REFERENCE GUIDE

GreenRE Energy Certificate

Version 1.0

April 2024

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.

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

2. Introduction

The GreenRE Energy Certificate was established in 2024 and is tailored for the tropical climate. GreenRE sets parameters and establishes indicators to guide the benchmarking of energy performance in existing non-residential buildings.

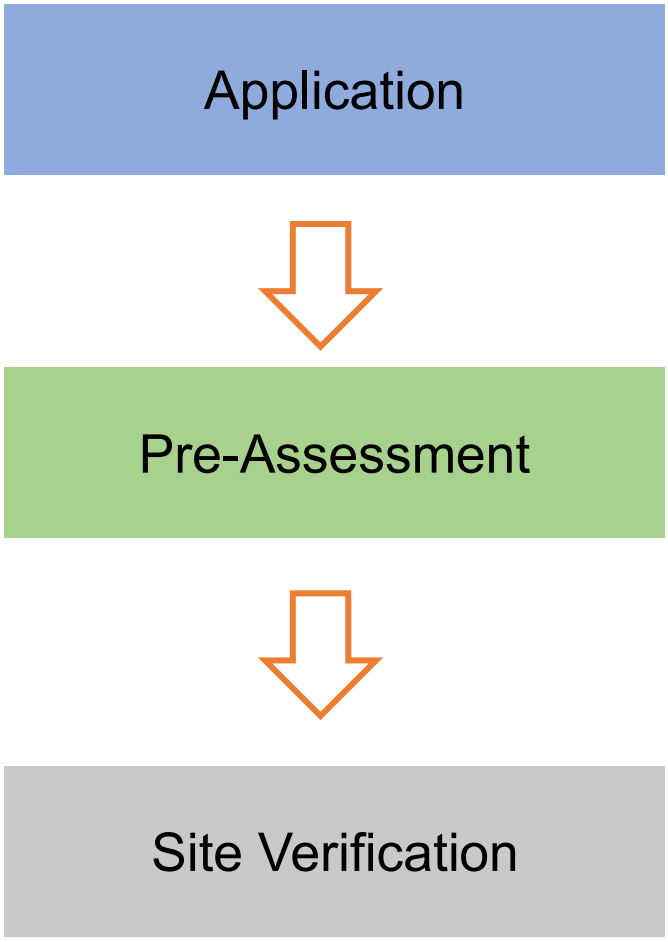
This Guideline is not intended to abridge safety, health, environmental or related requirements contained in other applicable laws, codes or policies administered by relevant authorities. Where there is a conflict between a requirement of this Guideline and such other regulations affecting the design,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

3. Revision Log

Revision	Description	Date Effective
1.0	Issued for Pilot	April 2024
2.0	Issued for Use	August 2024

4. GreenRE Assessment Stages

The GreenRE Energy Certificate 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.

Site verification to be conducted upon project completion.

Final Certificate will be issued upon completion of this stage.

5. GreenRE Energy Certificate Rating System

Overview

The GreenRE Energy Certificate is aimed at benchmarking the energy performance of existing non-residential buildings encompassing the following categories:

- Office Building
- Hotel
- Retail Mall
- School, University and College
- Hospital (Private & General)
- Polyclinics
- Nursing / Youth Homes

The energy rating works by benchmarking building performance through two (2) alternative pathways:

a) Pathway 1 - Comparing metrics for passive design and major active systems (performance based) against GreenRE's benchmarks.
b) Pathway 2 – Fixed metrics and comparing energy consumption of building (outcome based) against GreenRE's benchmarks.

Projects that achieve GreenRE's Energy Certificate will be eligible for Malaysia's Energy Commission Building Energy Label (BELS).

Renewal of certification will be conducted every three (3) years whereby adherence to Pathway 2 BEI benchmarks will be required for relevant rating tier.

Credit Allocation

Category		Credit allocation
(I) Energy Related Requirements		
Minimum 30 credits	**Part 1: Energy Efficiency**	
	EC 1-1 Thermal Performance of Building Envelope-OTTV	5
	EC 1-2 Air-Conditioning System (**applicable to air-conditioned areas)**	33
	EC 1-3 Natural Ventilation /Mechanical Ventilation **(Applicable to non-air – conditioner areas excluding carparks and common area)**	32
	EC 1-4 Artificial Lighting	13
	EC 1-5 Ventilation in Carparks	4
	EC 1-6 Ventilation in Common Areas	5
	EC 1-7 Lifts & Escalators	2
	EC 1-8 Energy Efficient Practices & Features	12
	EC 1-9 Energy Policy & Management	2
	EC 1-10 Renewable Energy	20
	Category Score for Part 1 – Energy Efficiency	**96**

6. GreenRE Energy Certificate Rating System Scoring

Score	Rating
70 and above	Super Low Energy (Applicable for Zero Energy and Positive Energy Buildings)
65 to ≤ 69	Platinum Energy
55 to ≤ 64	Gold Energy
45 to ≤ 54	Silver Energy

7. GreenRE Energy Certificate Rating System Criteria

Pre-requisites

PART 1 – ENERGY EFFICIENCY

1. ENERGY EFFICIENCY

GreenRE Energy Rating	Minimum credits achievement for EC1-1 to EC1-9
Silver Energy	35 credits
Gold Energy	40 credits
Platinum Energy	45 credits
Super Low Energy	50 credits

2. ENERGY EFFICIENCY COMPLIANCE

Projects shall demonstrate the stipulated performance through either pathway listed below:

Pathway 1 - Minimum System Efficiency (Fixed Metric)

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

(i) For buildings using Water-Cooled Chilled Water Plant

Energy Rating	Building Cooling Load (RT)	
	< 500	≥ 500
	Efficiency (kW/RT)	
Silver	0.80	0.70
Gold	0.75	0.68
Platinum	0.70	0.65
SLE	0.68	0.63

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

Energy Rating	Building Cooling Load (RT)	
	< 500	≥ 500
	Efficiency (kW/RT)	
Silver	1.0	1.0
Gold	0.85	Case by case (i)
Platinum	0.78	
SLE	0.75	

For building with building cooling load of more than 500RT, the use of air cooled central chilled water plant or other unitary air-conditioners are not encouraged for Gold and above ratings. In general, the system efficiency of the air cooled central

chilled-water plant and other unitary air-conditioners are to be comparable with the stipulated efficiency for water-cooled central chilled-water plant. Buildings that are designed with air cooled systems and for higher GreenRE rating will be assessed on a case-by-case basis.

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

Office Building Monday to Friday: 9am to 6pm 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

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

Pathway 2 – Building Energy Intensity (BEI) Benchmarking

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

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

The building shall demonstrate compliance to the Building Energy Intensity (BEI) stated in the table below through 12-months measured data with a requirement of minimum occupancy of 60% for the period of measurement (projection of energy consumption necessary for lower occupancy based on prescribed BEI formula):

Building Type	Silver Energy (kWh/m^2/year)	Gold Energy (kWh/m^2/year)	Platinum Energy (kWh/m^2/year)	Super Low Energy (kWh/m^2/year)
Office Building	180	135	120	90
Hotel	330	240	220	190
Retail Mall	315	230	210	160

School, University and College	145	110	100	80
School, University and College (MOE)	50	38	35	30
Hospital (Private & General)	510	375	340	300
Community Hospitals	315	230	210	185
Polyclinics	205	150	135	120
Nursing / Youth Homes	120	90	80	70

Table 1: Building Energy Intensity (BEI) Benchmarking

Building Type	Silver Energy ($kWh/m^2/year$)	Gold Energy ($kWh/m^2/year$)	Platinum Energy ($kWh/m^2/year$)	Super Low Energy ($kWh/m^2/year$)
Office Building	120	90	80	70
Hotel	220	150	135	120
Retail Mall	200	140	140	125
School, University and College	90	75	60	50
School, University and College (MOE)	30	25	20	15
Hospital (Private & General)	330	245	230	210
Community Hospitals	210	150	140	130
Polyclinics	130	95	90	85
Nursing / Youth Homes	75	55	55	50

Table 2: Building Energy Intensity (BEI) Benchmarking – District Cooling System (DCS)

4. For Zero Energy Buildings, the building shall demonstrate compliance to the committed 100% net replacement through onsite and/or off-site renewable sources.

5. Positive Energy Buildings, the building shall demonstrate compliance to the committed 115% net replacement through onsite renewable sources.

6. 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.

7. Building Energy Intensity (BEI) Calculation

8. Provision of Building User Guide

<table>
<tr><th>Part 1 – Energy Efficiency</th><th>EC Credits</th></tr>
<tr><td><u>EC 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>EC 1-2 AIR-CONDITIONING SYSTEM</u>

<u>Option 1 – Fixed Metrics</u>

Applicable to air-conditioned building areas.
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>
</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</td></tr>
</table>

OR

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

Air cooled Chilled-Water Plant:

- Air-Cooled Chiller
- Chilled Water Pump

Unitary Air-Conditioners:

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

Baseline	Building Cooling Load	
	< 500 RT	≥ 500 RT
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-conditioned system with unitary air-conditioned system, the computation for the credits scored will be pro-rated based on the air-conditioning system aggregate capacity.

Credit scored = 0.35 x (% improvement)

(up to 20 credits)

OR

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

Building cooling load ≤500RT

14 credits for achieving plant efficiency of 1.1 kW/ton

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

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)

<table>
<tr>
<td>
(c) Air Distribution system:
• Air Handling units (AHUs)
• Fan Coil Units (FCUs)
Fan System Input Power
Baseline: ASHRAE 90.1:2010 Clause 6.5.3.1 and as prescribed below;
<table>
<tr><td rowspan="2">Baseline
Air Distribution System Type</td><td colspan="2">Allowable Fan System Input Power</td></tr>
<tr><td>(kW/m³/s)</td><td>(W/CMH)</td></tr>
<tr><td>AHUs / FCUs ≥ 4kW
(Constant Volume)</td><td>1.5</td><td>0.42</td></tr>
<tr><td>AHUs ≥ 4kW
(Variable Volume)</td><td>2.1</td><td>0.58</td></tr>
<tr><td>Fan systems with nameplate motor power < 4kW</td><td>0.6</td><td>0.17</td></tr>
</table>
Note (3): For buildings using district cooling system, there is no need to compute the plant efficiency under Part 1-2 (a) and (b). The credits obtained will be pro-rated based on the air distribution system efficiency under Part 1-2(c).

(d) Provision of permanent measuring instruments for monitoring of water-cooled chilled water plant and air-cooled chilled water plant efficiency. The installed instrumentation shall have the capability to calculate resultant plant efficiency (i.e., kW/RT) within 5% of its true value and in accordance with ASHRAE Guide 22 and AHRI 550/590. The following instrumentation and installation are also required to be complied:
• Location and installation of the measuring devices to meet the manufacturer's recommendation.
• Data acquisition system to have a minimum resolution of 16 bit.
• All data logging with capability to trend at 1minute sampling time interval.
</td>
<td>
(c) Air Distribution system:

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

Credits scored = 0.15 x (% improvement)

(up to 8 credits)

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

2 credits
</td>
</tr>
</table>

• 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.	1 credit
(e) Verification of central water cooled chilled-water plant instrumentation: Heat Balance - substantiating test for water cooled chilled-water plant to be computed in accordance with AHRI 550/590. The operating system efficiency and heat balance to be submitted to GreenRE upon commissioning.	1 credit
(f) Provision of variable speed controls for chiller plant equipment such as chilled-water pumps and cooling tower fans to ensure better part-load plant efficiency.	1 credit
(g) Sensors or similar automatic control devices are used to regulate outdoor air flow rate to maintain the concentration of carbon dioxide. Indoor carbon dioxide acceptable range ≤700 ppm above outdoor concentration.	

Option 2 – BEI Benchmarking

i. Air-conditioning System

(a) Projects with air conditioning system

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

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

The project shall demonstrate the Building Energy Intensity (BEI) and show compliance to the table below (minimum occupancy >60% - (projection of energy consumption necessary for lower occupancy based on prescribed BEI formula):

Building Type	Silver Energy (kWh/m^2/year)	Gold Energy (kWh/m^2/year)	Platinum Energy (kWh/m^2/year)	Super Low Energy (kWh/m^2/year)
Office Building	180	135	120	90
Hotel	330	240	220	190
Retail Mall	315	230	210	160
School, University and College	145	110	100	80
School, University and College (MOE)	50	38	35	30
Hospital (Private & General)	510	375	340	300
Community Hospitals	315	230	210	185
Polyclinics	205	150	135	120
Nursing / Youth Homes	120	90	80	70

Table 1: Building Energy Intensity (BEI) Benchmarking (kwh/m2/yr)

20 credits for achieving BEI per table shown.

(b) Water-Cooled Chilled-Water Plant:

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

(b) Water-Cooled Chilled-Water Plant:

Building cooling load < 500RT

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

Credit scored = 0.3 x (% improvement)

Building cooling load ≥ 500RT

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

OR

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

Air cooled Chilled-Water Plant:

- Air-Cooled Chiller
- Chilled Water Pump

Unitary Air-Conditioners:

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

Baseline	Building Cooling Load	
	< 500 RT	≥ 500 RT
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-conditioned system with unitary air-conditioned system, the computation for the credits scored will be pro-rated based on the air-conditioning system aggregate capacity.

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

Credit scored = 0.35 x (% improvement)

(up to 8 credits)

OR

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

Building cooling load < 500RT

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

Credit scored = 0.2 x (% improvement)

Building cooling load < 500RT

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

Credit scored = 0.25 x (% improvement)

(up to 8 credits)

(d) Provision of permanent measuring instruments for monitoring of water-cooled chilled water plant and air-cooled chilled water plant efficiency. The installed instrumentation shall have the capability to calculate resultant plant efficiency (i.e., kW/RT) within 5% of its true value and in accordance with ASHRAE Guide 22 and AHRI 550/590. The following instrumentation and installation are also required to be complied: • Location and installation of the measuring devices to meet the manufacturer's recommendation. • Data acquisition system to have a minimum resolution of 16 bit. • All data logging with capability to trend at 1minute sampling time interval. • Dedicated digital power meters shall be provided for the following groups of equipment: chiller(s), chilled water pump(s), 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.	Applicable only to buildings with provision of water-cooled chilled water plants 2 credits
(e) Verification of central water cooled chilled-water plant instrumentation: Heat Balance - substantiating test for water cooled chilled-water plant to be computed in accordance with AHRI 550/590. The operating system efficiency and heat balance to be submitted to GreenRE upon commissioning.	1 credit

(f) Provision of variable speed controls for chiller plant equipment such as chilled-water pumps and cooling tower fans to ensure better part-load plant efficiency.

1 credit

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

1 credit

ii. <u>District Cooling System</u>

<u>(a) Projects with district cooling system</u>

20 credits for achieving BEI per table shown.

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

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

The project shall demonstrate the Building Energy Intensity (BEI) and show compliance to the table below (minimum occupancy >60% - (projection of energy consumption necessary for lower occupancy based on prescribed BEI formula):)

Building Type	Silver Energy (kWh/m^2/year)	Gold Energy (kWh/m^2/year)	Platinum Energy (kWh/m^2/year)	Super Low Energy (kWh/m^2/year)
Office Building	120	90	80	70
Hotel	220	150	135	120
Retail Mall	200	140	140	125
School, University and College	90	75	60	50
School, University and College (MOE)	30	25	20	15
Hospital (Private & General)	330	245	230	210
Community Hospitals	210	150	140	130
Polyclinics	130	95	90	85
Nursing / Youth Homes	75	55	55	50

Table 2: Building Energy Intensity (BEI) Benchmarking – District Cooling System (DCS)

<u>(b) Air Distribution system:</u>

(b) Air Distribution system:

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

Fan System Input Power

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

Baseline Air Distribution System Type	Allowable Fan System Input Power	
	(kW/m³/s)	(W/CMH)
AHUs / FCUs ≥ 4kW (Constant Volume)	1.5	0.42
AHUs ≥ 4kW (Variable Volume)	2.1	0.58
Fan systems with nameplate motor power < 4kW	0.6	0.17

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

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)

<table>
<tr>
<td><u>EC 1-3 NATURAL VENTILATION / MECHANICAL VENTILATION</u>

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) <u>Natural Ventilation</u>
(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) <u>Mechanical Ventilation</u>
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:
<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>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.</td>
<td>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)</td>
</tr>
<tr>
<td><u>EC 1-4 ARTIFICIAL LIGHTING</u>

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

<u>Baseline:</u> Luminance level stated in
MS 1525:2019–Energy Efficient and use of renewable energy for non-residential building - Code of Practice</td>
<td>0.25 credit for every percentage improvement in lighting power budget

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

Excluding tenant lighting provision –
(Up to 5 credits)</td>
</tr>
</table>

EC 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)
EC 1-6 VENTILATION IN COMMON AREAS Encourage the use of energy efficient of ventilation systems in the following common areas: • Toilets • Staircases • Lift Lobbies • Corridors • 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 Mechanical Vent. – 0.5 credit for each area (Up to 5 credits)
EC 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

EC 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 Building Energy Intensity (BEI) (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)
EC 1-9 ENERGY POLICY AND MANAGEMENT (a) Energy policy, energy targets and regular review with top management's commitment as part of an environmental strategy (b) To show intent, measures and implementation strategies of energy efficiency improvement plans to achieve energy target set over the next three years. Committed energy savings accrued from proposed measures should be quantified.	1 credit 1 credit

EC 1-10 RENEWABLE ENERGY Encourage the application of renewable energy sources in buildings.	5 credits for every 1% replacement of electricity (based on total electricity consumption) by renewable energy OR 3 credits for every 1% replacement of electricity (based on the total electricity consumption excluding tenant's usage) by renewable energy OR 3 credits for every 10% of roof area used for solar panels. (Up to 20 credits)
PART 1 – ENERGY EFFICIENCY CATEGORY SCORE:	(EC 1-2) x Air-conditioned Building Floor Area / Total Floor Area + (EC 1-3) x Non-Air-Conditioned Building Floor Area / Total Floor Area + (EC 1-1, EC1-4 to EC 1-10) Where: EC 1-2 = Total GreenRE credits obtained under EC 1-2 EC 1-3 = Total GreenRE credits obtained under EC 1-3 EC 1-1, EC 1-4 to EC 1-10 = Total GreenRE credits obtained under EC 1-1, EC 1-4 to EC 1-10

Option 1– Minimum Design System Efficiency (Fixed Metric)

Requirements

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

(i) For buildings using Water-Cooled Chilled Water Plant

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

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

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

For building with building cooling load of more than 500RT, the use of air cooled central chilled water plant or other unitary air-conditioners are not encouraged for Gold and Platinum ratings. In general, the system efficiency of the air cooled central chilled-water plant and other unitary air-conditioners are to be comparable with the stipulated efficiency for water-cooled central chilled-water plant. Buildings that are designed with air cooled systems and for higher GreenRE rating will be assessed on a case-by-case basis.

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

Documentary Evidences	<u>Actual Assessment:</u> • Details report from simulation software <u>Site Verification Assessment</u> • Scenario 1), based on utility bill, if the occupancy rate is low, e.g. only 20% occupancy rate, it needs to be projected to 80% to get the BEI which reflects the actual operation situation; • Scenario 2), based on the utility bills, If the actual operation hours are the same as what were used during the design stage, no adjustment required for operational hours; If fixed operational hours were used during design and they are different from actual operation hours, adjustment needs to be done based on actual operational hours

Option 2– Building Energy Intensity (BEI)

Requirements

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

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

The project shall demonstrate the Building Energy Intensity (BEI) and show compliance to the table below:

Building Type	Silver Energy (kWh/m^2/year)	Gold Energy (kWh/m^2/year)	Platinum Energy (kWh/m^2/year)	Super Low Energy (kWh/m^2/year)
Office Building	180	135	120	90
Hotel	330	240	220	190
Retail Mall	315	230	210	160
School, University and College	145	110	100	80
School, University and College (MOE)	50	38	35	30
Hospital (Private & General)	510	375	340	300
Community Hospitals	315	230	210	185
Polyclinics	205	150	135	120
Nursing / Youth Homes	120	90	80	70

Table 2: Building Energy Intensity (BEI) Benchmarking

Building Type	Silver Energy (kWh/m^2/year)	Gold Energy (kWh/m^2/year)	Platinum Energy (kWh/m^2/year)	Super Low Energy (kWh/m^2/year)
Office Building	120	90	80	70
Hotel	220	150	135	120
Retail Mall	200	140	140	125
School, University and College	90	75	60	50
School, University and College (MOE)	30	25	20	15
Hospital (Private & General)	330	245	230	210
Community Hospitals	210	150	140	130
Polyclinics	130	95	90	85
Nursing / Youth Homes	75	55	55	50

Table 3: Building Energy Intensity (BEI) Benchmarking – District Cooling System (DCS)

Documentary Evidences

Site Verification Assessment

- Scenario 1), based on utility bill, if the occupancy rate is low (below 60%), e.g. only 30% occupancy rate, it needs to be projected to 80% to get the BEI which reflects the actual operation situation;
- Scenario 2), based on the utility bills, If the actual operation hours are the same as what were used during the design stage, no adjustment required for operational hours; If fixed operational hours were used during design and they are different from actual operation hours, adjustment needs to be done based on actual operational hour

Worked Example

Example 1

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

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

Example 2:

During verification stage, if the occupancy rate is only 30%:

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

With adjusted BEI of 103.2 the project can pass the verification requirement for Super Low Energy

EC 1-1 Thermal Performance of Building Envelope-OTTV
EC 1-2 Air-Conditioning System
EC 1-3 Natural Ventilation /Mechanical Ventilation
EC 1-4 Artificial Lighting
EC 1-5 Ventilation in Carparks
EC 1-6 Ventilation in Common Areas
EC 1-7 Lifts and Escalators
EC 1-8 Energy Efficient Practices & Feature
EC 1-9 Energy Policy & Management
EC 1-10 Renewable Energy

EC 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 1525:2019.
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 (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 1525:2019 - Energy Efficiency and use of renewable energy for non-residential building – Code of Practice

EC 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.

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 1525:2019 or SS 530 & SS CP 13.

• <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 25 of MS 1525:2019 to calculate Its Coefficient of Performance (COP)

ii & iii. Chilled-water pump and condenser water pump efficiency – Refer to Clause 8.2.5 in MS 1525:2019 which states that for chilled water or condenser water pumping system operating for more than 750 hours a year, the pump efficiency shall be:

Table 21. Maximum power consumption for pumping system
<table>
<tr><th>Type of pumping system</th><th>Maximum Power consumption [W/(m3/h)]</th></tr>
<tr><td>Condenser water pump</td><td>84</td></tr>
<tr><td>Chilled water pump</td><td>97</td></tr>
</table>

• 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

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

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

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

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

- Provision of permanent measuring instruments to monitor water-cooled and air-cooled chilled water plant

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

Description	Measurement error
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%

	• 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 Option 1: Fixed Metric (a) Water-Cooled Chilled-Water 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**

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

(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)

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

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

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

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

1-2 Option 2: BEI Benchmarking

i. Projects with air conditioning system

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

Building Type	Silver Energy (kWh/m^2/year)	Gold Energy (kWh/m^2/year)	Platinum Energy (kWh/m^2/year)	Super Low Energy (kWh/m^2/year)
Office Building	180	135	120	90
Hotel	330	240	220	190
Retail Mall	315	230	210	160
School, University and College	145	110	100	80
School, University and College (MOE)	50	38	35	30
Hospital (Private & General)	510	375	340	300
Community Hospitals	315	230	210	185
Polyclinics	205	150	135	120
Nursing / Youth Homes	120	90	80	70

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

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

Table 2: Building Energy Intensity (BEI) Benchmarking (kwh/m2/yr)

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

- **Building cooling load ≥ 500RT**:

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

Credit scored = 0.35 x (% improvement)

- **Building cooling load < 500RT:**
  0.3 credit for every percentage improvement in the chiller plant efficiency better than 0.85 kW/ton

  Credit scored = 0.3 x (% improvement)

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

- **Building cooling load ≥ 500RT**:
  0.25 credit for every percentage improvement in the chiller plant efficiency better than 1.0 kW/ton

  Credit scored = 0.25 x (% improvement)

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

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

  Credit scored = 0.2 x (% improvement)

  (up to 8 credits)

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

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

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

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

ii. Project with District Cooling System

(a) 20 credits for achieving BEI per table shown

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

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

Building Type	Silver Energy (kWh/m^2/year)	Gold Energy (kWh/m^2/year)	Platinum Energy (kWh/m^2/year)	Super Low Energy (kWh/m^2/year)
Office Building	120	90	80	70
Hotel	220	150	135	120
Retail Mall	200	140	140	125
School, University and College	90	75	60	50
School, University and College (MOE)	30	25	20	15
Hospital (Private & General)	330	245	230	210
Community Hospitals	210	150	140	130
Polyclinics	130	95	90	85
Nursing / Youth Homes	75	55	55	50

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

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

Credits scored = 0.15 x (% improvement)

Documentary Evidences	<u>For 1-2 Option 1 (a) & (b) and Option 2 (b) & (c)</u> • 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. <u>For 1-2 Option 1 (c) and Option 2(ii) District Cooling (b)</u> • 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 Option 1 and Option 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 Option 1 and Option 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 Option 1 and Option 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. <u>For Option 2 (i) Air Conditioning System (a) and (ii) District Cooling system (a)</u> • 12 months of utility bill *(if the occupancy rate is low, e.g. only 20% occupancy rate, it needs to be projected to 80% to get the BEI which reflects the actual operation situation)* • BEI Calculation *(Refer example page 27)*

References	(a) MS 1525:2019 – Energy efficient and use of renewable energy for non-residential building – Code of Practice (b) SS 530 – Code of Practice for Energy Efficiency Standard for Building Services and Equipment. (c) SS CP 13 – Code of Practice for Mechanical Ventilation and Air-Conditioning in Buildings.

EC 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.

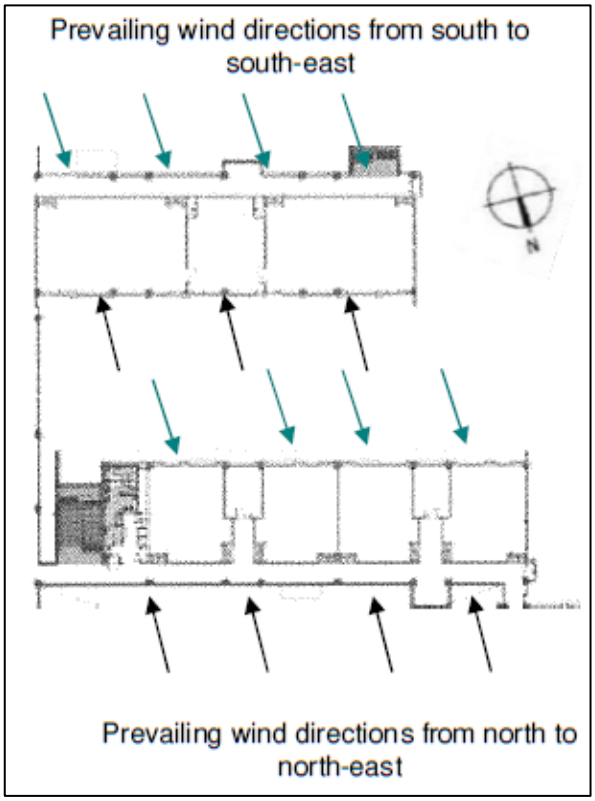
1.2 credits for every (10% of units/ rooms with window openings facing north and south directions)

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.

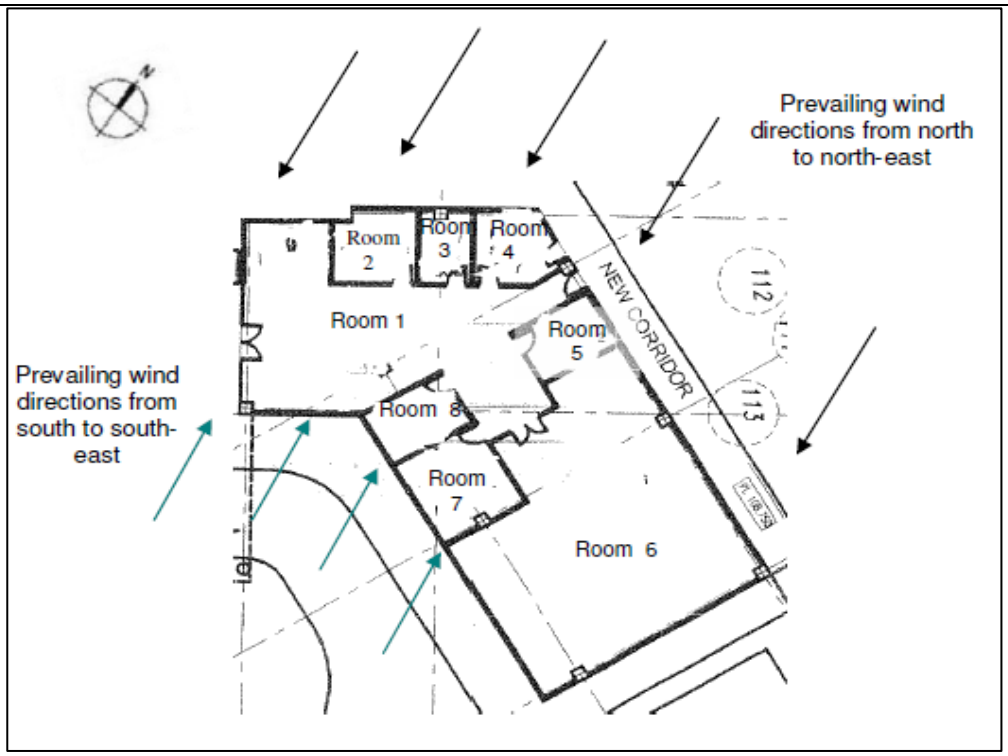
It is not necessary for the window openings to be located perpendicularly to the prevailing wind direction. Only window adjoining the habitable to be considered. Window adjoining toilets/ bathroom and store room will not be considered
An oblique angle is considered acceptable (see illustrations as shown in the next page).</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

EC 1-4 ARTIFICIAL LIGHTING

Objectives	Encourage the use of energy efficient lighting to minimize energy consumption from lighting usage while maintaining proper lighting level
Applicability	Applicable to lighting provisions that designed in accordance to the luminance level as recommended in MS 1525: 2019.
Baseline Standard	Luminance level stated in MS 1525:2019 – Energy Efficient and use of renewable energy for non-residential building – Code of Practice.
Requirements	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. 0.25 credit for every percentage improvement in the lighting provisions over the baseline standard. That is: Credits scored = 0.25 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 1525:2019 – 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 1525:2019 – Energy Efficiency and use of renewable energy for non-residential building – Code of Practice.

EC 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	-

EC 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	-

EC 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 and 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)

EC 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 Building Energy Intensity (BEI) as a building performance indicator to measure the building's unit area energy consumption for future monitoring and improvements. BEI is derived using the following equation: BEI = [(TBEC – CPEC) / (GFA excluding carpark - GLA x FVR) x (NF/OH) Where: (a) TBEC = Total building energy consumption (kWh/year) (b) CPEC = Car Park Energy Consumption in (kWh/year) (c) GFA = Gross Floor Area (exclude car park area) (m^2) (d) GLA = Gross Lettable Area (m^2) (e) FVR = Floor Vacancy Rate (NLA) (m^2) (f) NF = Normalizing factor based on a typical weekly operating hour that is 52 Hrs/week [only for office category] (g) OH = Weighted weekly operating hours (hrs/week) [only for office category] Note: 1) Design BEI is based on 100% occupancy rate for consistency. 2) All major active equipment to be included in the estimation of TBEC. 3) During verification stage, if the occupancy rate is low, e.g., only 20% occupancy rate, it needs to be projected to 80% to get the BEI which reflects the actual operation situation . 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	<u>For 1-8(a)</u> • Calculation of the Building Energy Intensity (BEI) 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 BEI calculation <u>For 1-8(b)</u> • 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. <u>For 1-8(c)</u> • 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	-

EC 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	1-9(a) 1 credit for energy policy, energy targets and regular review with top management's commitment as part of an environmental strategy. 1-9(b) 1 credit 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	-

EC 1-10 RENEWABLE ENERGY

Objectives	Encourage the application of renewable energy sources in buildings.
Applicability	Includes all renewable energy sources.
Baseline Standard	-
Requirements	Up to 20 credits can be scored for the use of renewable energy. Credit scored based on % replacement of electricity by renewable energy source 5 credits for every 1% replacement of electricity (based on total electricity consumption) by renewable energy OR 3 credits for every 1% replacement of electricity (based on the total electricity consumption excluding tenant's usage) by renewable energy OR 3 credits for every 10% of roof area used for solar panels.
Documentary Evidences	• 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.
References	-