
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 efficiency index (EEI) (b) Use of energy efficiency product that are certified by approved local certification body (c) Use of energy efficient features Example: • Re-generative lift • Heat recovery system • Motion sensors • Sun pipes • Light shelves • Photocell sensors to maximize the use of Daylight • Heat pumps, etc.	1 credit 0.5 credit for each equipment type (Up to 2 credits) 2 credits for every 1% energy saving over the total building energy consumption (Up to 9 credits)

<table>
<tr>
<td><u>ENRB 1-9 ENERGY POLICY AND MANAGEMENT</u>

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

(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.</td>
<td>0.5 credit

0.5 credit</td>
</tr>
<tr>
<td><u>ENRB 1-10 RENEWABLE ENERGY</u>

Encourage the application of renewable energy sources in buildings.</td>
<td>Credit scored based on the expected energy efficiency index (EEI) and % replacement of electricity by renewable energy source

<table>
<tr><th rowspan="2">Energy Efficiency Index (EEI)</th><th colspan="2">Every 1% replacement of electricity (based on total electricity consumption) by renewable energy source</th></tr>
<tr><th>Include tenant's usage</th><th>Exclude tenant's usage</th></tr>
<tr><td>≥ 50 kWh/m²/yr</td><td>5 credits</td><td>3 credits</td></tr>
<tr><td>< 50 kWh/m²/yr</td><td>3 credits</td><td>1.5 credits</td></tr>
</table>

(Up to 15 credits)</td>
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</table>

<table>
<tr><td>PART 1 – ENERGY EFFICIENCY CATEGORY SCORE:</td><td>(ENRB 1-2) x Air-conditioned Building Floor Area / Total Floor Area
+
(ENRB 1-3) x Non Air-Conditioned Building Floor Area / Total Floor Area
+
(ENRB 1-1, ENRB 1-4 to ENRB 1-10)

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</td></tr>
<tr><th>Part 2 – Water Efficiency</th><th>GreenRE Credits</th></tr>
<tr><td><u>ENRB 2-1 WATER USAGE AND LEAK DETECTION</u>

Provide sub-metering and leak detection system for better control and monitoring

(a) To monitor the water consumption on monthly basis

(b) Provision of sub-meters for major water uses (e.g. cooling tower, water features, irrigation, swimming pools, tenants’ usage)

(c) Provision of automated / smart metering for monitoring and leaking detection</td><td>

1 credit

1 credit

2 credits</td></tr>
<tr><td><u>ENRB 2-2 WATER EFFICIENT FITTINGS</u>

Encourage the use of water efficient fittings under Water Efficiency Product Labelling Scheme (WEPLS) or Water Efficiency Labelling Scheme (WELS).</td><td>

<table><tr><td colspan="3">Weightage Based on Water Efficiency Products Labelling Scheme (WEPLS)</td></tr><tr><td>Efficient *</td><td>Highly Efficient **</td><td>Most Efficient ***</td></tr></table></td></tr>
</table>

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<tr>
<td>

- Basin taps and mixers
- Showers
- Sink/Bib taps and mixers
- Urinals and Urinal Flush Valves
- Dual flushing cistern for WC
- Other water fittings (eg. Ablution taps and mixers)

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<td>

<table>
<tr><th>6</th><th>9</th><th>12</th></tr>
</table>

Credits scored based on the number and water efficiency rating of the fitting type used

(Up to 12 credits)

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ENRB 2-3 ALTERNATIVE WATER SOURCES

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.

</td>
<td>

Credits awarded based on % reduction in total potable water usage of the applicable uses

<table>
<tr><td>> 50 %</td><td>3 credits</td></tr>
<tr><td>≥ 10 % to 50 %</td><td>2 credits</td></tr>
<tr><td>< 10 %</td><td>1 credit</td></tr>
</table>

(Up to 3 credits)

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</tr>
<tr>
<td>

ENRB 2-4 WATER EFFICIENCY IMPROVEMENT PLANS

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.

</td>
<td>1 credit</td>
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ENRB 2-5 IRRIGATION SYSTEM AND LANDSCAPING

Reduce potable water consumption for irrigation and landscaping.

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

(b) Use of automatic water efficient irrigation system with rain sensor, soil moisture sensor or equivalent control system.

</td>
<td>

1 credit

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

</td>
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(c) Use of drought tolerant plants that require minimal irrigation.	Extent of Coverage: At least 80% of the landscape areas 1 credit
ENRB 2-6 WATER CONSUMPTON OF COOLING TOWERS Reduce potable water use for cooling purpose. (a) Use of cooling tower water treatment system which can achieve 6 or better cycles of concentration at acceptable water quality. (b) Use of recycled water from approved sources for cooling purpose.	 1 credit 1 credit
PART 2 – WATER EFFICIENCY CATEGORY SCORE :	Sum of GreenRE credits obtained from ENRB 2-1 to 2-6

Part 3 – Sustainable Operation & Management	GreenRE Credits
ENRB 3-1 BUILDING OPERATION & MAINTENANCE (a) The environmental policy that reflects the sustainability goals set. (b) A green guide for the occupants or visitors should be disseminated through various channels. Best practices to reduce energy use, water use and maintain a good indoor environment should be documented in this green guide. To demonstrate evidences of occupant involvement in environmental sustainability.	 1 credit 1 credit

(c) In-house building management team comprises one Certified GreenRE Manager/ Green Mark Manager	1 credit
(d) Project team comprises one Certified GreenRE/Green Mark Manager (GM)	1 credit
(e) The environmental management system of the building is ISO14000 or ISO 50001 certified.	1 credit
ENRB 3-2 POST OCCUPANCY EVALUATION (a) Conduct post occupancy survey for occupant's satisfaction on energy and environmental performance. Required number of people surveyed shall be: • 10% of total occupancy and up to 100 maximum. • Minimum 5 people shall be surveyed if total occupancy is less than 50.	2 credits
(b) List of corrective actions taken following the post occupancy evaluation, if any.	1 credit
ENRB 3-3 WASTE MANAGEMENT (a) Provision of facilities or recycling bins for collection and storage of different recyclable waste such as paper, glass, plastic, food waste, etc.	2 credits
(b) Promote and encourage waste minimization and recycling among occupants, tenants and visitors through various avenues	2 credits
(c) Provide the proper storage area for the recyclable waste	1 credit

<table>
<tr><td>(d) To quantify and monitor the recycling programme for continuous improvement.</td><td>2 credits</td></tr>
<tr><td><u>ENRB 3-4 SUSTAINABLE PRODUCTS</u>

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.</td><td><table><tr><th>Extent of use of environmentally friendly product</th><th>Weightage for Credit Allocation</th></tr><tr><td>Low Impact</td><td>0.5</td></tr><tr><td>Medium impact</td><td>1</td></tr><tr><td>High Impact</td><td>2</td></tr></table>
Credits scored will be based on the extent of use of environmentally friendly product.

(Up to 8 credits)</td></tr>
<tr><td><u>ENRB 3-5 GREENERY PROVISION</u>

Encourage greater use of greenery to reduce heat island effect.

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

(b) Restoration of trees on site, conserving or relocating of existing trees on site.
(c) Use of compost recycled from horticulture waste.</td><td><table><tr><th>GnPR</th><th>Credits Allocation</th></tr><tr><td>1.0 to < 2.0</td><td>1</td></tr><tr><td>2.0 to < 3.0</td><td>2</td></tr><tr><td>3.0 to < 4.0</td><td>3</td></tr><tr><td>4.0 to < 5.0</td><td>4</td></tr><tr><td>5.0 to < 6.0</td><td>5</td></tr><tr><td>≥ 6.0</td><td>6</td></tr></table>
1 credit

1 credit</td></tr>
<tr><td><u>ENRB 3-6 ENVIRONMENTAL PROTECTION</u>

(a) Green procurement policy – Adoption of sustainable and environmental-friendly procurement and purchasing policy in the operation and maintenance of the building.

(b) Reduce the potential damage to the ozone layer and the increase in global warming through the release of ozone</td><td>1 credit</td></tr>
</table>

depleting substances and greenhouse gases. • 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.	 1 credit 1 credit
ENRB 3-7 GREEN TRANSPORT Promote the use of public transport or bicycles to reduce pollution from individual car use with the following provision: (a) Good access (<800m walking distance) to public transport networks such as MRT/LRT stations or bus stops. (b) Provision of covered walkway to facilitate connectivity and the use of public transport. (c) Provision of hybrid/electric vehicle charging stations and priority parking lots within the development. (d) Provision of covered / sheltered bicycles parking lots with adequate shower and changing facilities.	 1 credit 1 credit Extent of coverage: Minimum 1 number priority parking bays for every 100 carpark lots. EV chargers – 1 for every 200 parking bays. (Cap at 3) (1 credit) Extent of Coverage : Minimum 10 number and maximum 50 numbers of bicycle parking lots (1 credit)
PART 3 – SUSTAINABLE OPERATION & MANAGEMENT CATEGORY SCORE :	Sum of GreenRE credits obtained from ENRB 3-1 to 3-7

Part 4 – Indoor Environmental Quality	GreenRE Credits
ENRB 4-1 INDOOR AIR QUALITY PERFORMANCE To promote a healthy indoor environment. (a) *Prerequisite Requirements:* 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). (b) Implement effective IAQ management plan to ensure building ventilation systems are frequently maintained to ensure clean delivery of air. (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 (d) Room Temperature display (at least 1 unit per floor) (e) Additional carbon dioxide sensor display (at least 1 unit per floor)	4 credits 1 credit 1 credit 1 credit 1 credit
ENRB 4-2 INDOOR AIR POLLUTANTS Minimise airborne contaminants, mainly from inside sources to promote a healthy indoor environment. (a) Use of low volatile organic compounds (VOC) paints certified by approved local certification body. (b) Use of environmental friendly adhesives certified by approved local certification body.	1 credit 1 credit

<table>
<tr>
<td><u>ENRB 4-3 LIGHTING QUALITY</u>

To encourage good workplace lighting quality to promote productivity and occupant's comfort

(a) Lighting level to comply with MS1525:2014

(b) Controllability of lighting system

(c) High frequency ballast OR use of driver with output frequency < 200Hz and < 30% flicker for LED lighting.</td>
<td>

1 credit

At least 90% of occupants are able to adjust lighting to suit their task needs and preference

<table><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>(Up to 2 credits)

All applicable areas in the entire building that are served by fluorescent / LED lighting.
<table><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>(Up to 2 credits)</td>
</tr>
<tr>
<td><u>ENRB 4-4 THERMAL COMFORT</u>

(a) Ensure the consistent indoor conditions for thermal comfort:
• Indoor dry-bulb temperature between 23°C to 26°C
• Relative humidity between 50% to 70%

(b) Controllability of temperature.</td>
<td>

1 credit

1 credit</td>
</tr>
<tr>
<td><u>ENRB 4-5 INTERNAL NOISE LEVEL</u>

Building is designed to achieve ambient internal noise level as specified:
• 55 dB (6am – 10pm) L_{Aeq}
• 45 dB (10pm – 6am) L_{Aeq}</td>
<td>

1 credit</td>
</tr>
<tr>
<td>PART 4 – INDOOR ENVIRONMENTAL QUALITY CATEGORY SCORE:</td>
<td>Sum of GreenRE credits obtained from ENRB 4-1 to 4-5</td>
</tr>
</table>

Part 5 – Other Green Features	GreenRE Credits
ENRB 5-1 GREEN FEATURES & INNOVATIONS To encourage the use of other green features which are innovative or/and have positive environmental impact. Examples : • 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	2 credits for high impact item 1 credit for medium impact item 0.5 credit for low impact item (Up to 10 credits)
PART 5 – OTHER GREEN FEATURES CATEGORY SCORE :	Sum of GreenRE credits obtained from ENRB 5-1

Part 6 – Carbon Emission of Development	GreenRE Credits
ENRB 6-1 CARBON EMISSION OF DEVELOPMENT Recognise the carbon emission based on operational carbon footprint computation of the building comprising energy and water consumption To identify carbon debt and quantify environmental impact and embodied energy, as well as allow benchmarking of projects over time using BCA's online embodied carbon calculator.	1 credit 1 credit – Carbon footprint calculation of any four (4) building materials listed 2 credits – complete carbon footprint calculation for all building materials listed. (up to 2 credits)
PART 6 – CARBON EMISSION OF DEVELOPMENT CATEGORY SCORE:	Sum of GreenRE credits obtained from ENRB 6-1

GreenRE Score (Existing Non-Residential Building)

GreenRE Score (ENRB) = ∑Category 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)]

Where:
Category Score for Part 1≥ 30 credits and
∑Category score for Part 2, 3, 4, 5 & 6 ≥ 20 credits

(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	Maximum permissible OTTV = 50 W/m^2 OTTV stands for Overall Thermal Transfer Value. Maximum permissible RTTV = 25 W/m^2 RTTV stands for Roof Thermal Transfer Value. 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. The computation of OTTV & RTTV shall be based on the methodology specified in the MS 1525:2014.
Requirements	Up to 5 credits can be scored for building envelope with better thermal performance than the baseline standard: 0.5 credits for every reduction of 1 W/m^2 in OTTV from the baseline. Credits scored = 0.5 x [50 – OTTV] where OTTV ≤ 50 W/m^2 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. That is, $OTTV_{\text{weighted average}} = \sum (OTTV_{bldg} \times A_{bldg}) / A_{devt}$ Where: $OTTV_{bldg}$ = OTTV for building (W/m^2) A_{bldg} = Summation of all façade areas that enclose all the air-conditioning areas (m^2) in a building A_{devt} = Summation of total applicable façade areas of all buildings within the development (m^2) (i.e. $\sum A_{bldg}$)

Documentary Evidences	• 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) *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.* • RTTV Calculation (if applicable) • Skylight specification showing the U Value and SC Value.
References	MS 1525:2014 - Energy Efficiency and use of renewable energy for non-residential building – Code of Practice

ENRB 1-2 AIR-CONDITIONING SYSTEM

<table>
<tr><td>Objectives</td><td>Encourage the use of better efficient air-conditioned equipment to minimise energy consumption.</td></tr>
<tr><td>Applicability</td><td>Applicable to air-conditioned building areas where its aggregate air-conditioned areas > 1000m^2.

Scope covers on below air-conditioned equipment installed for the buildings:
• Chillers
• Chilled water pumps
• Condenser water pumps
• Cooling Towers
• Air Handling Units (AHU)
• Fan Coil Units (FCU)
• Unitary Air-Conditioners/ Condensing Units which include single-split units, multi-spilt units and variable refrigerant flow (VRF) system</td></tr>
<tr><td>Baseline Standard</td><td>Minimum efficiency requirement of the air-conditioning system stated in MS 1525:2014 or SS 530 & SS CP 13.

1-2(a) <u>Water-Cooled Chilled Water Plant</u>

<table>
<tr><td rowspan="2">Baseline</td><td colspan="2">Building Cooling Load</td></tr>
<tr><td>< 500 RT</td><td>≥ 500 RT</td></tr>
<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>
</table>

i. Water-Cooled Chiller – Refer Table 23 of MS 1525:2014 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 1525:2014 which states that for chilled water or condenser water pumping system operating for more than 750 hours a year, the pump efficiency shall be:

a) > 70% for flowrate between 50 m^3/h to 100 m^3/h
b) > 73% for flowrate between 100 m^3/h to 270 m^3/h
c) >80% for flowrate exceeding 270 m^3/h
This data can be collect during Testing & Commissioning (T&C)

iv. Cooling tower performance at the rating condition states in Table 3 SS 530.

<u>Rating condition is as follows</u>: 35°C Entering water
29°C Leaving water
24°C Wet Bulb Outdoor air</td></tr>
</table>

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:

Cooling tower performance ≤ 1kW / 3.23 L/s
≤ 0.310 kW/ L/s

Centrifugal fan cooling tower:

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

Cooling tower performance ≤ 1kW / 1.7 L/s
≤ 0.588 kW / L/s

OR

1-2(b) Air-Cooled Chilled-Water Plant / Unitary Air-Conditioners

Baseline	Building Cooling Load	
	< 500 RT	≥ 500 RT
Prerequisite Requirements 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 23 of MS 1525:2014 to calculate its Coefficient of Performance (COP).
- Unitary Air-Conditioners / Condensing Units – Refer Table 21 of MS 1525:2014.

Note: If the specific type of air conditioned is not found in MS 1525:2014, please refer to SS 530 to make the calculation on COP. Priority given to MS 1525:2014.

1-2(c) Air Distribution System – Refer to Clause 7.11.5 in CP 13

- For fan systems which are able to vary system air volume (VAV) automatically as a function of load, the power required by the motors for the combined fan system at the design conditions shall not exceed 2.4 kW/m^3/s of supply air
- For Constant Air Volume (CAV), the motors for fan system shall not exceed 1.7 kW/m^3/s of supply air.

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

1-2(d) 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
Temperature sensors - 10K/30K Thermistor - Platinum Resistance Thermometers	± 0.03 – 0.05 °C at 0°C
Floor Sensor Meter - Ultrasonic - Full bore magnetic	± 0.5 – 1.0 % over entire measurement range
Power meter	ANSI C12.1-2008, Class 1 ±1%

1-2(e) Verification of central chilled water plant instrumentation – Heat Balance substantiating test

- 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 ± 5% over the audit period

Heat balance is denoted by below equation:

$q_{condenser} = q_{evaporator} + W_{input}$

Where;

$q_{condenser}$ = heat rejected (in kW or RT)
$q_{evaporator}$ = cooling load (in kW or RT)
W_{input} = measured electrical power input to compressor

1-2(f) Provisioning of variable speed controls for chiller plant equipment

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.

Requirements	1-2(a) Air-Conditioned Plant (Up to 20 credits) • **Building cooling load ≥ 500RT** : 14 credits for achieving plant efficiency of 0.75 kW/ton 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:** 14 credits for achieving plant efficiency of 0.85 kW/ton 0.3 credit for every percentage improvement in the chiller plant efficiency better than 0.85 kW/ton Credit scored = 0.3 x (% improvement) (up to 20 credits) **OR** 1-2(b) Air-Conditioned Plant (Up to 20 credits) • **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 Credit scored = 0.25 x (% 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 x (% improvement) (up to 20 credits)

	1-2 (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 x (% improvement) Note (1): For building using district cooling system, there is no need to compute the plant efficiency under item ENRB 1-2(a). The credit obtained will be pro-rated based on the air distribution system efficiency under ENRB 1-2(c). 1-2 (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 1-2 (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. 1-2(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. 1-2(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) ≤ 700 ppm above outdoor.
Documentary Evidences	For 1-2 (a) and (b) • 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. For 1-2 (c)

	• 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 <u>For 1-2 (d)</u> • 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. <u>For 1-2 (e)</u> • Computation of the percent heat balance that is the total heat gain and total heat rejected must be within ± 5% for 80% of the sampled credits over the normal building operations hours accordance with AHRI550/590. • Detailed calculations of the overall uncertainly of measurement of the resultant chiller plant efficiency in kW/RT to be within ± 5% of the true value based on instrumentation specification. <u>For 1-2 (f) and (g)</u> • 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.
References	(a) MS 1525:2014 – 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.
Worked Example	**Case: District Cooling Plant (DCP)** <u>For 1-2(a) (ii)</u> An air-conditioned building equipped only AHU and FCU. Whilst its chiller, cooling tower and pumps are placed outside the building. The AHU performance system is 8 %. 0.5 credit for AHU improvement; 0.5 x 8 % = 4 credits <u>For 1-2(a) (i),</u> The pro-rate calculation shall be;

	$\frac{4 \text{ credits}}{5 \text{ credits}} \times 20 \text{ credits} = 16 \text{ credits}$ Total credits scored for part 1-2(a)(i) and 1-2(a)(ii) = 4 + 16 = 20 credits

ENRB 1-3 NATURAL VENTILATION/ MECHANICAL VENTILATION

<table>
<tr><td>Objectives</td><td>Encourage building that facilitates good natural ventilation. Encourage energy efficient mechanical ventilation system as the preferred ventilation mode to air-conditioning in buildings.</td></tr>
<tr><td>Applicability</td><td>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.</td></tr>
<tr><td>Baseline Standard</td><td>Fan power limitation in mechanical ventilation systems:

<table>
<tr><th colspan="2">Allowable nameplate motor power</th></tr>
<tr><td>Constant volume</td><td>Variable volume</td></tr>
<tr><td>1.7 kW/m^3/s</td><td>2.4 kW/m^3/s</td></tr>
</table>
</td></tr>
<tr><td>Requirements</td><td><u>1-3(a) Natural Ventilation</u>

Up to 32 credits will be awarded for natural ventilation in the building.

20 base credits will be awarded for use of natural ventilation,

Up to 12 credits can be scored for building design that utilises prevailing wind conditions to achieve adequate cross ventilation.

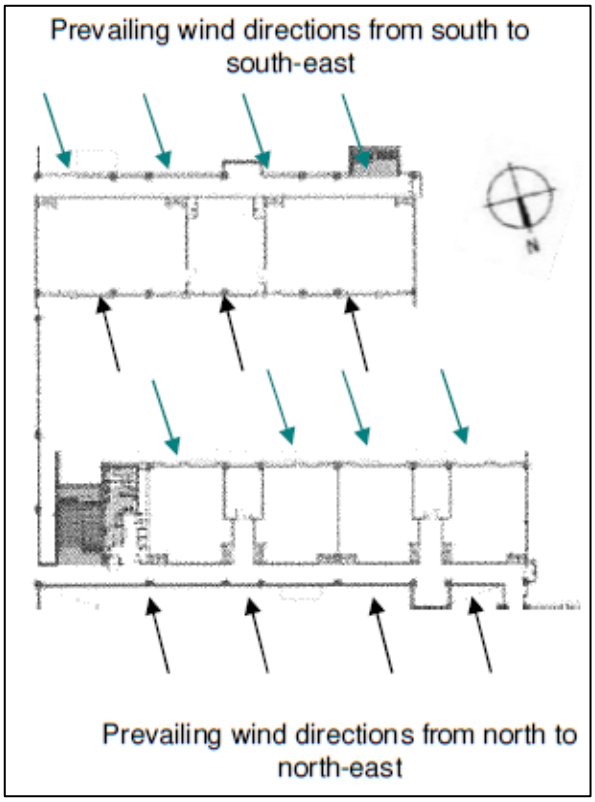
1.2 credits for every (10% of units/ rooms with window openings facing north and south directions)

Credits scored = 1.2 x (% of units / 10)

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.

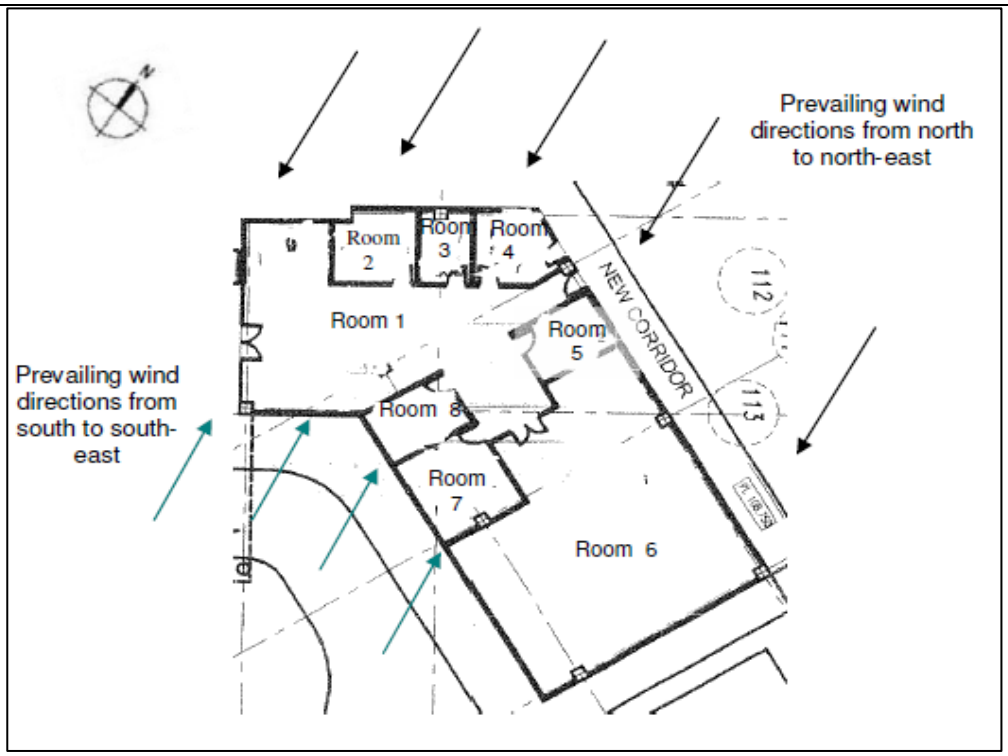
It is not necessary for the window openings to be located perpendicularly to the prevailing wind direction. An oblique angle is considered acceptable (see illustrations as shown in the next page).</td></tr>
</table>

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

1-3(a) Natural Ventilation

- 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).

Table 1-3(a) – Percentage of units with window opening in N-S direction

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			∑ (a) / ∑(b) x 100
2	Classroom Blk B			
3	Offices, meeting rooms and computer rooms with air-conditioning			
	Total:			

Credits scored = 1.2 x (% of units / 10)
= 1.2 x [(∑ (a) / ∑(b) x 100) / 10] + 20 (for use of NV)

1-3(b) Mechanical Ventilation

- 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.

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: 2014.
Baseline Standard	Luminance level stated in MS 1525:2014 – Energy Efficient and use of renewable energy for non-residential building – Code of Practice.
Requirements	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. 0.3 credit for every percentage improvement in the lighting provisions over the baseline standard. That is: Credits scored = 0.3 x (% improvement) Display lighting and specialised lighting are to be included in the calculation of lighting power budget. The design service illuminance, lamp efficiencies and the light output ratios of luminaries shall be in accordance with in MS 1525:2014 – Energy Efficiency and use of renewable energy for non-residential building – Code of Practice.
Documentary Evidences	• 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 1525:2014 – 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	1-5(a) 4 credits can be scored if the carparks spaces that are fully naturally 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. Note: Where there is a combination of different ventilation mode adopted for carpark design, the credits scored under this requirement will be prorated accordingly.
Documentary Evidences	<u>For 1-5 (a)</u> • 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. <u>For 1-5 (b)</u> • 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. • Toilets • Staircases • Corridors • Lift Lobbies • Atriums
Baseline Standard	-
Requirements	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. Credits are scored based on the mode of ventilation provided in these applicable areas. Natural ventilation – 1.5 credits for each area Mechanical ventilation – 0.5 credit for each area
Documentary Evidences	• 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 **ALL** lifts and/or escalators in the development.
Baseline Standard	-
Requirements	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. 1 credit can be scored for the use if lifts with sleep mode features. 1 credit can be scored for the use of escalators with motion sensors to regulate usage.
Documentary Evidences	• 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	Proposed development has the following provision : Two lift types : Type L1 with VVVF motor drive and sleep mode features Type L2 with VVVF motor drive and sleep mode features Two escalator types : Type E1 with VVVF motor drive and motion sensors Type E2 without VVVF motor drive and motion sensors 1 credit for the use of lifts with VVVF motor drive; and 1 credit for the use of lifts with sleep mode features No credits for escalators as not all escalators are designed with motion sensors Credits scored for 1-7 = 2 credits (out of 3 credits)

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	1-8(a) 1 credit can be scored for the practice of using Energy Efficient Index (EEI) as a building performance indicator to measure the building's unit area energy consumption for future monitoring and improvements. Calculation of EEI: EEI = [(TBEC – DCEC) / (GFA – DCA)] X (NF/OH) Where: (a) TBEC : Total building energy consumption (kWh/year) (b) DCEC : Data centre energy consumption (kWh/year) (c) GFA : Gross Floor Area (exclude car park area)(m^2) (d) DCA : Data centre area (m^2) (e) NF : Normalising factor based on a typical weekly operating hour that is 55hr/week (f) OH : Weighted weekly operating hours (hrs/week) Note: (1) EEI is based on 100% occupancy rate for consistency. (2) All major energy consumption equipments are to be included in the estimation of total building energy consumption. (3) For industrial buildings, process load should be excluded. 1-8(b) 0.5 credits can be scored for each equipment type used up to 2 credits. Examples include: • Re-generative lift • Heat recovery system • Motion sensors • Sun pipes • Light shelves • Photocell sensors to maximize the use of Daylight • Heat pumps, etc. 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. 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.

Documentary Evidences	For 1-8(a) • Calculation of the Energy Efficiency Index (EEI) 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 EEI calculation For 1-8(b) • 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. For 1-8(c) • 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.
References	-

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	0.5 credits for energy policy, energy targets and regular review with top management's commitment as part of an environmental strategy. 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
Documentary Evidences	For 1-9 (a) • Energy policy showing energy saving commitments or energy targets from the top management. For 1-9 (b) • Improvement plans showing the calculation of energy saving that can be achieved over the next three years.
References	-

ENRB 1-10 RENEWABLE ENERGY

<table>
<tr><td>Objectives</td><td>Encourage the application of renewable energy sources in buildings.</td></tr>
<tr><td>Applicability</td><td>Includes all renewable energy sources.</td></tr>
<tr><td>Baseline Standard</td><td>-</td></tr>
<tr><td>Requirements</td><td>Up to 15 credits can be scored for the use of renewable energy. Credit scored based on the expected energy efficiency index (EEI) and % replacement of electricity by renewable energy source
<table>
<tr><th rowspan="2">Energy Efficiency Index (EEI)</th><th colspan="2">Every 1% replacement of electricity (based on total electricity consumption) by renewable energy source</th></tr>
<tr><th>Include tenant’s usage</th><th>Exclude tenant’s usage</th></tr>
<tr><td>≥ 50 kWh/m²/yr</td><td>5 credits</td><td>3 credits</td></tr>
<tr><td>< 50 kWh/m²/yr</td><td>3 credits</td><td>1.5 credits</td></tr>
</table></td></tr>
<tr><td>Documentary Evidences</td><td>• Plan layout showing the location of proposed renewable energy system.
• Technical product information on the salient features if 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.</td></tr>
<tr><td>References</td><td>-</td></tr>
</table>

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	(a) 1 credit can be scored by monitoring the water consumption on a monthly basis. (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) (c) Up to 2 credits can be scored for the provision of automated/smart metering for monitoring and leakage detection.
Documentary Evidences	For 2-1 (a) • Monitoring plan of water consumptions. For 2-1 (b) • Schematic drawings of cold water distribution system showing the location of the sub meters provided. • List of sub metering and its location. For 2-1 (c) • 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-meters.
References	-

ENRB 2-2 WATER EFFICIENT FITTINGS

<table>
<tr><td>Objectives</td><td>Encourage the use of water efficient fittings under Water Efficient Product Labelling Scheme (WELPS) or Water Efficiency Labelling Scheme (WELS)</td></tr>
<tr><td>Applicability</td><td>Applicable to all water fittings covered by the WEPLS or WELS as follows:
Basin taps and mixers
Sink/taps and mixers
Dual Flush Low Capacity Flushing Cisterns
Showerheads
Shower taps and mixers
Urinals and Flush Valves</td></tr>
<tr><td>Baseline Standard</td><td>As specified under Water Efficiency Products Labelling Scheme (WEPLS) or Water Efficiency Labelling Scheme (WELS).</td></tr>
<tr><td>Requirements</td><td>Up to 12 credits can be scored based on the number and water efficiency rating of the fitting type used.

<table><tr><td colspan="3">Weightage Based on Water Efficiency Products Labelling Scheme (WEPLS)</td></tr><tr><td>Efficient *</td><td>Highly Efficient **</td><td>Most Efficient ***</td></tr><tr><td>6</td><td>9</td><td>12</td></tr></table></td></tr>
<tr><td>Documentary Evidences</td><td>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.</td></tr>
<tr><td>References</td><td>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
Or WELS, refer to
(http://www.pub.gov.sg/wels/Pages/default.aspx)</td></tr>
<tr><td>Worked Example 2-2</td><td>Example of a water fitting schedule showing the numbers, types and the approve rating of the proposed fitting for a residential development (including common facilities such as clubhouse toilets).</td></tr>
</table>

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	∑A = 225
Weightage (B)		6	9	12	0	
Total (AxB)		0	1035	1260	0	∑(AxB) = 2295

Credits scored = ∑(AxB) / ∑A
= 2295 / 225
= 10.2 credits

Percentage of fittings with water efficiency rating = 220/225 = 97.7%

ENRB 2-3 ALTERNATIVE WATER SOURCES

<table>
<tr><td>Objectives</td><td>Encourage the use of suitable systems that utilize alternative water sources for non-potable uses: irrigation, washing, water features, toilet flushing, etc</td></tr>
<tr><td>Applicability</td><td>Generally applicable to building that uses alternative water sources.</td></tr>
<tr><td>Baseline Standard</td><td>-</td></tr>
<tr><td>Requirements</td><td>Up to 3 credits will be awarded based on the % reduction in total potable water usage of the applicable uses
<table><tr><td>> 50 %</td><td>3 credits</td></tr><tr><td>≥ 10 % to 50 %</td><td>2 credits</td></tr><tr><td>< 10 %</td><td>1 credit</td></tr></table></td></tr>
<tr><td>Documentary Evidences</td><td>• 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.</td></tr>
<tr><td>References</td><td>-</td></tr>
</table>

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	• 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	2-5(a) 1 credit can be scored for the use of non-potable water including rainwater for landscape irrigation. 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. 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.
Documentary Evidences	<u>For 2-5(a)</u> • 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. <u>For 2-5(b)</u> • 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. <u>For 2-5(c)</u> • 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	2-6(a) 1 credit can be scored for the use of cooling tower water treatment system which can achieve 7 or better cycles of concentration at acceptable water quality. 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.
Documentary Evidences	For 2-6(a) • 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. For 2-6(b) • 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 environmental friendly practices during construction and building operation.
Applicability	Generally applicable to all building developments.
Baseline Standard	-
Requirements	3-1(a) 1 credit can be scored if the environmental policy that reflects the sustainable goals set. 3-1(b) 1 credit for the provision of a green guide to the occupants of the building. 3-1(c) 1 credit can be scored if the building maintenance team comprises of 1 GreenRE manager / Green Mark manager 3-1(d) 1 credit can be scored if the project team comprises 1 GreenRE Manager / Green Mark manager 3-1(e) Up to 1 credit if the environmental management system of the building is ISO 14000 or ISO 50001 certified.
Documentary Evidences	For 3-1(a) • Documentation related to the building environmental policy. For 3-1(b) • Green guide book for the occupants where it contains best practices to reduce energy use, water use, maintain a good indoor environmental. This guide should also demonstrate evidences of occupant involvement. For 3-1(c) • 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. For 3-1(d) • A certified true copy of certificate of GreenRE Manager/Green Mark Manager where applicable and a confirmation of their involvement in the project. For 3-1(e) • 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	3-2(a) 2 credits for the conduct of post occupancy survey for occupants satisfaction on energy and environmental practices. Required number of people surveyed shall be: • 10% of total occupancy and up to 100 maximum. • Minimum 5 people shall be surveyed if total occupancy is less than 50. 3-2(b) 1 credit can be scored for the list of corrective actions taken following the post evaluation.
Documentary Evidences	For 3-2(a) • Draft of survey form. • Letter of commitment to conduct the survey. For 3-2(b) • 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	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. 3-3(b) 2 credits for promoting and encouraging minimization and recycling among occupants, tenants and visitors through various avenues. 3-3(c) 1 credit for providing proper storage area for recyclable waste. 3-3(d) 2 credit for quantifying and monitoring the recycling programme for continuous improvement.
Documentary Evidences	For 3-3(a) • Layout plan showing the collection and storage for the different recyclable waste. For 3-3(b) • Draft of promotion and encouragement plan for minimization and recycling among occupants. For 3-3(c) • Layout plan showing the location of the storage area for recyclable waste. For 3-3(d) • Waste management plan
References	-

ENRB 3-4 SUSTAINABLE PRODUCTS

<table>
<tr><td>Objectives</td><td>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.</td></tr>
<tr><td>Applicability</td><td>Generally applicable to all building developments.</td></tr>
<tr><td>Baseline Standard</td><td>-</td></tr>
<tr><td>Requirements</td><td>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.

The environmentally friendly product proposed must be approved by a valid international or local certification body and is subject to GreenRE’s evaluation.

Table 3-2.1 : Weightage for credits allocation
<table><tr><th>Extent of use of environmentally friendly product</th><th>Weightage for Credits Allocation</th></tr><tr><td>Low impact</td><td>0.5</td></tr><tr><td>Medium impact</td><td>1</td></tr><tr><td>High Impact</td><td>2</td></tr></table>
The use of environmental 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).

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).

Notes:
(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) 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.</td></tr>
</table>

<table>
<tr><td>Documentary Evidences</td><td>

Extracts from the tender specification and drawings showing the requirements to incorporate the environmental 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.

</td></tr>
<tr><td>References</td><td>For more info on product certification, refer to;
1. http://www.sirim-qas.com.my/index.php/zh/our-services/product-certification/eco-labelling-scheme
2. http://www.sec.org.sg/sgls/</td></tr>
<tr><td>Worked Example 3-4</td><td>
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 high impact or medium impact. Products that are meant for common areas and external works such as toilets, lobbies and landscaping areas are considered as medium impact or low impact.

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.

Example of a proposed development with the following provisions:

(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.

<table>
<tr><th colspan="2">Products and Extent of coverage</th><th>With approved certification</th><th>Extent of use category</th><th>Credits scored</th></tr>
<tr><td>(a)</td><td>Carpets for all office spaces</td><td>No</td><td>N/A</td><td>0</td></tr>
<tr><td>(b)</td><td>Panel boards as internal partition for more than 50% of office spaces</td><td>Yes</td><td>2</td><td>2</td></tr>
</table>
</td></tr>
</table>

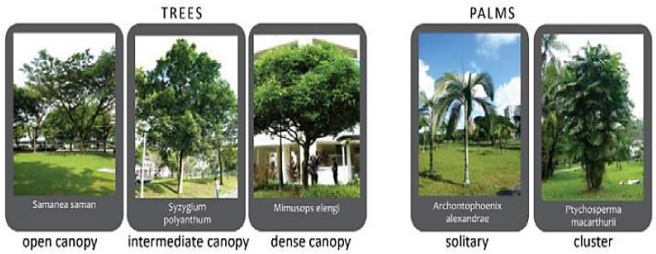
	(c)	Precast road kerbs	Yes	0.5	0.5
	(d)	Roof waterproofing	Yes	1	1
	(e)	Wooden doors for all areas	Yes	2	2

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

ENRB 3-5 GREENERY PROVISION

<table>
<tr><td>Objectives</td><td>Encourage greater use of greenery and restoration of existing trees reduce heat island effect.</td></tr>
<tr><td>Applicability</td><td>Applicable to building developments with landscaping areas.</td></tr>
<tr><td>Baseline Standard</td><td>-</td></tr>
<tr><td>Requirements</td><td>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.

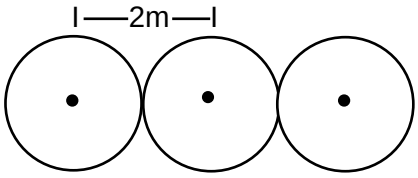
Greenery Plot Ratio (GnPR) is calculated by considering the 3D volume covered by plants using the following Leaf Area Index(LAI) :

<table>
<tr><th>Plant group</th><th>Trees</th><th>Palms</th><th>Shrubs & Groundcover</th><th>Turf</th></tr>
<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 m^2</td><td>Solitary = 20m^2
Cluster = 17m^2</td><td>Planted area</td><td>Planted area</td></tr>
</table>


<table>
<tr><th>GnPR</th><th>Credits Allocation</th></tr>
<tr><td>1.0 to < 2.0</td><td>1</td></tr>
<tr><td>2.0 to < 3.0</td><td>2</td></tr>
<tr><td>3.0 to < 4.0</td><td>3</td></tr>
<tr><td>4.0 to < 5.0</td><td>4</td></tr>
<tr><td>5.0 to < 6.0</td><td>5</td></tr>
<tr><td>≥ 6.0</td><td>6</td></tr>
</table>
Green Plot Ratio(GnPR) = Total leaf area index / site area

3-5 (b) 1 credit for restoration of trees on-site, conservation or relocation of existing trees on site.

3-5 (c) 1 credit for the use of compost recycled from horticulture waste.</td></tr>
</table>

Documentary Evidences	<u>For 3-5(a)</u> • 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://florafaunaweb.nparks.gov.sg/. <u>For 3-5 (b)</u> • 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. <u>For 3-5 (c)</u> • Extracts of the tender specification showing the requirements to use compost recycled from horticulture waste. • Product specifications. • Method statement with details steps of composting process (if applicable).
Exceptions	**TREES AND PALMS SPACING (CENTRE-TO-CENTRE)** (a) If the selected trees and palms are to be planted at ≤ 2m 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).  **OLUMNAR TREES** (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: • Garciniacymosa forma pendula • Garciniasubelliptica • Polyalthialongifolia • Carallia brachiate • Gnetumgnemon
References	The plant species, its sub categories and LAI values may be obtained from the online website: http://florafaunaweb.nparks.gov.sg

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)** LAI value	**(B)** Canopy area	**(C)** Qty/Planted Area	**(A)x(B)x(C)** 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 m^2
Green Plot Ratio (GnPR) = total leaf area / site area
= 6234 / 2000 = 3.117 < 4.0

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	For 3-6(a) • 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. For 3-6(b) • 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	For 3-6(a) • Draft green procurement policy documents to demonstrate environmental preferable services (operation and maintenance). For 3-6(b) • 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 environmental friendly transport options and facilities to reduce pollution from individual car use.
Applicability	Generally applicable to all building developments.
Baseline Standard	-
Requirements	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. 3-7(b) 1 credit can be scored for provision of covered walkway to facilitate connectivity and the use of public transport. 3-7(c) 1 credit can be scored for provision of electric vehicle charging stations and priority parking lots within the development. 3-7(d) Up to 1 credit can be scored for the provision of covered/sheltered bicycles parking lots with rack / locking bar.
Documentary Evidences	<u>For 3-7(a)</u> • 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. <u>For 3-7(b)</u> • 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. <u>For 3-7(c)</u> • 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. <u>For 3-7(d)</u>

	• 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.

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

<table>
<tr><td>Objectives</td><td>To promote a healthy indoor environment for occupant</td></tr>
<tr><td>Applicability</td><td>Generally applicable to all building developments (air-conditioned areas only)</td></tr>
<tr><td>Baseline Standard</td><td>Indoor Air Contaminants Parameters:
Notes:
<table>
<tr><th>Physical Parameters</th><th colspan="3">Acceptable Range</th></tr>
<tr><td>Air Temperature</td><td colspan="3">23-26 °C</td></tr>
<tr><td>Relative Humidity</td><td colspan="3">50-70%</td></tr>
<tr><td>Air Movement</td><td colspan="3">0.15-0.5 m/s</td></tr>
<tr><th rowspan="2">Chemical Contaminants</th><th colspan="3">Acceptable Limits</th></tr>
<tr><th>ppm</th><th>mg/m³</th><th>Cfu/m³</th></tr>
<tr><td>Carbon Monoxide</td><td>10</td><td>-</td><td>-</td></tr>
<tr><td>Formaldehyde</td><td>0.1</td><td>-</td><td>-</td></tr>
<tr><td>Ozone</td><td>0.05</td><td>-</td><td>-</td></tr>
<tr><td>Respirable particulates</td><td>-</td><td>0.15</td><td>-</td></tr>
<tr><td>Total volatile organic compounds (TVOC)</td><td>3</td><td>-</td><td>-</td></tr>
<tr><th rowspan="2">Biological Contaminants</th><th colspan="3">Acceptable Limits</th></tr>
<tr><th>ppm</th><th>mg/m³</th><th>Cfu/m³</th></tr>
<tr><td>Total Bacteria Counts</td><td>-</td><td>-</td><td>500</td></tr>
<tr><td>Total Fungal Counts</td><td>-</td><td>-</td><td>1000</td></tr>
<tr><th rowspan="2">Ventilation Performance Indicator</th><th colspan="3">Acceptable Limits</th></tr>
<tr><th>ppm</th><th>mg/m³</th><th>Cfu/m³</th></tr>
<tr><td>Carbon Dioxide</td><td>C1000</td><td>-</td><td>-</td></tr>
</table>

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.
</td></tr>
<tr><td>Requirements</td><td>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).

4-1(b) 1 credit for the implementation of effective IAQ management plan to ensure building ventilation systems are frequently maintained.

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

4-1(d) 1 credit for providing room temperature display (at least 1 unit per floor)

4-1(e) 1 credit for additional carbon dioxide sensor display (at least 1 unit per</td></tr>
</table>

	Floor)
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	For 4-1(a): • 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. For 4-1(b): • Provision of IAQ Management Plan which evaluates overall building ventilation system using checklist and any comparable methods. For 4-1(c): • Technical product specification of the filter that is implemented in the AHU. • Layout plan showing the location of the AHU in the building. For 4-1(d): • Layout plan for every floor showing the location of the room temperature displays. • Technical specification of the temperature displays. For 4-1(e): • 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 POLUTANTS

Objectives	Minimise airborne contaminants, mainly from inside sources to promote a healthy indoor environment.
Applicability	Generally applicable to all building developments.
Baseline Standard	-
Requirements	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. 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.
Documentary Evidences	<u>For 4-2(a)</u> • 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. <u>For 4-2(b)</u> • 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

<table>
<tr><td>Objectives</td><td>To encourage good workplace lighting quality to promote productivity and occupants comfort</td></tr>
<tr><td>Applicability</td><td>Generally applicable to all building developments.</td></tr>
<tr><td>Baseline Standard</td><td>Luminance level stated in MS 1525:2014 – Energy Efficient and use of renewable energy for non-residential buildings – Code of Practice.</td></tr>
<tr><td>Requirements</td><td><u>4-3(a) Lighting level to comply with MS 1525:2014</u>
• 1 credit will be provided if the lighting level comply with MS 1525:2014.

<u>4-3(b) Controllability of the lighting system</u>
• 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><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>
<u>4-3(c) High Frequency Ballast</u>
Up to 2 credits will be given if all applicable areas in the entire building are served with fluorescent tubes using high frequency ballast.

<table><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></td></tr>
<tr><td>Documentary Evidences</td><td><u>For 4-3(a):</u>
• Current lighting schedule showing lighting levels in various building areas.
• Lighting layout plan.
• Lux simulation showing the lighting level comply with MS1525:2014.
• Technical product information of the lighting luminaries used.

<u>For 4-3(b):</u>
• Schematic drawing showing the location of controllable switches / task lights.
• Layout plan showing the coverage of each switches.

<u>For 4-3(c):</u>
• 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.</td></tr>
</table>

	• Electrical lighting layout indicating all the fittings with high frequency ballast/LED driver.
References	Luminance level stated in MS 1525:2014 - 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	• Indoor dry-bulb temperature within 23°C to 26°C • Relative humidity between 50% to 70%
Requirements	4-4(a) 1 credit can be scored by ensuring the consistent indoor conditions for thermal comfort: 4-4(b) 1 credit can be scored by giving the flexibility of temperature controllability.
Documentary Evidences	For 4-4(a) • 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. For 4-4(b) • 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

<table>
<tr><td>Objectives</td><td>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.</td></tr>
<tr><td>Applicability</td><td>Generally applicable to building developments.</td></tr>
<tr><td>Baseline Standard</td><td>ASTEM E413 or equivalent</td></tr>
<tr><td>Requirements</td><td>1 credit can be scored if the building is designed to achieve ambient internal noise level as specified:

• 55dB (6am – 10pm) L_{Aeq}
• 45dB (10pm – 6 am) L_{Aeq}

This can be achieved by adhering to the following STC values for residential building partitions

<table>
<tr><th>Description</th><th>Sound Transmission Class (STC)</th></tr>
<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>
</table>

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.</td></tr>
<tr><td>Documentary Evidences</td><td>• 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>
<tr><th>Location</th><th>STC rating of partitions</th></tr>
<tr><td>Between General Office Space</td><td>40 - 50</td></tr>
<tr><td>Hotel Rooms, Classrooms, Lecture Theaters, 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>
</table></td></tr>
</table>

	• 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. **OR** • A report of detail analysis and recommendations from acoustic consultant (if applicable).
References	-

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	Up to 10 credits are awarded for the use of the following green features depending on their potential environmental benefits or reduced environmental impacts. <u>Water efficiency</u> i. Use of self cleaning façade system • 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 • 2 credits for all blocks of the development. • 1 credit for at least one block of the development. iii. Recycling of AHU condensate • 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. <u>Environmental Protection</u> i. Provision of green roof and roof top garden • 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 • 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. <u>Indoor Air Quality</u> i. Use of Titanium Dioxide solutions to remove odour in toilets: • 1 credit for more than 50% of all toilets

	• 0.5 credit for at least 25% of all toilets ii. 1 credit for the use of pneumatic waste collection system. iii. 0.5 credit for the use of Ultraviolet light-C band (UV) emitters in all air handing units (AHUs) to improve indoor air quality. <u>Others</u> i. Provision of landscape drainage and infiltration trenches: • 1 credit for at least 25% of the green areas • 0.5 credit for less than 25% of the green areas ii. Provision of system to recycle surface runoff from the vertical green wall and sky garden: • 1 credit for at least 25% of green areas • 0.5 credit for less than 25% green areas iii. 0.5 credit for the use of siphonic rainwater discharge system at roof. iv. 0.5 credit for the provision of eco-pond. v. 0.5 credit for the provision of carpark guidance system. 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.
Documentary Evidences	• 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. • Demolition audit showing the summary of the total and actual quantity of concrete waste and delivery records or receipts from approved recycling firm.
References	-

Part 6 – Carbon Emission of Development

ENRB 6-1 CARBON EMMISION OF DEVELOPMENT

<table>
<tr><td>Objectives</td><td>To calculate the carbon emission resulted from the associated energy used during construction and operational phase of a development.</td></tr>
<tr><td>Applicability</td><td>Generally applicable to all building development.</td></tr>
<tr><td>Baseline Standard</td><td>-</td></tr>
<tr><td>Requirements</td><td>1 credit can be scored for the calculation of the carbon footprint report of the building comprising of energy and water consumption savings with comparison of the baseline parameters.
Up to 2 credits can be scored for identifying embodied carbon of building materials used for construction.</td></tr>
<tr><td>Documentary Evidences</td><td>• 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.</td></tr>
<tr><td>References</td><td>-</td></tr>
<tr><td>Worked Example 6-1</td><td>Energy Consumption
<table>
<tr><td rowspan="2">Type of usage</td><td>Design</td><td>Baseline</td></tr>
<tr><td>(kWh/yr)</td><td>(kWh/yr)</td></tr>
<tr><td>Lighting</td><td>819,498</td><td>1,151,575</td></tr>
<tr><td>Air-Conditioning</td><td>860,589</td><td>1,406,899</td></tr>
<tr><td>M/V System</td><td>25,550</td><td>25,550</td></tr>
<tr><td>Total Energy Usage</td><td>1,705,637</td><td>2,584,024</td></tr>
</table>
Water Consumption
<table>
<tr><td rowspan="2">Type of fixtures</td><td>Design</td><td>Baseline</td></tr>
<tr><td>(m^3/yr)</td><td>(m^3/yr)</td></tr>
<tr><td>Flow Fixtures</td><td>2,402</td><td>6,899</td></tr>
<tr><td>Flush Fixtures</td><td>5,366</td><td>5,161</td></tr>
<tr><td>Total Water Usage</td><td>7,768</td><td>12,060</td></tr>
</table>
Carbon Footprint
<table>
<tr><td rowspan="2">Type of usage</td><td>Design</td><td>Baseline</td></tr>
<tr><td>kgCO_2e/yr</td><td>kgCO_2e/yr</td></tr>
<tr><td>Energy</td><td>1,226,619</td><td>1,860,497</td></tr>
<tr><td>Water</td><td>155,344</td><td>241,192</td></tr>
<tr><td>Total Annual Carbon Footprint</td><td>1,381,963</td><td>2,101,689</td></tr>
</table>
*CO_2 conversion factor for energy = 0.72, water = 0.02.
Please use up-to-date CO_2 conversion factor for both energy and water.

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

Credits scored for 6-1 (a) = 1 credit</td></tr>
</table>

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 • 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.