

Green Mark



Super Low Energy Buildings

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Revision	Description	Date Effective
RO	Launch for Implementation	05/09/2018
R1	Definition of Positive Energy Building EUI Revision Alignment of New and Existing Building Criteria	10/12/2020
R2	Addition of SLE for Residential Buildings Part of the Green Mark 2021 framework, including the development of 3 parallel pathways for demonstration of performance, EUI, Fixed Metrics and Energy Savings	22/04/2021

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.







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	8
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	
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	27
Residential (Non-Landed)	28
Tables	
Table 1A Energy Efficiency pathways	32
TABLE 1B Energy Use Intensity (EUI) Quick look up table	
TABLE 1C Energy Use Intensity (EUI) Quick look up table –DCS	
TABLE 2A Lighting Power Budget	35
TABLE 2B Mechanical Ventilation_ MV	
TABLE 3A Energy Savings Details	

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 in Singapore 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 GoldPLUS 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
GoldPLUS	GoldPLUS 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.

<u> Pathway 1 – EUI</u>

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	0.8	0.9
Airside efficiency for buildings supplied by DCS	0.18	0.2
EUI occupancy rate	100% (design)	≥60%
Renewable Energy included	On-S	iite

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	0.8	0.9
Airside efficiency (for buildings supplied by DCS)	0.18	0.2
Savings from Renewable Energy	no cap	
Savings from Passive Design no cap		ар

Green Mark SLE: Criteria

Certification Level	Requirement
SLE	 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 <u>Table 1A</u>.
ZE	 Use of onsite and off-site renewable energy to generate more than 100% of energy needed for building operation. SLE performance shall be demonstrated. Off-site renewables can be used to offset the energy only where: 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 Singapore through renewable energy generated within Singapore. The length of time of REC commitment is minimally three years with commitment of re-certification
PE	 Use of onsite renewable energy to generate more than 115% of energy needed for building operation. SLE performance shall be demonstrated.

New Buildings under Design and Existing Buildings Pre-retrofit

All projects shall demonstrate the stipulated performance through the relevant pathways indicated in <u>Table</u> <u>1A</u>.

Pathway 1 - Benchmark EUI (<u>Table 1B</u> and <u>Table 1C</u>) 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.

<u>Stage 1 Verification (New Buildings)</u>: 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.

<u>Stage 2 Verification and Existing Buildings in operation:</u> 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.



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 N	1ETRICS	
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	Energy consumption monitoring and benchmarking system. 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.	
deficiencies from the above list, with safety factor	1.1	
PATHWAY 3 ENERGY SAVINGS		
Demonstrated Energy Savings	60%	

Retail Mall.

RETAIL		
PATHWAY 1 - EUI		
Retail Mall	160	
PATHWAY 2 - FIXED MET	RICS	
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	Energy consumption monitoring and benchmarking system. 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.	
deficiencies from the above list, with safety factor	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 M	ETRICS	
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	Energy consumption monitoring and benchmarking system. 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. 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.	
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%	

MOE Primary and Secondary Schools

MOE PRIMARY AND SECONDARY SCHOOLS		
PATHWAY 1 - EUI		
MOE School	30	
PATHWAY 2 - FIXED N	1ETRICS	
PARAMETER		
Reduced Heat Gain (ETTV) [New Development only]	40	
Non AC Areas	70%	
ACMV TSE	0.7	
OR 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 METH	RICS	
PARAMETER	SLE	
Reduced Heat Gain (ETTV) [New Development only]	40	
Non AC Areas	60%	
ACMV TSE	0.7	
OR 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 M	ETRICS	
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	Energy consumption monitoring and benchmarking system. 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	1.2	
PATHWAY 3 ENERGY SAVINGS		
Demonstrated Energy Savings 60%		

Institute of Higher Learning

INSTITUTE OF HIGHER LEARNING	
PATHWAY 1 - EU	I
IHL (University, Polytechnics and ITE)	90
PATHWAY 2 - FIXED N	IETRICS
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	Energy consumption monitoring and benchmarking system. 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	1.2
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Hospitals

HOSPITALS	
PATHWAY 1 - EL	JI
General (& Private) Hospitals Community Hospital	300 185
PATHWAY 2 - FIXED N	IETRICS
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	Energy consumption monitoring and benchmarking system. 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	1.1
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Polyclinics

POLYCLINICS		
PATHWAY 1 - EUI		
Polyclinic	120	
PATHWAY 2 - FIXED METI	RICS	
PARAMETER		
Reduced Heat Gain (ETTV) [New Development only]	40	
Non AC Areas	50%	
ACMV TSE	0.7	
OR 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. 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	1.3	
PATHWAY 3 ENERGY SAVINGS		
Demonstrated Energy Savings	60%	

Nursing and Youth Homes

NURSING / YOUTH HOMES	
PATHWAY 1 - EU	I
Nursing and Youth Homes	70
PATHWAY 2 - FIXED M	ETRICS
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	40
Non AC Areas	60%
ACMV TSE	0.7
OR 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	Lighting controls shall be provided in accordance with SS 530: 2014 Code of Practice for Energy Efficiency Standard for Building Services and Equipment. 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.
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 - E	UI
N/A	
PATHWAY 2 - FIXED N	NETRICS
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	Energy consumption monitoring and benchmarking system. 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	1.1
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Light Industrial

LIGHT INDUSTRIAL	
PATHWAY 1 - EUI	
N/A	
PATHWAY 2 - FIXED MET	RICS
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	40
Non AC Areas	30%
ACMV TSE	0.7
OR 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 - EU	I
N/A	
PATHWAY 2 - FIXED M	ETRICS
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	40
Non AC Areas	40%
ACMV TSE	0.7
OR 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 - EL	JI
Community clubs/centres, childcare centres	110
PATHWAY 2 - FIXED N	IETRICS
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	38
Non AC Areas	40%
ACMV TSE	0.7
OR 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. 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	1.2
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Civic Buildings

CIVIC BUILDINGS	
PATHWAY 1 - EUI	
Civic Buildings (e.g., courts, police stations, fire stations)	60
PATHWAY 2 - FIXED METH	RICS
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	38
Non AC Areas	30%
ACMV TSE	0.7
OR 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. 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	1.2
PATHWAY 3 ENERGY SAVINGS	
Demonstrated Energy Savings	60%

Cultural Institutions

CULTURAL INSTITUTION		
PATHWAY 1 - EUI		
Cultural (e.g. performing arts, library, museum, art gallery)	120	
PATHWAY 2 - FIXED M	ETRICS	
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	Energy consumption monitoring and benchmarking system. 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	1.2	
PATHWAY 3 ENERGY SAVINGS		
Demonstrated Energy Savings	60%	

Sports and Recreation

SPORTS AND RECREATION		
PATHWAY 1 - EUI		
Sports and Recreation Centres	50	
PATHWAY 2 - FIXED N	IETRICS	
PARAMETER		
Reduced Heat Gain (ETTV) [New Development only]	40	
Non AC Areas	30%	
ACMV TSE	0.7	
OR 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. 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	1.2	
PATHWAY 3 ENERGY SAVINGS		
Demonstrated Energy Savings	60%	

Religious / Places of Worship

RELIGIOUS/PLACES OF WORSHIP	
PATHWAY 1 - EL	JI
N/A	
PATHWAY 2 - FIXED N	IETRICS
PARAMETER	
Reduced Heat Gain (ETTV) [New Development only]	40
Non AC Areas	25%
ACMV TSE	0.7
OR 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%



Residential Buildings Details

Residential (Non-Landed)

Residential Envelope Thermal Transfer Value (RETV)

Minimise thermal heat gain through the building envelope to enhance indoor thermal comfort and reduce the energy needed to condition the indoor environment.

Assessment

The RETV of the building, as determined in accordance with the formula set out in the BCA Code on Envelope Thermal Performance for Buildings, shall not exceed the following limit

RETV	20 w/m ²
New Building	Applicable
Existing Buildings	Not Applicable

Ventilation Performance (Dwelling Units)

Ventilation Performance of living rooms, bedrooms (including home office spaces)

Assessment

A minimum 60% of living rooms, bedrooms (including home office spaces) shall be designed to achieve good levels of natural ventilation. There are 2 methods for demonstrating performance.

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.

OPTION 1: PLAN LEVEL

60% of applicable spaces with unobstructed air flow between spaces and the outside The dwelling unit design is considered to have cross ventilation when there is an unobstructed air flow path between the openings on opposite sides of the building, or *within a room* on adjacent walls.

OPTION 2: SIMULATION

Area weighted average wind speed 0.6m/s for 60% of applicable areas. Use of Ventilation simulation modelling to identify the most effective design and layout to achieve good natural ventilation. Micro level CFD to be conducted which demonstrate that 60% of the typical units achieve an average weighted velocity of 0.6m/s.

OR

Where the wind speed cannot be met alone, conduct thermal comfort modelling which can include the use of ceiling fans, where supplied by the developer, to achieve a PMV of +/- 0.6

New Building	Applicable
Existing Buildings	Not Applicable

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.

Air Conditioning System Efficiency

AC Performance

Assessment

Use energy efficient air-conditioners that are certified under Singapore Energy Labelling Scheme or of equivalent COP (Coefficient of Performance) for dwelling units and/ or common facilities and spaces

<u>Requirement:</u> Single Phase systems – 5 tick Three Phase System – 4 tick

New Building	Applicable for Units and Common areas, where supplied
Existing Buildings	Applicable to common areas with AC

Energy Efficient Equipment Selection

Supply & Installation of energy efficient household equipment

Assessment

All applicable* developer / MCST supplied electrical appliances within all dwelling units and common areas shall be 5 ticks (4 ticks where 5 tick equipment is not available within the market) energy labelled appliances.

*applicable appliances include all appliances that are NEA Energy Label that are supplied by the developer or MCST within the dwelling units or with in any of the common facilities.

New Building	Applicable for Units and Common areas, where supplied
Existing Building	Applicable to common areas

Ventilation Performance Common Areas

All above ground lobbies and corridors to be naturally ventilated.

New Building	Applicable
Existing Building	Applicable

Vertical Transportation Efficiency

Adopt use of energy efficient lifts and escalators.

Assessment

All lifts (serving 12 storeys or more) shall be VVVF, have sleep mode and equipped with regenerative drive feature.

Escalators within the development or linking to the development (within the developer's / MCST control) shall be VVVF with go slow or sleep mode

New Building	Applicable
Existing Building	Applicable upon replacement

Lighting Efficiency

Meet the lighting power budget as outlined in

TABLE 2A

New Building	Applicable
Existing Building	Applicable

Mechanical Ventilation

Meet the prescribed mechanical ventilation performance as outlined in

TABLE 2B

New Building	Applicable
Existing Building	Applicable

Demand Control

Use of demand control systems to reduce energy use.

Assessment

Provision of Lighting and ventilation controls (such as timer, sensor, dimming, switches) for common areas including corridors, function rooms, gyms, pavilions etc

New Building	Applicable
Existing Building	Applicable

Adoption of Renewable Energy

Use of renewable energy to reduce the building development's power consumption from the grid and carbon emission.

Assessment

30% replacement of club house, function room, swimming pool pumps, gym and MCST office electricity consumption through on-site renewable energy.

Additional use of renewables can be deployed on-site to make up the shortfall of any of the performance criteria above, excluding RETV and Dwelling Unit Ventilation Performance. It shall be based on an annual energy consumption of the shortfall (kWh) x 1.2.

New Building	Applicable
Existing Building	Applicable



Tables

Table 1A Energy Efficiency pathways

Building Type	PATHWAY 1	PATHWAY 2	PATHWAY 3	
Commercial				
Office Buildings	•	•	•	
Hotels	•	•	•	
Retail Buildings	•	•	•	
Educationa	I			
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-Resid	ential			
Mixed Develpments		by GFA mix		
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				
Multi Residential (HDB, EC, Condo, pte 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.

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

Ruilding Type			
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	By GFA mix		
Community Centres	110		
Civic Buildings	60		
Cultural Institution	120		
Sports and Recreation Centres	50		
Religious/ Place of Worship	NA		
Industrial			
High Tech Industrial			
Light Industrial	NA		
Warehouses, Workshops and Others			
Residential			
Non Landed Residential (HDB, EC, Condo, pte apartments)			
Cluster Housing	NA		
Landed Housing			

Additional Notes	New	Existing
AC Total System Efficiency	0.8	0.9
Airside efficiency for buildings supplied by DCS	0.18	0.2
EUI occupancy rate	100% (design)	≥60%
Renewable Energy included	On-Site	

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

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	By GFA mix	
Community Centres	80	
Civic Buildings	40	
Cultural Institution	85	
Sports and Recreation Centres	35	
Religious/ Place of Worship	NA	
Industrial		
High Tech Industrial		
Light Industrial	NA	
Warehouses, Workshops and Others		
Residential		
Non-Landed Residential (HDB, EC, Condo, pte apartments)		
Cluster Housing	NA	
Landed Housing		

Additional Notes	New	Existing
Airside efficiency for buildings supplied by DCS	0.18	0.2
EUI occupancy rate	100% (design)	≥60%
Renewable Energy included	On-Site	

TABLE 2A Lighting Power Budget

	LPB Targets (W/m2)		
Description	SLE	Reference Lighting Power Budget (W/m ²)	
Of	fice, 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	
A	tria, 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 & Bevarge 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	

Rest, Clean, Exercise and Play			
Hotel Guest Rooms	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	

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	0.8	0.9
Airside efficiency (for buildings supplied by		
DCS)	0.18	0.2
Savings from Renewable Energy	no cap	
Savings from Passive Design	no cap	

*Based on Energy Modelling framework guidelines or saving generated from <u>SLEB Smart Hub</u>.

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Super Low Energy Buildings

