DESIGN REFERENCE GUIDE

EXISTING INDUSTRIAL FACILITIES

Version 2.0, February 2026

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1. About GreenRE

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

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2. Introduction

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

The intent of this Design Reference Guide for Existing Industrial Facilities (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
1.0	Issued for Implementation	22nd November 2018
1.1	Issued for Implementation	June 2023
1.1	Revised for Implementation	January 2024
1.2	Revised for Implementation	May 2025
2.0	Revised for Implementation	February 2026

4. GreenRE Assessment Stages

The GreenRE Existing Industrial Facilities certification process is as follows:

Application

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

Pre-Assessment

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

Actual Assessment

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

Site Verification

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

5. GreenRE Existing Industrial Facilities Rating System

OVERVIEW:

The Existing Industrial Facilities Rating System is applicable to buildings that meet the following criteria:

- The building has been in completed for more than one (1) year; and
- The building maintains an occupancy rate of more than 60%

These conditions ensure that sufficient operational data is available to support a meaningful assessment of the building's performance under the rating system.

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

1. **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.
2. **Part 2** – Water Efficiency: This category focuses on the selection of fittings and strategies enabling water use efficiency during construction and building operation.
3. **Part 3** – Sustainable Operation & Management: This category focuses on the sustainability of operation and management that would reduce the environmental impacts upon building operation.
4. **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.
5. **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.
6. **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 EIND 1-13 – On-Site Energy Generation).

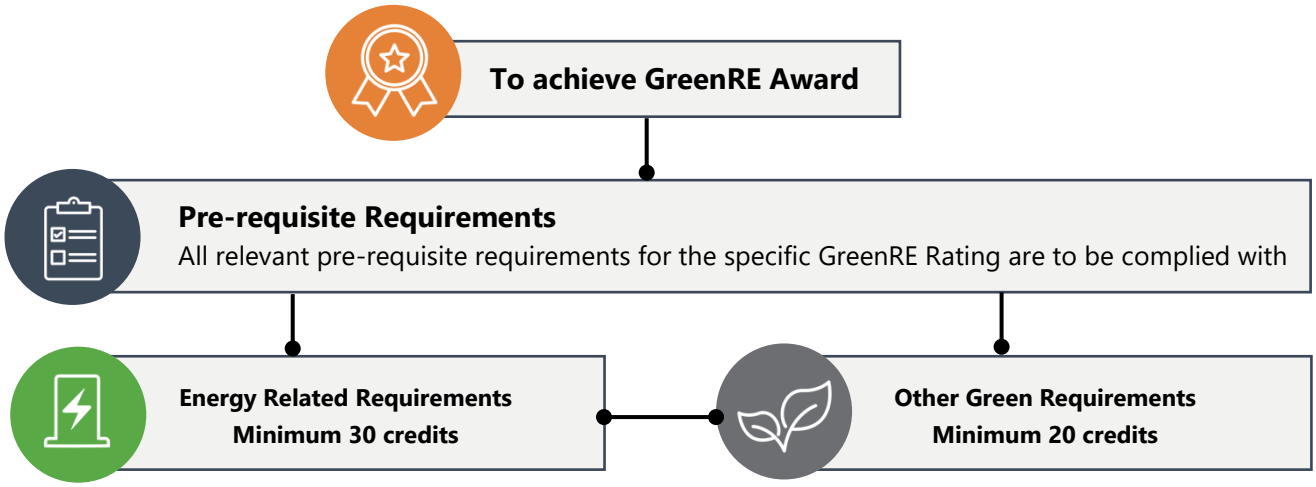
Other Green Requirements consist of Part 2 – Water Efficiency; Part 3 – Sustainable Operation & Management; Part 4 – Indoor Environmental Quality; Part 5 – Other Green Features and Part 6: Carbon Emission of Development. Credits are allocated for the water efficient features, environmentally friendly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

This design guide is to be read in conjunction with Existing Non-Residential Building toolkit.

Framework for Existing Industrial Facilities (EIND):



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

PART 1 - ENERGY EFFICIENCY

EIND 1-1 Thermal Performance of Building Envelope - OTTV
EIND 1-2 Air-Conditioning System
EIND 1-3 Natural Ventilation /Mechanical Ventilation
EIND 1-4 Artificial Lighting
EIND 1-5 Lighting Zoning
EIND 1-6 Ventilation in Carparks
EIND 1-7 Ventilation in Common Areas
EIND 1-8 Vertical Transportation Efficiency
EIND 1-9 Electrical Services
EIND 1-10 Local Energy Generation for Centralised Service Hot Water Heating
EIND 1-11 Energy Efficient Practices & Features
EIND 1-12 Energy Policy & Management
EIND 1-13 On-site Energy Generation

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

PART 2 - WATER EFFICIENCY

EIND 2-1 Water Usage and Leak Detection
EIND 2-2 Water Efficient Fittings
EIND 2-3 Alternative Water Sources
EIND 2-4 Water Efficiency Improvement Plans
EIND 2-5 Irrigation System and Landscaping
EIND 2-6 Water Consumption of Cooling Towers

PART 3 – SUSTAINABLE OPERATIONS & MANAGEMENT

EIND 3-1 Building Operation & Maintenance
EIND 3-2 EE Monitoring & Maintenance
EIND 3-3 Post Occupancy Evaluation
EIND 3-4 Waste Management
EIND 3-5 Sustainable Products
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EIND 4-1 Indoor Air Quality Performance
EIND 4-2 Indoor Air Pollutants
EIND 4-3 Lighting Quality
EIND 4-4 Thermal Comfort
EIND 4-5 Noise Level

PART 5 – OTHER GREEN FEATURES

EIND 5-1 Green Features & Innovations

PART 6 – CARBON EMISSION OF DEVELOPMENT

EIND 6-1 Carbon Emission of Development

CREDIT ALLOCATION:

Category		Credits Allocations
(I) Energy Related Requirements		
Minimum 30 credits	**Part 1: Energy Efficiency**	
	EIND 1-1 Thermal Performance of Building Envelope-OTTV	5
	EIND 1-2 Air-Conditioning System (Applicable to air-conditioned areas)	33
	EIND 1-3 Natural Ventilation / Mechanical Ventilation (Applicable to non air-conditioned areas excluding carparks and common areas)	32
	EIND 1-4 Artificial Lighting	10
	EIND 1-5 Lighting Zoning	3
	EIND 1-6 Ventilation in Carparks	2
	EIND 1-7 Ventilation in Common Areas	5
	EIND 1-8 Vertical Transportation Efficiency	1
	EIND 1-9 Electrical Services	7
	EIND 1-10 Local Energy Generation for Centralised Service Hot Water Heating	6
	EIND 1-11 Energy Efficient Practices & Features	10
	EIND 1-12 Energy Policy & Management	1
	EIND 1-13 Renewable Energy	15
	Category Score for Part 1 – Energy Efficiency	**97**
(II) Other Green Requirements		
Minimum 20 credits	**Part 2: Water Efficiency**	
	EIND 2-1 Water Usage and Leak Detection System	4
	EIND 2-2 Water Efficient Fittings	6
	EIND 2-3 Alternative Water Sources	3
	EIND 2-4 Water Efficiency Improvement Plans	1
	EIND 2-5 Irrigation System and Landscaping	3
	EIND 2-6 Water Consumption of Cooling Towers	2
	Category Score for Part 2 – Water Efficiency	**19**
	Part 3: Sustainable Operations & Management	
	EIND 3-1 Building Operation & Maintenance	5
	EIND 3-2 EE Monitoring & Maintenance	3
	EIND 3-3 Post Occupancy Evaluation	3
	EIND 3-4 Waste Management	5
	EIND 3-5 Sustainable Products	8
	EIND 3-6 Greenery Provision	8
	EIND 3-7 Environmental Protection	3
	EIND 3-8 Green Transport	5
	Category Score for Part 3 – Sustainable Operations & Management	**40**
	Part 4: Indoor Environmental Quality	
	EIND 4-1 Indoor Air Quality Performance	8
	EIND 4-2 Indoor Air Pollutants	3
	EIND 4-3 Lighting Quality	3
	EIND 4-4 Thermal Comfort	2
	EIND 4-5 Internal Noise Level	2
	Category Score for Part 4: Indoor Environmental Quality	**18**
	Part 5: Other Green Features	
	EIND 5-1 Green Features & Innovations	10
	Category Score for Part 5: Other Green Features	**10**
	Part 6: Carbon Emission of Development	
	EIND 6-1 Carbon Emission of Development	2
	Category Score for Part 6: Carbon Emission of Development	2
	Category Score for Part 2 to Part 6 – Other Green Requirements	**89**
	GreenRE Existing Industrial Facility Score:	**186 (MAX)**

6. GreenRE Existing Industrial Facilities Rating System Scoring

			
Score: 91 and above	Score: 86 to ≤ 90	Score: 76 to ≤ 85	Score: 50 to ≤ 75
GreenRE Platinum	**GreenRE Gold**	**GreenRE Silver**	**GreenRE Bronze**

7. GreenRE Existing Industrial Facilities System Criteria

PRE-REQUISITE

Part 1 – Energy Efficiency

ENERGY EFFICIENCY

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

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.

Building Energy Intensity (BEI) calculation, proper submetering is essential. Projects must ensure that energy consumption is accurately tracked through dedicated submeters.

Provision of Building User Guide and Sustainable Operation Management Guide

Part 4 – Indoor Environmental Quality

INDOOR ENVIRONMENTAL QUALITY

A formal IAQ management plan must be established and implemented to ensure a healthy indoor environment for all occupants. The policy should outline procedures for maintaining acceptable indoor air quality, including ventilation, pollutant source control, and regular maintenance of HVAC systems. The policy should contain at least the following:

- **Ventilation Management:** Ensure adequate ventilation rates in accordance with recognized standards (e.g., ASHRAE 62.1 or local equivalents) to dilute indoor pollutants and maintain fresh air supply.
- **Pollutant Source Control:** Identify and minimize sources of indoor air contaminants, including volatile organic compounds (VOCs), particulate matter, and biological pollutants. This includes the selection of low-emission materials and proper storage of chemicals.
- **HVAC System Maintenance:** Establish a routine inspection and maintenance schedule for HVAC systems to ensure optimal performance, cleanliness, and efficiency. Filters should be replaced regularly, and air ducts cleaned as needed.
- **Monitoring and Response:** Implement procedures for periodic IAQ monitoring and establish a response procedure for occupant complaints or IAQ-related incidents.
- **Occupant Awareness:** Promote awareness and education among building users regarding IAQ practices, including the importance of reporting issues and maintaining cleanliness.

Part 1

Energy Efficiency

Part 1 – Energy Efficiency

EIND 1-1 THERMAL PERFORMANCE OF BUILDING ENVELOPE - OTTV	GREENRE CREDITS
Enhance the overall thermal performance of building envelope to minimize heat gain thus reducing the overall cooling load requirement. Baseline: Maximum permissible OTTV = 50 W/m2	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)

EIND 1-2 AIR-CONDITIONING SYSTEM	GREENRE CREDITS
Option 1 – Fixed Metrics Applicable to Air-conditioned Building Areas (with an aggregate air-conditioned area > 1000m2) Encourage the use of better efficiency air-conditioned equipment to minimize the energy consumption. (System efficiency in kW/ton)	

a. Water-Cooled Chilled-Water Plant:
   i. Water-Cooled Chiller
   ii. Chilled water pump
   iii. Condenser water pump
   iv. Cooling tower

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

a. Water-Cooled Chilled-Water Plant

Building cooling load < 500 RT

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

Credits scored = 0.3 x (%improvement)

Building cooling load ≥ 500 RT

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
- 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.

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

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

Building cooling load < 500 RT

14 credits for achieving plant efficiency of 1.1 kW/ton

0.2 credits for every percentage improvement in the chiller plant efficiency 1.1 kW/ton

Credits scored = 0.2 x (% improvement)

Building cooling load ≥ 500 RT

14 credits for achieving plant efficiency of 1.0 kW/ton

0.25 credits for every percentage improvement in the chiller plant efficiency 1.0 kW/ton

Credits scored = 0.25 x (% improvement)

(Up to 20 credits)

Option 2 – Energy Savings

a. Energy savings from Business as Usual (BAU) pre-retrofit and verified post-retrofit via energy modelling or on-site measurements to demonstrate the following:

Energy Savings (including process load):

GreenRE Rating	Energy Saving Required (%)
Bronze	5
Silver	15
Gold	25
Platinum	30

Energy Savings (excluding process load):

GreenRE Rating	Energy Saving Required (%)
Bronze	15
Silver	25
Gold	45
Platinum	50

To show the energy savings one (1) year pre-retrofit and six (6) months post-retrofit via on site measurements.

14 credits for achieving energy savings stipulated.

a. Water-Cooled Chilled-Water Plant:

Building cooling load < 500 RT

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

Credits scored = 0.3 x (% improvement)

Building cooling load ≥ 500 RT

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

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

Building cooling load < 500 RT

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 ≥ 500 RT

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 20 credits)

c. Air Distribution system:

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

Baseline – Fan power limitation in air conditioning system

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 (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).

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. 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 of measuring devices to be reviewed by competent person or engineer to ensure accuracy of measurements. Installation of sensors to be performed in accordance to manufacturer's recommendations.
- 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 (minimum four (4) sensors; two (2) for supply and return at chilled water header and similarly two (2) for condenser water header). 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 one (1) spare thermo-wells located at at either side of the temperature sensor for verification of measurement accuracy.

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
EIND 1-3 NATURAL VENTILATION / MECHANICAL VENTILATION	**GREENRE CREDITS**
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 utilizes prevailing wind conditions to achieve adequate cross ventilation.	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)
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:	0.6 credit for every subsequent 1% improvement from the baseline (Up to 32 credits)

Allowable nameplate motor power	
Nameplate motor power > 4kW	Nameplate motor power < 4kW
0.32 W/CMH	0.17 W/CMH

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.

EIND 1-4 ARTIFICIAL LIGHTING	GREENRE CREDITS
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	0.20 credit for every percentage improvement in lighting power budget Credit scored = 0.20 x (% improvement) (Up to 10 credits)

EIND 1-5 LIGHTING ZONNING	GREENRE CREDITS
a. Lighting zones to not exceed 100m^2 for 90% of the occupied areas with controls clearly labelled and accessible for occupants.	1 credit
b. To use photocell and / or motion sensors in the following areas (>90% of spaces):	
Circulation areas (staircases and corridors)	1 credit
Transient spaces (lift lobbies, atrium, toilets)	1 credit

EIND 1-6 VENTILATION IN CARPARKS	GREENRE CREDITS
Encourage the use of energy efficient design and control of ventilation systems in carparks.	
a. Carparks designed with natural ventilation	Naturally Ventilated Carparks - 2 credits
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.	Credits scored based on the mode of mechanical ventilation provided: Fume extract -1 credit MV with or without supply -1 credit (Up to 2 credits)

EIND 1-7 VENTILATION IN COMMON AREAS	GREENRE CREDITS
Encourage the use of energy efficient of ventilation systems in the following common areas: • Toilets • Staircases (Include BOMBA Staircase) • 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)

EIND 1-8 VERTICAL TRANSPORTATION EFFICIENCY	GREENRE CREDITS
Encourage the use of lift with energy efficient features such as sleep mode or regenerative features and motorless lift.	Extent of Coverage: All lifts 1 credit

EIND 1-9 ELECTRICAL SERVICES	GREENRE CREDITS
Encourage the provision of better energy efficient service transformers, UPS and related controls of energy monitoring.	
a. Energy Use and Sub-metering Promote energy use monitoring with sub-metering to facilitate building operations, and to allow engagement of building occupants. I. Separately meter either i. Substantial energy uses such as space cooling, domestic hot water, ventilation, lighting and plug loads **OR** ii. High energy load and process areas II. And link all energy sub-meters to BMS, EMS or other automated system	2 credits
b. Provision of low-loss service transformers Efficiency of service transformers to meet the requirements of MS-1525.	2 credits
c. Provision of energy-efficient UPS (uninterrupted power supply)	All UPS operating in the following systems must meet the minimum efficiency: i. Double conversion on-line mode

	UPS Range (kVA)				
	≥5 to <10	10 to <20	20 - <40	40 - <200	≥200
25% load	82.5%	86.5%	87.5%	89.0%	90.0%
50% load	85.0%	91.0%	91.5%	92.0%	92.5%
75% load	87.0%	92.0%	92.5%	93.0%	93.5%
100% load	87.0%	92.0%	92.5%	93.0%	93.5%

ii. Line interactive or ECO mode

	UPS Range (kVA)				
	≥5 to <10	10 to <20	20 - <40	40 - <200	≥200
25% load	85.5%	90%	91%	91.5%	93%
50% load	91.5%	93%	93.5%	94%	95.5%
75% load	92.5%	93.5%	94%	94.5%	96%
100% load	94%	96.5%	97%	97.5%	98%

iii. Stand-by mode

	UPS Range (kVA)				
	≥5 to <10	10 to <20	20 - <40	40 - <200	≥200
25% load	90%	94%	94.5%	95%	95.5%
50% load	93%	96%	96.5%	97%	97.5%
75% load	94%	96.5%	97%	97.5%	98%
100% load	94%	96.5%	97%	97.5%	98%

The credits awarded will be based on the aggregated kVA meeting the minimum efficiency as a proportion to the total installed kVA for UPS rated ≥ 5 kVA

(Up to 3 credits for IND 1-9 (c))

EIND 1-10 LOCAL ENERGY GENERATION FOR CENTRALISED SERVICE HOT WATER HEATING	GREENRE CREDITS
Promote local energy generation from renewable sources or waterside energy recovery to meet service hot water heating demand in industrial facilities:	
a. Solar Thermal Hot Water System The solar thermal hot water system must meet minimum Solar Fraction (SF) of 0.5 or Solar Energy Factor (SEF) of 2.	
b. Heat Pumps The heat pump meeting minimum heating COP of 3.5 under the standard testing conditions as follows: • Heating water from 15°C to 55°C • Air source heat of 20°C dry bulb/15°C wet bulb for air-to-water heat pump • Water source heat of 15°C for water-to- water heat pump	2 credits for every 30% of service hot water needs catered by local energy generation. (up to 6 credits)
c. Combined Heat and Power (CHP) System The CHP system such as co-generation or tri-generation must meet the minimum Effective Electrical Efficiency as follows: -	
d. Photovoltaic Thermal (PV/T) or other low and zero carbon technology hot water systems	

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

EIND 1-11 ENERGY EFFICIENT PRACTICES & FEATURES	GREENRE CREDITS
Encourage the use of energy efficient practices and features which are innovative and/or have positive environmental impact.	
a. To create an energy breakdown of entire facility to indicate major energy consumers within the facility and to calculate Building Energy Intensity (BEI). Formula to be standardized as follows: BEI = [(TBEC – CPEC) / (GFA excluding carpark - GLA x FVR) Where: TBEC = Total building energy consumption excluding renewable energy replacement (kWh/year) CPEC = Car Park Energy Consumption in (kWh/year) GFA = Gross Floor Area (exclude car park area) (m^2) GLA = Gross Lettable Area (m^2) FVR = Floor Vacancy Rate (NLA) (m^2)	1 credit

b. To benchmark process loads within the facility against industry norms and demonstrate savings. **Process loads within the facility** **Percentage savings compared to industry norms** • For process loads < 25% of Total Building Energy Consumption (TBEC) 10% - 1 credit 20% - 2 credits >30% - 3 credits • For process loads < 50% of Total Building Energy Consumption (TBEC) 10% - 2 credit 20% - 4 credits >30% - 6 credits • For process loads ≥ 50% of Total Building Energy Consumption (TBEC) 10% - 3 credit 20% - 6 credits >30% - 9 credits	Up to 9 credits

EIND 1-12 ENERGY POLICY AND MANAGEMENT	GREENRE CREDITS
a. Energy policy, energy targets and regular review with top management's commitment as part of an environmental strategy	0.5 credit
b. To show intent, measures and implementation strategies of energy efficiency improvement plans to achieve energy target set over the next three years. Committed energy savings accrued from proposed measures should be quantified.	0.5 credit

EIND 1-13 ON-SITE ENERGY GENERATION	GREENRE CREDITS
Encourage on-site energy generation through renewable energy or energy recovery / regeneration:	5 credits for every 1% replacement of electricity (based on total electricity consumption) **OR** 2 credits for every 10% of roof area used for solar panels. Note: The credit scored for renewable energy provision shall not result in a double grade jump in GreenRE rating (i.e from GreenRE Bronze or Silver to Gold or Platinum) (Up to 15 credits)
PART 1 – ENERGY EFFICIENCY CATEGORY SCORE:	$(\text{EIND 1-2}) \times \frac{\text{Air-conditioned Building Floor Area}}{\text{Total Floor Area}} + (\text{EIND 1-3}) \times \frac{\text{Non Air-Conditioned Building Floor Area}}{\text{Total Floor Area}} + (\text{EIND 1-1, EIND 1-4 to EIND 1-13})$ Where: EIND 1-2 = Total GreenRE credits obtained under EIND 1-2 EIND 1-3 = Total GreenRE credits obtained under EIND 1-3 EIND 1-1, EIND 1-4 to EIND 1-13 = Total GreenRE credits obtained under EIND 1-1, EIND 1-4 to EIND 1-13

Part 2

Water Efficiency

Part 2 – Water Efficiency

EIND 2-1 WATER USAGE AND LEAK DETECTION	GREENRE CREDITS
Provide sub-metering and leak detection system for better control and monitoring	
a. To monitor the water consumption on monthly basis	1 credit
b. Provision of sub-meters for major water uses (e.g., cooling tower, water features, irrigation, swimming pools, tenants' usage and the non-portable water replacement system)	1 credit
c. Provision of automated / smart metering for monitoring and leaking detection	2 credits

EIND 2-2 WATER EFFICIENT FITTINGS	GREENRE CREDITS
Encourage the use of water efficient fittings under Water Efficiency Product Labelling Scheme (WEPLS) or Water Efficiency Labelling Scheme (WELS). • Basin taps and mixers • Shower taps and mixers or showerheads • Sink/Bib taps and mixers • Urinals and Urinal Flush Valves • Dual flushing cistern for WC • Other water fittings (e.g., Ablution taps and mixers)	

Weightage Based on Water Efficiency Products Labelling Scheme (WEPLS)		
Efficient *	Highly Efficient **	Most Efficient ***
2	4	6

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

(Up to 6 credits)

EIND 2-3 ALTERNATIVE WATER SOURCES	GREENRE CREDITS
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.	Credits awarded based on % reduction in total potable water usage of the applicable uses > 50 % — 3 credits ≥ 10 % to 50 % — 2 credits < 10 % — 1 credit (Up to 3 credits)

EIND 2-4 WATER EFFICIENCY IMPROVEMENT PLANS	GREENRE CREDITS
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.	1 credit

EIND 2-5 IRRIGATION SYSTEM AND LANDSCAPING	GREENRE CREDITS
Reduce potable water consumption for irrigation and landscaping.	
a. Use of non-potable water including rainwater for landscape irrigation	1 credit
b. Use of automatic water efficient irrigation system with rain sensor, soil moisture sensor or equivalent control system.	Extent of Coverage: At least 50% of the landscape areas are served by the system 1 credit
c. Use of drought tolerant plants that require minimal irrigation.	Extent of Coverage: At least 80% of the landscape areas 1 credit

EIND 2-6 WATER CONSUMPTON OF COOLING TOWERS	GREENRE CREDITS
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.	1 credit
b. Use of recycled water from approved sources for cooling purpose.	1 credit
PART 2 – WATER EFFICIENCY CATEGORY SCORE :	Sum of GreenRE credits obtained from EIND 2-1 to 2-6

Part 3

Sustainable Operations & Management

Part 3 – Sustainable Operations & Management

EIND 3-1 BUILDING OPERATION & MAINTENANCE	GREENRE CREDITS
a. The environmental policy that reflects the sustainability goals set.	1 credit
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
c. In-house building management team comprises one Certified GreenRE Accredited Professional (GREAP) / Green Mark Manager (GM)	1 credit
d. Project team comprises one Certified GreenRE Accredited Professional (GREAP) / Green Mark Manager (GM)	1 credit
e. The environmental management system of the building is ISO14000 or ISO 50001 certified.	1 credit

EIND 3-2 EE MONITORING AND MAINTENANCE	GREENRE CREDITS
a. To conduct (or have conducted in last two (2) years an energy audit of facilities by ST approved auditor.	2 credits
b. Use BMS / EMS to monitor and trend log energy consumption for building and process loads.	1 credit

EIND 3-3 POST OCCUPANCY EVALUATION	GREENRE CREDITS
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

EIND 3-4 WASTE MANAGEMENT	GREENRE CREDITS
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	1 credit
c. Provide the proper storage area for the recyclable waste	1 credit
d. To quantify and monitor the recycling programme for continuous improvement.	1 credit

EIND 3-5 SUSTAINABLE PRODUCTS

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.

GREENRE CREDITS

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

Credits scored

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

(Up to 8 credits)

EIND 3-6 GREENERY PROVISION

GREENRE CREDITS

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).

GnPR	Credits Allocation
1.0 to < 2.0	1
2.0 to < 3.0	2
3.0 to < 4.0	3
4.0 to < 5.0	4
5.0 to < 6.0	5
≥ 6.0	6

b. Restoration of trees on site, conserving or relocating of existing trees on site.

1 credit

c. Use of compost recycled from horticulture waste.

1 credit

EIND 3-7 ENVIRONMENTAL PROTECTION	GREENRE CREDITS
a. Green procurement policy – Adoption of sustainable and environmental-friendly procurement and purchasing policy in the operation and maintenance of the building.	1 credit
b. Reduce the potential damage to the ozone layer and the increase in global warming through the release of ozone depleting substances and greenhouse gases.	
• Refrigerants with ozone depletion potential (ODP) of zero or with global warming potential (GWP) of less than 100.	1 credit
• Use of refrigerant leak detection system at critical areas of plant rooms containing chillers and other equipment with refrigerants.	1 credit

EIND 3-8 GREEN TRANSPORT	GREENRE CREDITS
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.	1 credit
b. Shuttle service for facility employees.	1 credit
c. Project is accessible from major highway outlets and / or within close proximity to major cargo services (i.e airport, seaport, railway stations). Project to be within 10km of these facilities.	1 credit

d. Provision of hybrid/electric vehicle charging stations and priority parking lots within the development.	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)
e. Provision of covered / sheltered bicycles parking lots with adequate shower and changing facilities.	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 EIND 3-1 to 3-8

Part 4

Indoor Environmental Quality

Part 4 – Indoor Environmental Quality

EIND 4-1 INDOOR AIR QUALITY PERFORMANCE	GREENRE CREDITS
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).	4 credits
b. Implement effective IAQ management plan to ensure building ventilation systems are frequently maintained to ensure clean delivery of air.	1 credit
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	1 credit
d. Room Temperature display (at least 1 unit per floor)	1 credit
e. Additional carbon dioxide sensor display (at least 1 unit per floor)	1 credit

EIND 4-2 INDOOR AIR POLLUTANTS	GREENRE CREDITS
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.	1 credit

b. Use of environmental friendly adhesives certified by approved local certification body.	1 credit
c. Use of environmentally friendly cleaning products for general maintenance.	1 credit

EIND 4-3 LIGHTING QUALITY	GREENRE CREDITS
To encourage good workplace lighting quality to promote productivity and occupant's comfort	
a. Lighting level to comply with MS1525:2014	1 credit
b. High frequency ballast OR use of driver with output frequency < 200Hz and < 30% flicker for LED lighting.	All applicable areas in the entire building that are served by fluorescent / LED lighting. 20% to < 40% — 0.5 credit 40% to < 60% — 1 credit 60% to < 80% — 1.5 credits 80% and above — 2 credits (Up to 2 credits)

EIND 4-4 THERMAL COMFORT	GREENRE CREDITS
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%	1 credit
b. Controllability of temperature.	1 credit

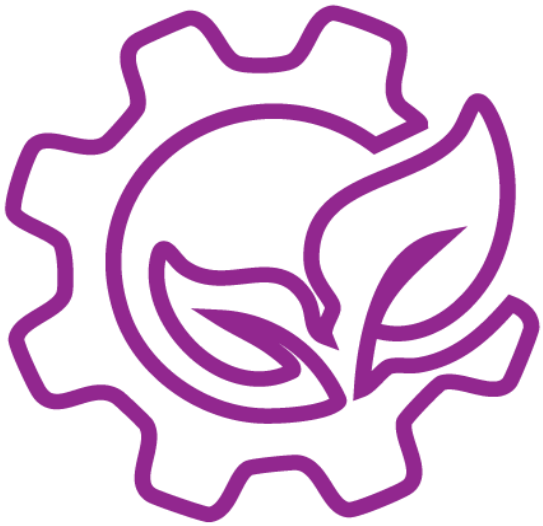
<table>
<tr><th>EIND 4-5 INTERNAL NOISE LEVEL</th><th>GREENRE CREDITS</th></tr>
<tr><td>For office and process areas:

Demonstrate acoustic performance of internal partitions as follows:

<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>

and / or</td><td>1 credit</td></tr>
<tr><td>For process areas:

To make efforts to reduce noise pollution to external environment. Building / plant envelope is designed to reduce noise by NR20dBA in standard operation.</td><td>1 credit</td></tr>
<tr><td>PART 4 – INDOOR ENVIRONMENTAL QUALITY CATEGORY SCORE:</td><td>Sum of GreenRE credits obtained from EIND 4-1 to 4-5</td></tr>
</table>

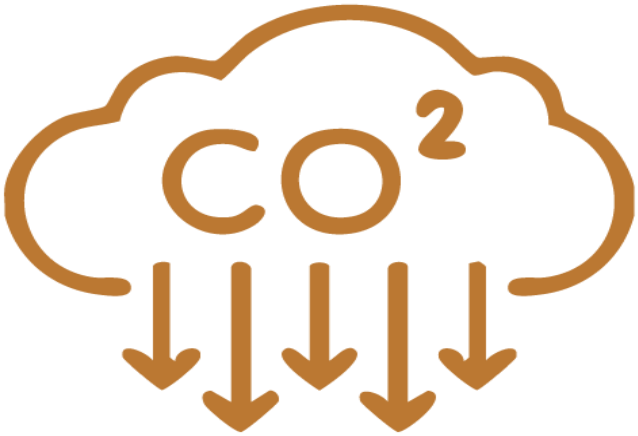


Part 5

Other Green Features

Part 5 – Other Green Features

EIND 5-1 GREEN FEATURES AND INNOVATIONS	GREENRE CREDITS
To encourage the use of other green features which are innovative or/and have positive environmental impact.	2 credits for high impact item 1 credit for medium impact item 0.5 credit for low impact item (Up to 10 credits)
Examples:	
• Vertical greening	
• 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 odor in toilets	
• Use of pneumatic waste collection system	
• Use of double refuse chutes for separating recyclable from non-recyclable waste	
Part 5 – OTHER GREEN FEATURES QUALITY CATEGORY SCORE	Sum of GreenRE credits obtained from EIND 5-1



Part 6

Carbon Emission of Development

Part 6 – Carbon Emission of Development

EIND 6-1 CARBON EMISSION OF DEVELOPMENT	GREENRE CREDITS
a. Recognize the carbon emission based on operational carbon footprint computation of the building comprising energy [B6] and water consumption [B7].	1 credit
b. Calculation of product stage embodied carbon based on following building materials [A1-A3]: • concrete • steel • bricks • cement • Metal and Aluminium	1 credit
PART 6 – CARBON EMISSION OF DEVELOPMENT CATEGORY SCORE:	Sum of GreenRE credits obtained from EIND 6-1

GreenRE Score (Existing Industrial Facility)

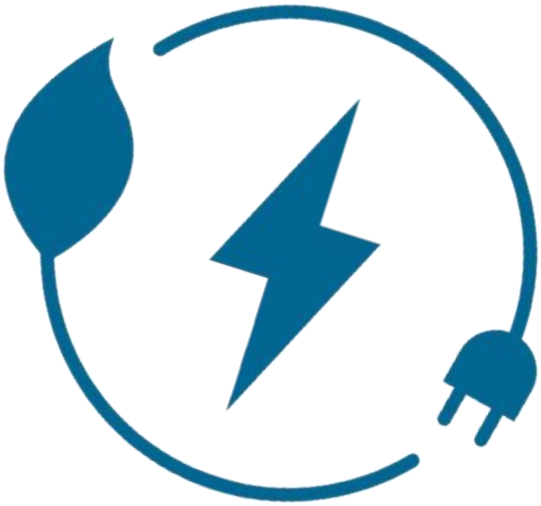
GreenRE Score (EIND) = ∑Category score [(Part 1-Energy Efficiency) +
(Part 2-Water Efficiency) +
(Part 3-Sustainable Operation & Management) +
(Part 4-Indoor Environmental Quality) +
(Part 5-Other Green Features) +
(Part 6-Carbon Emission of Development)]

Where:

Category Score for Part 1≥ 30 credits and

∑Category score for Part 2, 3, 4, 5 & 6 ≥ 20 credits

Energy Efficiency Compliance



Option 1 – Fixed Metric

Option 2 – Energy Saving Requirement

OPTION 1 – 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 & Platinum, the project also needs to provide the permanent measuring instruments for monitoring of water-cooled chilled-water system and air-cooled chilled water system operating system efficiency. The installed instrumentation shall have the capability to calculate resultant plant operating system efficiency (i.e., kW/RT) within 5% of its true value and in accordance with ASHRAE Guide 22 and AHRI 550/590. Heat balance test for water-cooled chilled water system is required for verification of the accuracy of the Measurement and Verification (M&V) instrumentation.

DOCUMENTARY EVIDENCES

Actual Assessment:

- Details report from simulation software

Site Verification Assessment:

- Scenario 1), based on utility bill, if the occupancy rate is low, e.g. only 20% occupancy rate, it needs to be projected to 80% to get the 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 – ENERGY SAVING REQUIREMENT

REQUIREMENTS

Energy savings from Business as Usual (BAU) pre-retrofit and verified post-retrofit via energy modelling or on-site measurements to demonstrate the following:

I. Energy Saving (Including process load):

GreenRE Rating	Energy Saving Required (%)
Silver	5
Silver	15
Gold	25
Platinum	30

II. Energy Saving (Not Including process load):

GreenRE Rating	Energy Saving Required (%)
Bronze	15
Silver	25
Gold	45
Platinum	50

To show the energy saving 1 year before pre-retrofit and 1-year post-retrofit via on site measurements.

Sub-meters are required to capture the annual consumption of data centre and car park lighting and mechanical ventilation. Separate meters shall be provided during design stage to record the annual energy consumption generated by renewable energy e.g. solar photovoltaic (PV) and energy savings claimed by energy saving devices, e.g. escalators, lifts, CO sensors and occupancy sensors and photo sensors. Dedicated meters shall be installed to measure the operational energy consumption and intensities of receptacle load (W/m2) of office space to verify on the energy savings claimed.

DOCUMENTARY EVIDENCES

Actual Assessment:

- At least 12 months of pre-retrofit energy consumption data
- Energy Audit report

Site Verification Assessment:

- 12 months of post retrofit energy consumption data.
- Justification of energy saving
- Breakdown of the energy consumption based on power meters reading.
- Energy audit report