



Green Mark

SLE

Super Low Energy Buildings

Copyright 2021 by Building and Construction Authority.

All rights reserved. The Green Mark Criteria may be used by individuals for reference purposes only. Any sale, modification, reproduction, display or distribution of the Green Mark Criteria or any copies thereof is not allowed without BCA's prior written consent, which may be obtained by writing to the following address or via email to bca_enquiry@bca.gov.sg.

Environmental Sustainability Group
Building and Construction Authority
52 Jurong Gateway Road
#11-01, Singapore 608550
(Above JEM)

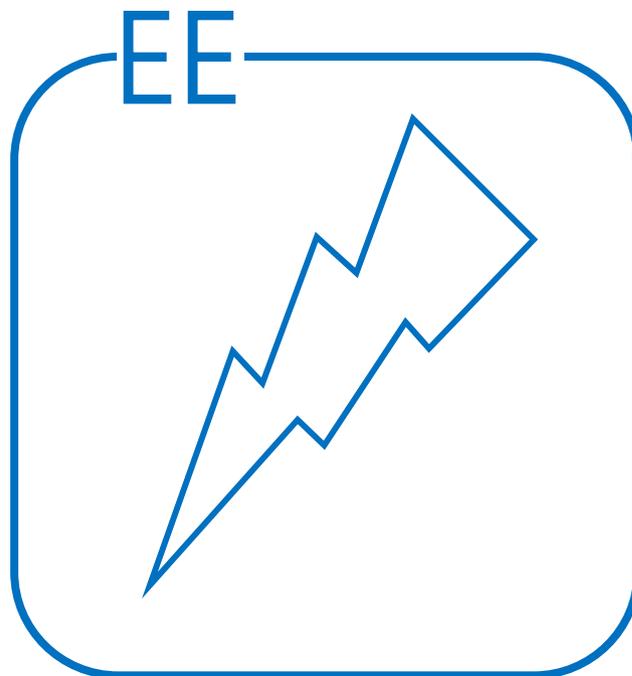
Revision	Description	Date Effective
R0	Launch for Implementation	05/09/2018
R1	<ul style="list-style-type: none">• Definition of Positive Energy Building• EUI Revision• Alignment of New and Existing Building Criteria	10/12/2020
R2	<ul style="list-style-type: none">• Addition of SLE for Residential Buildings• Development of 3 parallel EE compliance pathways• Part of GM 2021 Pilot exercise	22/04/2021
R3	<ul style="list-style-type: none">• Revision of Air-side Efficiency (DCS)• Adjustments to tables• Fully integrated as part of GM 2021 EE	1/11/2021

The Green Mark for Super Low Energy Buildings (GM SLE) is a rating tool that recognises projects that are on the path to net zero energy or have gone beyond this to be a positive energy building. The approach is aligned and been an integral part of the development of ISO draft technical standard 23764 'Approach for non-residential Zero Energy Buildings'.

GM SLE provides a robust framework for both new and existing, residential, and non-residential projects alike can utilise to push the boundaries of performance necessary in the transition to a low carbon economy within the built environment. Projects certified are in a class of their own demonstrating the highest of energy performance in design, retrofit and operation.

GM SLE is a key national lever under Singapore's Long-Term Low-Emissions Development Strategy (LEDS) aligned to meeting our international obligations under the Paris Agreement, and part of an aggressive move towards the necessary climate action within our sector.

The approach taken is aligned with Green Mark 2021 and the Energy Efficiency Section which maps performance from Gold^{PLUS} through to SLE for projects wishing to attain holistic Green Mark certification.



Green Mark 2021



Energy Efficiency

Helps projects meet targets under the following SDGs



Contents

Definition and Categories under Green Mark SLE	3
SLE and Green Mark 2021 Ecosystem.....	4
Green Mark SLE: Criteria	6
Non-Residential Buildings Details.....	
Office Buildings	9
Retail Mall.....	10
Hotels.....	11
MOE Primary and Secondary Schools.....	12
MOE Junior Colleges.....	13
Private Schools and Colleges.....	14
Institute of Higher Learning	15
Hospitals.....	16
Polyclinics.....	17
Nursing and Youth Homes	18
Industrial – High Technology	19
Light Industrial	20
Warehouses, Workshops and Other Industrial.....	21
Community Buildings.....	22
Civic Buildings	23
Cultural Institutions	24
Sports and Recreation.....	25
Religious / Places of Worship.....	26
Residential Buildings Details.....	
Residential (Non-Landed).....	28
Tables.....	
Table 1A Energy Efficiency pathways.....	30
TABLE 1B Energy Use Intensity (EUI) Quick look up table	31
TABLE 1C Energy Use Intensity (EUI) Quick look up table – DCS	32
TABLE 2A Lighting Power Budget.....	34
TABLE 2B Mechanical Ventilation_ MV	36
TABLE 3A Energy Savings Details	37

Definition and Categories under Green Mark SLE

GM SLE refers to the following 3 performance categories of buildings:

Super Low Energy Building (SLE)

The best-in-class energy performing Green Mark Building that achieve at least 60%^[1] energy savings.

[1] This refers to 60% energy saving above 2005 building codes which is being used as the anchor reference for Green Mark energy savings.

Zero Energy Building (ZE):

A super low energy (SLE) building with all energy consumption, including plug load, supplied from renewable energy sources.^[2] (both on-site and off-site).

[2] Building development should maximise the on-site renewable source first before exploring off-site renewable sources. Where the project is using REC's, these must be generated accordance with SS 673: 2021 Code of practice for renewable energy certificates through renewable energy generated within Singapore. The length of time of REC commitment is minimally three years with commitment of re-certification.

Positive Energy Building (PE):

A super low energy (SLE) building with 115% of all energy consumption, including plug load, supplied from onsite renewable energy sources

Assessment Process

The BCA Green Mark SLE Certification Process is as follows:

Application

- Submittal of application with relevant supporting documents for certification upon finalisation of building design.
- Upon acceptance of application and fee payable, a BCA Green Mark Assessor will be assigned for the duration of the project.

Assessment

- To be conducted when design and documentary evidences are ready.
- Comprises design and documentary reviews to verify if the building project meets the intents of the criteria.
- A presentation to BCA panel for evaluation is required.

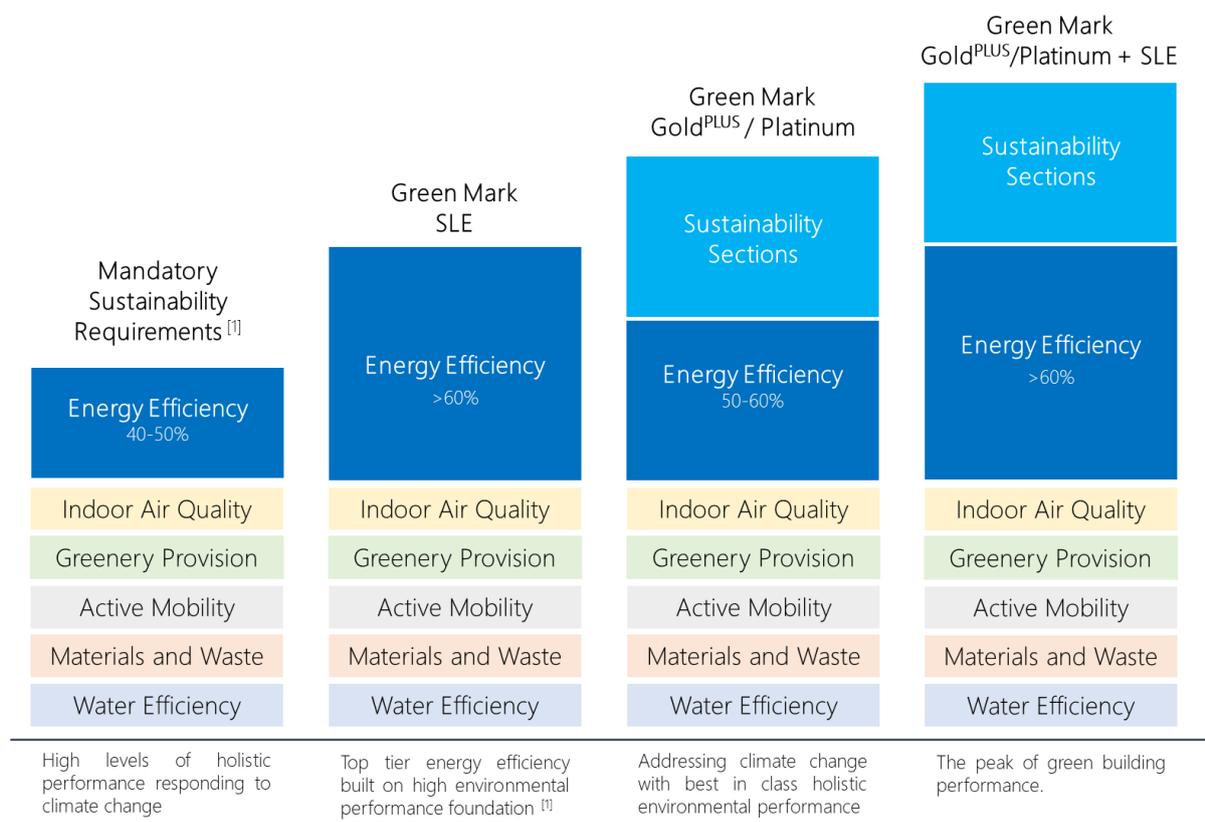
Verification

- To be conducted upon project completion.
- Includes review of delivery records, updated documents on building energy performance data. Site inspection and measurement will be conducted

SLE and Green Mark 2021 Ecosystem

Green Mark for Super Low Energy (SLE) buildings is an Energy (EE) focused series with robust holistic underpinnings from mandatory sustainability requirements through the national regulatory and policy system.

Green Mark Framework



[1] Mandatory requirements are based on development control and building plan provisions for new buildings, for existing buildings under retrofit, the requirements would vary depending on the type and extent of the works being undertaken.

Green Mark Certification

Project teams can choose either to follow the Green Mark Gold^{PLUS} or Platinum certification, or Green Mark SLE certification. Or choose to do both, demonstrating world leading environmental performance of their assets.

GM Series	GM SLE Series
-	SLE, ZE, PE
Gold ^{PLUS}	Gold ^{PLUS} SLE
Platinum	Platinum SLE

Energy Efficiency Pathways

GM: SLE and GM: 2021 use the same parallel pathways for projects to demonstrate their energy performance. The GM SLE Criteria groups these together in one place for each building typology. **For buildings not covered, Pathway 3, Energy Savings would be the default compliance route.** However, BCA could work with the project team on bespoke arrangements for the other pathways. Bespoke pathways will be updated periodically and will be made available.

The Green Mark Energy Pathways are:

- Data driven and flexible – aligned to real project performance with validated data. Flexible routes for projects to demonstrate their performance.
- Outcome based – full recognition of passive design strategies and renewable energy systems contribution to energy savings.
- Supportive of innovation, encourage the use of new technologies, approaches and solutions to energy performance.

Pathway 1 – EUI

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

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

Additional Notes	New	Existing
AC Total System Efficiency (kW/RT)	0.8	0.9
Airside efficiency for buildings supplied by DCS (kW/RT)	0.2	0.25
EUI occupancy rate	100% (design)	≥60%
Renewable Energy included	On-Site	

Pathway 2 – Fixed Metrics

- Key performance metrics (ingredients) that make an energy efficient project. All aspects must be met individually.
- Any shortfall in performance can be made up with the use of onsite renewables, subject to the building typology multiplication factor.
- For projects utilising a District Cooling System the airside performance shall be used in lieu of Total System Efficiency (TSE) and shall be 0.16kW/RT.

Pathway 3 – Energy Savings

Demonstrated energy savings following the Green Mark Energy Modelling guideline which looks at holistic energy performance against a reference model. The default pathway for projects not covered in Table 1A

Additional Notes	New	Existing
AC Total System Efficiency (kW/RT)	0.8	0.9
Airside efficiency (for buildings supplied by DCS) (kW/RT)	0.2	0.25
Savings from Renewable Energy	no cap	
Savings from Passive Design	no cap	

Green Mark SLE: Criteria

Certification Level	Requirement
SLE	<ul style="list-style-type: none"> To achieve at least 60% of energy saving through adopting energy efficient measures and onsite renewable energy. Through demonstrating the stipulated performance through the relevant pathways indicated in Table 1A.
ZE	<ul style="list-style-type: none"> Use of onsite and off-site renewable energy to generate more than 100% of energy needed for building operation for building operation, including all process/ receptacle loads SLE performance shall be demonstrated. Off-site renewables can be used to offset the energy only where: <ul style="list-style-type: none"> SLE performance has been achieved through onsite measures. Onsite renewables have been maximised. Where the project is using REC's, these must be generated in accordance with SS 673: 2021 Code of practice for renewable energy certificates through renewable energy generated within <u>Singapore</u>. The length of time of REC commitment is minimally three years with commitment of re-certification
PE	<ul style="list-style-type: none"> Use of onsite renewable energy to generate more than 115% of energy needed for building operation, including all process/ receptacle loads. SLE performance shall be demonstrated.



GREEN MARK 2021



Super Low Energy

GREEN MARK 2021



Zero Energy

GREEN MARK 2021



Positive Energy

New Buildings under Design and Existing Buildings Pre-retrofit

All projects shall demonstrate the stipulated performance through the relevant pathways indicated in [Table 1A](#).

Pathway 1 - Benchmark EUI ([Table 1B](#) and [Table 1C](#)) a detailed calculation (Existing buildings) or energy model (new buildings) shall be used to calculate and justify the design EUI.

Pathway 2 – Fixed Metrics, the prescriptive performance values shall be met in all areas. Where there is a shortfall of performance, this shall be annualised and required to be off set through onsite renewables with the listed multiplication factor. Detailed calculations, drawings and specifications would be required to substantiate the declared performance.

Pathway 3 - Energy Savings, the energy modelling for evaluating the energy performance of a building shall be carried out in a prescribed manner to quantify the potential savings based on energy efficiency measures and improvements that reduce cooling load requirement over the Reference Model. Projects are to refer to the BCA Green Mark 2021 Energy Modelling Guide for details.

Note on Renewable Energy:

During design or pre-retrofit stage, the expected renewable energy generated percentage and the total annual electricity consumption of the development shall be calculated. Technical product information of the renewable energy system and detailed drawings showing the location of the system shall be provided.

New Building Verification Stage and Existing Buildings in Operation

When the building awarded Green Mark SLE has completed construction or its retrofit, a verification audit shall be carried out. For Buildings in operation, not undergoing retrofit, the assessment would be based upon its operational data.

Stage 1 Verification (New Buildings): The Green Mark verification shall demonstrate the implementation of the design stage strategies and note any deviance from these and their effect on the ability of the project to achieve SLE/ZE/PE.

Stage 2 Verification and Existing Buildings in operation: The building shall demonstrate compliance to the committed performance stated in the pathway through 12-months measured data with a requirement of minimum occupancy of 60% for the period of measurement. The Energy Savings from energy modelling would require deviance less than 5% else a calibration would be required.

Note on Renewable Energy

the generated renewable energy, using 12-month actual operation data will be audited.

Note for Zero Energy Buildings

The building shall demonstrate compliance to the committed 100% net replacement through onsite and/or off-site renewable sources.

Note for Positive Energy Buildings

The building shall demonstrate compliance to the committed 115% net replacement through onsite renewable sources.

SLE

Non-Residential Buildings Details

Office Buildings

OFFICE	
PATHWAY 1 - EUI	
Large Office (GFA ≥15,000sqm)	115
Small Office (with GFA < 15,000sqm)	100
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	38
Non AC Areas	25%
ACMV TSE	0.68
Lighting Power Budget	TABLE 2A
Mechanical Ventilation	TABLE 2B
Integrated Energy Management & control Systems	<p>Energy consumption monitoring and benchmarking system.</p> <p>Automatic controls for the air-conditioning system to respond to periods of non-use, or reduced heat load.</p> <p>Lighting controls shall be provided in accordance with SS 530: 2014 Code of Practice for Energy Efficiency Standard for Building Services and Equipment.</p>
On-Site Renewables - <i>replacement to make up any deficiencies from the above list, with safety factor</i>	1.1
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Retail Mall.

RETAIL	
PATHWAY 1 - EUI	
Retail Mall	160
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	35
Non AC Areas	15%
ACMV TSE	0.68
Lighting Power Budget	TABLE 2A
Mechanical Ventilation	TABLE 2B
Integrated Energy Management & control Systems	<p>Energy consumption monitoring and benchmarking system.</p> <p>Automatic controls for the air-conditioning system to respond to periods of non-use, or reduced heat load.</p> <p>Lighting controls shall be provided in accordance with SS 530: 2014 Code of Practice for Energy Efficiency Standard for Building Services and Equipment.</p>
On-Site Renewables - <i>replacement to make up any deficiencies from the above list, with safety factor</i>	1.1
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Hotels.

HOTEL	
PATHWAY 1 - EUI	
Large Hotel (with GFA ≥ 15,000sqm)	190
Small Hotel (with GFA < 15,000sqm)	140
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	40
Non AC Areas	30%
ACMV TSE	0.68
Lighting Power Budget	TABLE 2A
Mechanical Ventilation	TABLE 2B
Integrated Energy Management & control Systems	<p>Energy consumption monitoring and benchmarking system.</p> <p>Automatic controls for the air-conditioning system to respond to periods of non-use, or reduced heat load.</p> <p>Lighting controls shall be provided in accordance with SS 530: 2014 Code of Practice for Energy Efficiency Standard for Building Services and Equipment.</p> <p>A control device shall be installed in every guestroom for the purpose of automatically switching off the lighting and reducing the air-conditioning loads when a guestroom is not occupied.</p>
On-Site Renewables - <i>replacement to make up any deficiencies from the above list, with safety factor</i>	1.1
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

MOE Primary and Secondary Schools

MOE PRIMARY AND SECONDARY SCHOOLS	
PATHWAY 1 - EUI	
MOE School	30
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	40
Non AC Areas	70%
ACMV TSE;OR	0.7
ACMV (Unitary)	Three phase - 4 Ticks Single phase - 5 Ticks
Lighting Power Budget	TABLE 2A
Mechanical Ventilation	TABLE 2B
Integrated Energy Management & control Systems	Energy consumption monitoring and benchmarking system.
On-Site Renewables - replacement to make up any deficiencies from the above list, with safety factor	1.5
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

MOE Junior Colleges.

MOE JUNIOR COLLEGE	
PATHWAY 1 - EUI	
MOE JC	40
PATHWAY 2 - FIXED METRICS	
PARAMETER	SLE
Reduced Heat Gain (ETTV) [New Development only]	40
Non AC Areas	60%
ACMV TSE;OR	0.7
ACMV (Unitary)	Three phase - 4 Ticks Single phase - 5 Ticks
Lighting Power Budget (% saving)	TABLE 2A
Mechanical Ventilation % savings	TABLE 2B
Integrated Energy Management & control Systems	Energy consumption monitoring and benchmarking system.
On-Site Renewables - replacement to make up any deficiencies from the above list, with safety factor	1.5
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Private Schools and Colleges.

PRIVATE SCHOOL	
PATHWAY 1 - EUI	
Private Schools and Colleges	80
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	35
Non AC Areas	40%
ACMV TSE	0.7
Lighting Power Budget (% saving)	TABLE 2A
Mechanical Ventilation % savings	TABLE 2B
Integrated Energy Management & control Systems	<p>Energy consumption monitoring and benchmarking system.</p> <p>Automatic controls for the air-conditioning system to respond to periods of non-use, or reduced heat load.</p> <p>Lighting controls shall be provided in accordance with SS 530: 2014 Code of Practice for Energy Efficiency Standard for Building Services and Equipment.</p>
On-Site Renewables - replacement to make up any deficiencies from the above list, with safety factor	1.2
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

INSTITUTE OF HIGHER LEARNING	
PATHWAY 1 - EUI	
IHL (University, Polytechnics and ITE)	90
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	38
Non AC Areas	50%
ACMV TSE	0.68
Lighting Power Budget (% saving)	TABLE 2A
Mechanical Ventilation % savings	TABLE 2B
Integrated Energy Management & control Systems	<p>Energy consumption monitoring and benchmarking system.</p> <p>Automatic controls for the air-conditioning system to respond to periods of non-use, or reduced heat load.</p> <p>Lighting controls shall be provided in accordance with SS 530: 2014 Code of Practice for Energy Efficiency Standard for Building Services and Equipment.</p>
On-Site Renewables - replacement to make up any deficiencies from the above list, with safety factor	1.2
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Hospitals

HOSPITALS	
PATHWAY 1 - EUI	
General (& Private) Hospitals	300
Community Hospital	185
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	38
Non AC Areas	15%
ACMV TSE	0.7
Heat Recovery	Run-around coils / heat recovery from exhaust air or other system where reheat is needed for conditioned air
Lighting Power Budget (% saving)	TABLE 2A
Mechanical Ventilation % savings	TABLE 2B
Integrated Energy Management & control Systems	<p>Energy consumption monitoring and benchmarking system.</p> <p>Automatic controls for the air-conditioning system to respond to periods of non-use, or reduced heat load.</p> <p>Lighting controls shall be provided in accordance with SS 530: 2014 Code of Practice for Energy Efficiency Standard for Building Services and Equipment.</p>
On-Site Renewables - replacement to make up any deficiencies from the above list, with safety factor	1.1
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Polyclinics

POLYCLINICS	
PATHWAY 1 - EUI	
Polyclinic	120
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	40
Non AC Areas	50%
ACMV TSE; OR	0.7
ACMV (Unitary)	Three phase - 4 Ticks Single phase - 5 Ticks
Lighting Power Budget (% saving)	TABLE 2A
Mechanical Ventilation % savings	TABLE 2B
Integrated Energy Management & control Systems	<p>Energy consumption monitoring and benchmarking system.</p> <p>Automatic controls for the air-conditioning system to respond to periods of non-use, or reduced heat load.</p> <p>Lighting controls shall be provided in accordance with SS 530: 2014 Code of Practice for Energy Efficiency Standard for Building Services and Equipment.</p>
On-Site Renewables - replacement to make up any deficiencies from the above list, with safety factor	1.3
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Nursing and Youth Homes

NURSING / YOUTH HOMES	
PATHWAY 1 - EUI	
Nursing and Youth Homes	70
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	40
Non AC Areas	60%
ACMV TSE; OR	0.7
ACMV (Unitary)	Three phase - 4 Ticks Single phase - 5 Ticks
Lighting Power Budget (% saving)	TABLE 2A
Mechanical Ventilation % savings	TABLE 2B
Integrated Energy Management & control Systems	<p>Lighting controls shall be provided in accordance with SS 530: 2014 Code of Practice for Energy Efficiency Standard for Building Services and Equipment.</p> <p>A control device shall be installed in every bedroom for the purpose of automatically switching off the lighting and reducing the air-conditioning loads when a guestroom is not occupied.</p>
On-Site Renewables - replacement to make up any deficiencies from the above list, with safety factor	1.5
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Industrial – High Technology

HIGH TECH/HIGH INTENSITY	
PATHWAY 1 - EUI	
N/A	
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	38
Non AC Areas	10%
ACMV TSE	0.75
Lighting Power Budget (% saving)	TABLE 2A
Mechanical Ventilation % savings	TABLE 2B
Integrated Energy Management & control Systems	<p>Energy consumption monitoring and benchmarking system.</p> <p>Automatic controls for the air-conditioning system to respond to periods of non-use, or reduced heat load.</p> <p>Lighting controls shall be provided in accordance with SS 530: 2014 Code of Practice for Energy Efficiency Standard for Building Services and Equipment.</p>
On-Site Renewables - replacement to make up any deficiencies from the above list, with safety factor	1.1
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Light Industrial

LIGHT INDUSTRIAL	
PATHWAY 1 - EUI	
N/A	
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	40
Non AC Areas	30%
ACMV TSE;OR	0.7
ACMV (Unitary)	Three phase - 4 Ticks Single phase - 5 Ticks
Lighting Power Budget (% saving)	TABLE 2A
Mechanical Ventilation % savings	TABLE 2B
Integrated Energy Management & control Systems	Energy consumption monitoring and benchmarking system.
On-Site Renewables - replacement to make up any deficiencies from the above list, with safety factor	1.2
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Warehouses, Workshops and Other Industrial

WAREHOUSES/ WORKSHOPS/OTHERS	
PATHWAY 1 - EUI	
N/A	
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	40
Non AC Areas	40%
ACMV TSE;OR	0.7
ACMV (Unitary)	Three phase - 4 Ticks Single phase - 5 Ticks
Lighting Power Budget (% saving)	TABLE 2A
Mechanical Ventilation % savings	TABLE 2B
Integrated Energy Management & control Systems	Energy consumption monitoring and benchmarking system.
On-Site Renewables - replacement to make up any deficiencies from the above list, with safety factor	1.4
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Community Buildings

COMMUNITY BUILDINGS	
PATHWAY 1 - EUI	
Community clubs/centres, childcare centres	110
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	38
Non AC Areas	40%
ACMV TSE;OR	0.7
ACMV (Unitary)	Three phase - 4 Ticks Single phase - 5 Ticks
Lighting Power Budget (% saving)	TABLE 2A
Mechanical Ventilation % savings	TABLE 2B
Integrated Energy Management & control Systems	<p>Energy consumption monitoring and benchmarking system.</p> <p>Automatic controls for the air-conditioning system to respond to periods of non-use, or reduced heat load.</p> <p>Lighting controls shall be provided in accordance with SS 530: 2014 Code of Practice for Energy Efficiency Standard for Building Services and Equipment.</p>
On-Site Renewables - replacement to make up any deficiencies from the above list, with safety factor	1.2
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Note: Community Buildings include: Community Centres, Childcare Centres

Civic Buildings

CIVIC BUILDINGS	
PATHWAY 1 - EUI	
Civic Buildings (e.g., courts, police stations, fire stations)	60
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	38
Non AC Areas	30%
ACMV TSE;OR	0.7
ACMV (Unitary)	Three phase - 4 Ticks Single phase - 5 Ticks
Lighting Power Budget (% saving)	TABLE 2A
Mechanical Ventilation % savings	TABLE 2B
Integrated Energy Management & control Systems	<p>Energy consumption monitoring and benchmarking system.</p> <p>Automatic controls for the air-conditioning system to respond to periods of non-use, or reduced heat load.</p> <p>Lighting controls shall be provided in accordance with SS 530: 2014 Code of Practice for Energy Efficiency Standard for Building Services and Equipment.</p>
On-Site Renewables - replacement to make up any deficiencies from the above list, with safety factor	1.2
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Note: Civic Buildings include: Courts, Police Stations, Fire Stations

Cultural Institutions

CULTURAL INSTITUTION	
PATHWAY 1 - EUI	
Cultural (e.g. performing arts, library, museum, art gallery)	120
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	38
Non AC Areas	20%
ACMV TSE	0.7
Lighting Power Budget (% saving)	TABLE 2A
Mechanical Ventilation % savings	TABLE 2B
Integrated Energy Management & control Systems	<p>Energy consumption monitoring and benchmarking system.</p> <p>Automatic controls for the air-conditioning system to respond to periods of non-use, or reduced heat load.</p> <p>Lighting controls shall be provided in accordance with SS 530: 2014 Code of Practice for Energy Efficiency Standard for Building Services and Equipment.</p>
On-Site Renewables - replacement to make up any deficiencies from the above list, with safety factor	1.2
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Note: Cultural Buildings include: Performing Arts, Library, Museum, Art Gallery

Sports and Recreation

SPORTS AND RECREATION	
PATHWAY 1 - EUI	
Sports and Recreation Centres	50
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	40
Non AC Areas	30%
ACMV TSE;OR	0.7
ACMV (Unitary)	Three phase - 4 Ticks Single phase - 5 Ticks
Lighting Power Budget (% saving)	TABLE 2A
Mechanical Ventilation % savings	TABLE 2B
Integrated Energy Management & control Systems	<p>Energy consumption monitoring and benchmarking system.</p> <p>Automatic controls for the air-conditioning system to respond to periods of non-use, or reduced heat load.</p> <p>Lighting controls shall be provided in accordance with SS 530: 2014 Code of Practice for Energy Efficiency Standard for Building Services and Equipment.</p>
On-Site Renewables - replacement to make up any deficiencies from the above list, with safety factor	1.2
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Religious / Places of Worship

RELIGIOUS/PLACES OF WORSHIP	
PATHWAY 1 - EUI	
N/A	
PATHWAY 2 - FIXED METRICS	
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	38
Non AC Areas	25%
ACMV TSE;OR	0.7
ACMV (Unitary)	Three phase - 4 Ticks Single phase - 5 Ticks
Lighting Power Budget (% saving)	TABLE 2A
Mechanical Ventilation % savings	TABLE 2B
Integrated Energy Management & control Systems	Automatic controls for the air-conditioning system to respond to periods of non-use, or reduced heat load. Lighting controls shall be provided in accordance with SS 530: 2014 Code of Practice for Energy Efficiency Standard for Building Services and Equipment.
On-Site Renewables - replacement to make up any deficiencies from the above list, with safety factor	1.5
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

SLE

Residential Buildings Details

Residential (Non-Landed)

NON-LANDED RESIDENTIAL	
PATHWAY 2 - FIXED METRICS	
PARAMETER	SLE EE \geq 60%
Reduced Heat Gain (RETV) [New Development only]	20
Ventilation Performance of Dwelling Units [New Development only]	<p><u>OPTION 1: PLAN LEVEL</u> 60% of applicable spaces with unobstructed air flow between spaces and the outside</p> <p><u>OPTION 2: SIMULATION</u> Area weighted average wind speed 0.6m/s for 60% of applicable areas.</p> <p>OR</p> <p>- PMV of +/- 0.6</p> <p><i>NOTE – For both options, the main entrance door (where the developer provides a lockable gate / grille), all windows and internal doors are assumed to be open.</i></p> <p><i>Simulations are to be conducted in accordance with the Green Mark 2021 Guideline for Computational Fluid Dynamics Simulation. PMV recognises the use of assisted ventilation where this is provided once minimum wind speeds are met.</i></p>
ACMV [New Development includes Dwelling Units]	Single phase - 5 Ticks
Energy Efficient Dwelling Unit Equipment Selection [New Development only]	5 Tick where provided
Ventilation Performance – Common Areas	All above ground lobbies and corridors to be naturally ventilated
Vertical Transportation System	VVVF & Sleep Mode Regenerative Drive for 12 Storeys or more.
Lighting Power Budget	TABLE 2A
Mechanical Ventilation	TABLE 2B
Demand Control Systems	Lighting and ventilation controls (timer, sensor, dimming, switches) for common areas such as corridors, function rooms, gyms, pavilions etc
On-Site Renewables to offset common area consumption	30% replacement of club house, function room, swimming pool pumps, gym and MCST office electricity consumption
On-Site Renewables - replacement to make up any deficiencies from the above, excluding RETV and Dwelling Unit Ventilation Performance, with safety factor	1.2

SLE

Tables

Table 1A Energy Efficiency pathways

Building Type	PATHWAY 1	PATHWAY 2	PATHWAY 3
Commercial			
Office Buildings	•	•	•
Hotels	•	•	•
Retail Buildings	•	•	•
Educational			
IHL (University, Polytechnics and ITE)	•	•	•
Private Schools and Colleges	•	•	•
Junior Colleges (MOE)	•	•	•
Secondary Schools (MOE)	•	•	•
Primary Schools (MOE)	•	•	•
Healthcare			
Hospitals (Private and General)	•	•	•
Community Hospitals	•	•	•
Polyclinic	•	•	•
Nursing Home/ Youth Homes	•	•	•
Other Non-Residential			
Mixed Developments	<i>by GFA mix</i>		
Community Centres	•	•	•
Civic Buildings	•	•	•
Cultural Institution	•	•	•
Sports and Recreation Centres	•	•	•
Religious/ Place of Worship	•	•	•
Industrial			
High Tech Industrial	•	•	•
Light Industrial	•	•	•
Warehouses, Workshops and Others	•	•	•
Residential			
Non Landed Residential (HDB, EC, Condo, private apartments)	•	•	•
Cluster Housing	•	•	•
Landed Housing	•	•	•

For Buildings not listed – Pathway 3 would be the default route, however BCA may be able to work with the project team to develop a bespoke pathway 2 set of requirements.

EC – Executive Condominium
HDB – Housing and Development Board
IHL – Institute of Higher Learning
ITE – Institute of Technical Education
MOE – Ministry of Education

TABLE 1B Energy Use Intensity (EUI) Quick look up table

Building Type	SLE EE ≥60%
Commercial	
Office Buildings (Large)	115
Office Buildings (Small)	100
Hotels (Large)	190
Hotels (Small)	140
Retail Malls	160
Educational	
IHL (University, Polytechnics and ITE)	90
Private Schools and Colleges	80
Junior Colleges (MOE)	40
Secondary Schools (MOE)	30
Primary Schools (MOE)	30
Healthcare	
Hospitals (Private and General)	300
Community Hospitals	185
Polyclinic	120
Nursing/Youth Homes	70
Other Non-Residential	
Mixed Developments	<i>By GFA mix</i>
Community Centres	110
Civic Buildings	60
Cultural Institution	120
Sports and Recreation Centres	50
Religious/ Place of Worship	NA
Industrial	
High Tech Industrial	NA
Light Industrial	
Warehouses, Workshops and Others	
Residential	
Non Landed Residential (HDB, EC, Condo, private apartments)	NA
Cluster Housing	
Landed Housing	

Additional Notes	New	Existing
AC Total System Efficiency kW/RT	0.8	0.9
EUI occupancy rate	100% (design)	≥60%
Renewable Energy included	On-Site	

TABLE 1C Energy Use Intensity (EUI) Quick look up table – DCS¹

Building Type	SLE EE ≥60%
Commercial	
Office Buildings (Large)	80
Office Buildings (Small)	75
Hotels (Large)	120
Hotels (Small)	95
Retail Malls	125
Educational	
IHL (University, Polytechnics and ITE)	65
Private Schools and Colleges	60
Junior Colleges (MOE)	30
Secondary Schools (MOE)	20
Primary Schools (MOE)	20
Healthcare	
Hospitals (Private and General)	210
Community Hospitals	130
Polyclinic	85
Nursing/Youth Homes	50
Other Non-Residential	
Mixed Developments	<i>By GFA mix</i>
Community Centres	80
Civic Buildings	40
Cultural Institution	85
Sports and Recreation Centres	35
Religious/ Place of Worship	NA
Industrial	
High Tech Industrial	NA
Light Industrial	
Warehouses, Workshops and Others	
Residential	
Non-Landed Residential (HDB, EC, Condo, private apartments)	NA
Cluster Housing	
Landed Housing	

¹ The supply of chilled water for cooling purpose from a central source to multiple buildings through a network of pipes. Individual users purchase chilled water from the district cooling system operator and do not need to install their own chiller plant other than air distribution system. This is different from buildings' in-house air-conditioning system, in part or in full, being maintained and operated by a third party.

Additional Notes	New	Existing
Airside efficiency for buildings supplied by DCS kW/RT	0.2	0.25
EUI occupancy rate	100% (design)	≥60%
Renewable Energy included	On-Site	

TABLE 2A Lighting Power Budget

Description	LPB Targets (W/m ²)	
	SLE	Reference Lighting Power Budget (W/m ²)
Office, Work and Study		
Offices	5	12
Meeting Room	5	12
Copy/Print Rooms	5	12
Classrooms	5	12
Lecture Theatre	5	12
Computer Rooms	5	12
Reading Areas	5	12
Laboratories	6	16
Atria, Halls and Retail		
Entrance Hall	4	10
Atriums	4	10
Retail Atriums	4	10
Retail Corridors (Interior)	3	7
Concourse	3.5	10
Lobby	3.5	10
Auditorium	3.5	10
Concert Hall	4	10
Multi Purpose Hall	6	16
Conference Hall	6	16
Retail (General Lighting)	6	15
Retail - Jewellery (Total)	14	35
Retail - Furniture, clothing & accessories, cosmetics, art (Total)	10	25
Retail - Supermarket, vehicle, sporting goods, stationary, hardware, others (Total)	8	20
Food & Beverage Areas		
Food Courts & Hawker Centres	4	10
Canteens	4	10
Restaurants	5	12
Lounges	5	12
Bars	5	12
Transport and Goods		
Corridors	3	7
Stairs, Escalators, Travelators	3.5	6
Lift Lobbies	3	7
Warehouses	4	7
Storage Areas	4	10
Carpark	2	5

Rest, Clean, Exercise and Play		
Hotel Guest Rooms ²	5	12
Toilets	4	10
Changing Rooms	4	10
Laundries	4	10
Washing Areas	4	10
Gymnasium & Physical Exercise Areas	4.5	11
Manufacturing & Maintenance		
Mechanical & Electrical Rooms	4	10
Manufacturing (general)	5.5	13
Manufacturing (electronic, fine detail or assembly)	6	14

The maximum lighting power budget for landscape lighting shall at minimum comply with SS 530:2014.

² In hotel buildings, a control device shall be installed in every guestroom to automatically switch off the lighting when unoccupied.

TABLE 2B Mechanical Ventilation_ MV

SLE EE ≥60%	
Fan System	Efficiency (W/CMH)
Nameplate motor power ≥ 4kW	0.25
Nameplate motor power < 4kW	0.17

TABLE 3A Energy Savings Details

	Pathway 3 - Energy Savings
	SLE EE ≥60%
Saving from BAU (2005 Code)	60
Saving from Current Reference (Annex C)	40

Including buildings with supplied by DCS

Additional Requirements	New	Existing
AC TSE (kW/RT)	0.8	0.9
Airside efficiency (for buildings supplied by DCS) (kW/RT)	0.2	0.25
Savings from Renewable Energy	no cap	
Savings from Passive Design	no cap	

**Based on Energy Modelling framework guidelines or saving generated from [SLEB Smart Hub](#).*

Developed by:

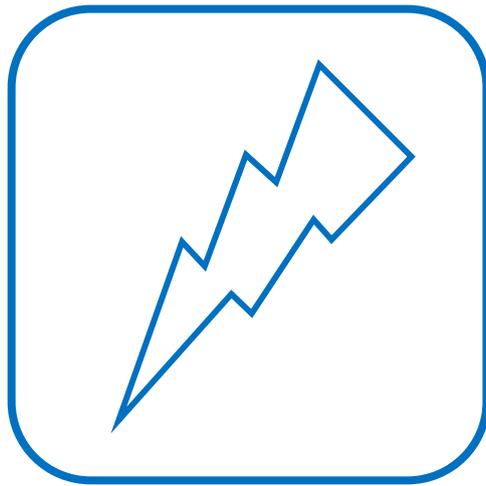


GM SLE Taskforce:

Ar. Owen Wee GMAAP	Surbana Jurong
Dr. Edward Ang GMAP	Building and Construction Authority
Dr. Gao Chun Ping	Building and Construction Authority
Er. Tay Cher Seng	Natflow Pte Ltd
Mr. Tan Sze Tiong	Housing & Development Board
Mr. Noel Chin	Building and Construction Authority
Ar. John McLaughlin GMAP	MKPL
Dr. Stephen Tay	National University of Singapore
Er. Ng Beow Suan GMAAP	Squire Mech
Mr. Joseph Koh	JTC Corporation
Mr. Daniel Lau	JTC Corporation
Mr. Yubin Moo	Ministry of Education
Ms. Farizan d'Avezac de Moran GMAAP	GreenA consultants
Ms. Irene Yong GMAAP	BECA Carter
Er. Loh Chee Shyong	United Overseas Bank
Mr. Wong Ee Ven GMAP	Keppel Land
Ms. Gillian Oh	National Environment Agency
Mr. Beh Lean Hooi GMAP	CapitaLand
Mr. Lee Zhenyi GMAAP	Cushman & Wakefield
Mr. Jidesh Kambil GMAP	Singapore Green Building Council

GM SLE Development Team:

Ar. Benjamin Towell GMAAP	Building and Construction Authority
Ms. Jacquelin Britto GMAAP	Building and Construction Authority
Ms. Regina Arokiaraj GMAAP	Building and Construction Authority
Er. Lee Si Min	Building and Construction Authority
Mr. Saw Cai Kwan	Building and Construction Authority
Ms. Laura Paramon GMAAP	Building and Construction Authority
Mr. Edwin Koh GMAP	Building and Construction Authority
Mr. Lewis Chua GMAAP	Building and Construction Authority
Ms. Goh Li Xuan	Building and Construction Authority



Green Mark

SLE

Super Low Energy Buildings

