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Building and Construction Authority

WELCOME TO INDUSTRY BRIEFING ON:

GREEN MARK VERSION 4.0 FOR NEW BUILDINGS

1) 20 Sep 2010 (2.30 – 4.30 pm)
2) 27 Sep 2010 (2.30 – 4.30 pm)
3) 1 Oct 2010 (9.30 – 11.30 am)



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Building and Construction Authority

Briefing Outline

1. **Overview of BCA Green Building Initiatives and Implementation Timeline of Green Mark Version 4.0 (15 mins)**
   – By SEDO Mrs Grace Cheok-Chan

2. **Key Changes to Green Mark Version 4.0 Residential Criteria (25 mins)**
   – By SEDO Ms Lee Sui Fung

3. **Key Changes to Green Mark Version 4.0 Non-Residential Criteria (25 mins)**
   – By SDO Mr Lim Chan Boon

4. **Daylighting & Glare Simulation Methodology / Sustainable Construction / Sustainable Products / Carbon Footprint (20 mins)**
   – By SDO Ms Ong Hui Wen

5. **Q&A Session**



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Overview of BCA Green Building Initiatives and Implementation Timeline

Presented by Grace Cheok-Chan
Green Mark Dept (ND)
Technology Development Division / BCA

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Presentation Outline

- BCA Green Mark Scheme – Updates
- BCA Green Mark GFA Incentive Scheme
- Public Sector Taking the Lead Initiatives
- Legislative Requirement on Environmental Sustainability of Buildings
  - ➢ Minimum Green Mark Score of 50 points
  - ➢ GLS programme and Requirements



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BCA Green Mark



Launched in Jan 2005



Our Singapore Brand - A green building rating system to evaluate building for its environmental impact and performance

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BCA Green Mark

- National Yardstick
- Qualifying Standard for Incentives
- Compliance Method for Regulatory Requirement

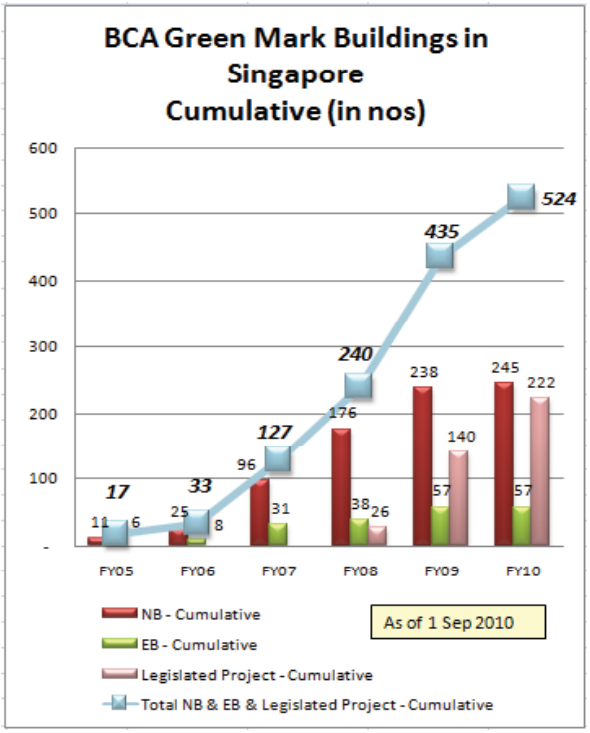


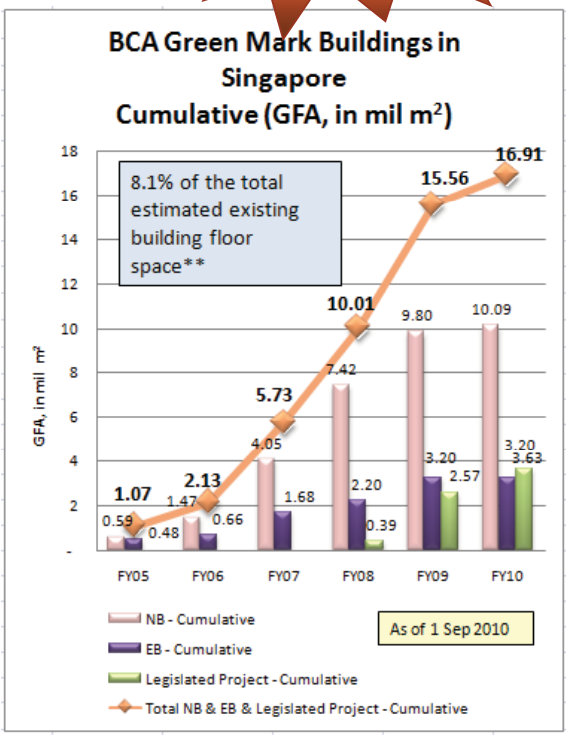
The Main Lever to drive Environmental Sustainability in Building Sector

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Currently more than 500 projects

What we have achieved so far….





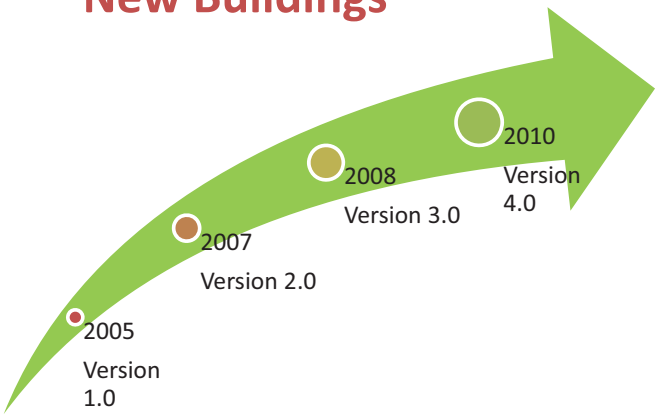
**The total estimated existing building floor space is 208 million m²

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Green Mark for New Buildings

Evolution of the criteria towards a more holistic approach

Versioning of GM for New Buildings



GM Version 4.0
(Effective from 1 Dec 2010)

Area of improvements

- Greater emphasis on Passive Design
  - Natural Ventilation
  - Daylighting
- Further enhancing building energy efficiency standard
- Promote Sustainable Construction
- Greater Emphasis on Greenery
- Enhanced pre-requisites for higher GM rating

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Consultation with Industry on the Revision

Aug 2009
- 8 consultation sessions involving 120 developers, consultants and Professionals

March 2010
- Circulated draft version for industry comments

April 2010
- Green Mark Advisory Committee and Technical Taskforces comprising Industry Professionals and Academics

Total of 170 Comments from Industry

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Implementation Timeline for BCA Green Mark Version 4.0

April 2010
- Green Mark Advisory Committee and Technical Taskforces comprising Industry Professionals and Academics

August 2010
- Finalise and publish BCA Green Mark Version 4.0 (in short GM V4)

1 Dec 2010
- GM V4 with effect from 1 Dec 2010
- No longer accept GM V3 applications

1 Dec 2011
- Auto migration from GM V3 to GM V4

BCA GREEN MARK

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From 1 Dec 2010 GM V3.0 will no longer applicable

For BCA Green Mark Certification

Implementation timeline for the adoption of GM V4.0 is based on the date of GM application

1 Dec 2010

1 Dec 2011

GM applications submitted **on or after 1 Dec 2010** will be assessed under GM V4.0

GM applications submitted **before 1 Dec 2010** will be assessed under GM V3.0

Projects where GM applications were submitted **before 1 Dec 2010** will be assessed under GM V4.0 from 1 Dec 2011 onwards

BCA GREEN MARK

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BCA Green Mark Certification



- The details of BCA Green Mark V4.0 is incorporated in the BCA Green Mark – Certification Standard for New Buildings

A copy of the Standard can be obtained from BCA website at

http://www.bca.gov.sg/EnvSusLegislation/others/GM_Certification_Std2010.pdf

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Green Mark GFA Incentive Scheme

New Buildings



Implemented in April 2009

Green Mark Gross Floor Area (GM GFA) Incentive Scheme

for private sector to achieve higher Green Mark ratings

Building and Construction Authority

URBAN REDEVELOPMENT AUTHORITY

For more information
http://www.bca.gov.sg/greenMark/gmgfa.html

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Green Mark GFA Incentive Scheme

New Buildings



Green Mark Platinum

- Up to 2% additional GFA beyond MP GPR
- Subject to cap of 5,000 sqm

Green Mark Gold^{Plus}

- Up to 1% additional GFA beyond MP GPR
- Subject to cap of 2500 sqm

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Strategic Thrust 2 Spurring The Private Sector

Eligibility – GM GFA Incentive

- New private developments, redevelopments and major A&A developments.

Residential	Non-landed, Mixed residential & commercial development
Non-Residential	Commercial, office, retail, business parks, industrial, institutional, community building, hotel, hospital, white site development

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BCA GM GFA Application and Evaluation Process

Stage 1

- Submit BCA GM GFA Application and green building concept plan for endorsement

Stage 2

- Submit BCA endorsement for Additional GFA and relevant form with planning submission to URA for approval
- Raise security deposit after approval granted

Stage 3

- Apply for BCA Green Mark Assessment and to obtain the intended Green Mark Rating before TOP

.....which BCA Green Mark Criteria will be applicable - GM V3.0 or GM 4.0 ?

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For BCA Green Mark GFA Incentive Scheme

Implementation timeline for the adoption of GM V4.0 is based on the **submission date of BCA GM-GFA application**



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New Buildings



Public Sector Taking the Lead

Key Initiatives: Implemented in April 2009

NEW Public Sector Buildings with more than 5000 m^2 air-conditioned floor areas to achieve Green Mark Platinum rating

- Beyond current mandatory requirement of GM Certified rating



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Public Sector Taking the Lead

New Buildings



When it is applicable ….

1	<u>Design and Build Project</u> Applicable if contract called on and after 1 Apr 2009
2	<u>Other Building Work Project</u> ▪ Applicable if consultancy services called on and after 1 Apr 2009

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For Public Sector Taking the Lead -

Implementation timeline for the adoption of GM V4.0 is based on the date of tender notices for consultancy or design and build contract

Projects with tenders for design that are called before 1 Dec 2010 will be assessed and certified using the BCA Green Mark Criteria for new Buildings (GM V3.0)

1 Dec 2010

Projects with tenders for design that are called on or after 1 Dec 2010 will be assessed and certified using the BCA Green Mark Criteria for new Buildings (GM V4.0)

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Legislation on Environmental Sustainability

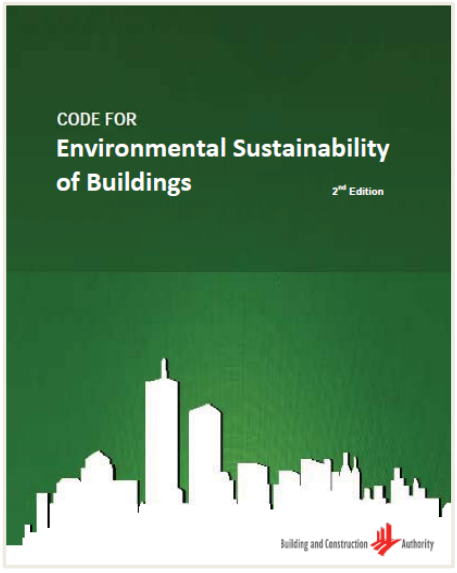


Self Declaration by QPs and Appropriate Practitioners

- BC (Environmental Sustainability) Regulations 2008 came into operation on 15 Apr 08
- Applicable to New Buildings and Existing Buildings undergoing Major Retrofitting with GFA of 2000 square metres or more
- Scoring Methodology for compliance based on Green Mark V3.0 which was incorporated in current Code for Environmental Sustainability of Buildings

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Legislation on Environmental Sustainability



- The BCA Green Mark V4.0 is incorporated in the Code for Environmental Sustainability of Buildings (2nd Edition)
- No change to the minimum GM score

Min 50 points

A copy of the Code can be obtained from BCA website at http://www.bca.gov.sg/EnvSusLegislation/others/Env_Sus_Code2010.pdf

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For Regulatory Requirement for Applicable Building Works

Implementation timeline for the adoption of GM V4.0 is based on the 1st submission date to URA for planning permission

On or after 15 April 2008

Scoring Methodology - Current Code on Environmental Sustainability of Buildings which comprises BCA GM Version 3.0

On or after 1 Dec 2010

Scoring Methodology - Revised Code on Environmental Sustainability of Buildings, 2nd Edition which comprises BCA GM Version 4.0

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GLS Programmes

New Buildings



Key Initiatives:

Implemented in April 2009

GOVT Land Sales Sites to require higher-Tier Green Mark ratings *(Platinum and GoldPlus)*

For strategic development projects in new growth areas



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GLS Programmes

Projects In GLS



Key Initiatives:

Regulation in place on 5 May 2010

GOVT Land Sales Sites to require higher-Tier Green Mark ratings *(Platinum and GoldPlus)*

For strategic development projects in new growth areas

Any new development located on land sold on or after 5 May 2010 under the GLS programme are subject to building regulatory control.

These projects must attain the prescribed ratings under the **BCA Green Mark Certification Process** before TOP/CSC can be granted.

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GLS Programmes

Projects In GLS



Key Initiatives:

Regulation in place on 5 May 2010

GOVT Land Sales Sites to require higher-Tier Green Mark ratings *(Platinum and GoldPlus)*

For strategic development projects in new growth areas

Declarations of the Green Mark score from the QPs are not required for these projects.

Instead QPs are to ensure that

- before building plan submission, an application is made to BCA for the Green Mark assessment
- upon project completion, the appropriate Green Mark certification has been obtained from BCA so that TOP/CSC can be granted

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For GLS Programmes in Strategic Areas

Implementation timeline for the adoption of GM V4.0 is based on the GLS tender closing date for the land sold

Land sold On or after 5 May 2010

- To comply with Green Mark Gold^{Plus} or Platinum Rating
- BCA Green Mark Assessment and Certification based on GM V3.0

GLS Tender Closing Date On or after 1 Dec 2010

- To comply with Green Mark Gold^{Plus} or Platinum Rating
- BCA Green Mark Assessment and Certification based on GM V4.0

.....which BCA Green Mark Criteria will be applicable - GM V3.0 or GM 4.0 ?

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Green Mark Tool - Score Calculator



Refer to http://210.23.8.189/GreenMarkscorecalculator/

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In Summary

Submission Date of GM Application

BCA Green Mark

1 Dec 2010

Based on 1st Submission Date to URA for Planning Permission

Legislative Requirement

Minimum Environmental Sustainability Standard Green Mark Score of 50 points

Submission Date of BCA GM GFA Application

BCA Green Mark GFA Incentive Scheme

Date of Tender Notice for Consultancy or Design & Build Contract

Public Sector Taking the Lead

Date of GLS Tender Closing Date

Legislative Requirement

GLS Programme for Strategic Areas

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Thank you



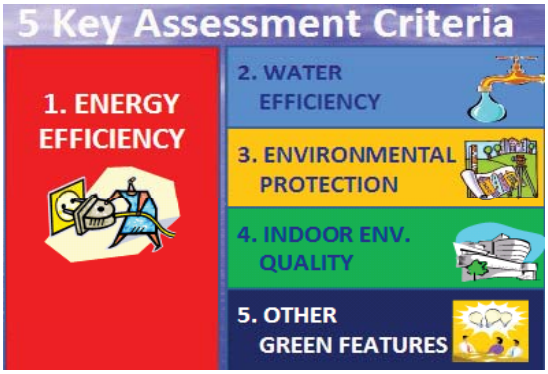
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Industry Briefing on

BCA Green Mark for New Residential Buildings Version RB/4.0



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Agenda

1. Summary of key changes
2. Green Mark for New Residential Buildings Version RB/4.0
3. Case Study on achieving Green Mark Certified and Green Mark Gold^{PLUS} rating

Green Mark	Try Again	Certified	Gold	Gold^{plus}	Platinum
Score	0 49	50 74	75 84	85 89	90 >90

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Summary of key changes from RB/3.0 to RB/4.0

General

1. Additional pre-requisite requirements for Green Mark Gold^{PLUS} and Platinum rating:
   - Naturally Ventilated staircases and common lobbies
   - 4 ticks air-con
   - Min Sustainable Construction scores
2. Removal of capping of maximum scores

Energy Related Requirements

3. Higher weightage for good natural ventilation and passive design
4. Additional new criteria for daylighting and revision of weightage for artificial lighting
5. Revision of weightage for ventilation in carparks and lifts
6. Enhancement of scoring for renewable energy

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Summary of key changes from RB/3.0 to RB/4.0

Other Green Requirements

7. Removal of point allocation for use of water efficient fittings with good rating (1 tick)
8. Additional new criteria on use of water efficient plants
9. Enhancement of scoring on sustainable construction and to support 'Multi-tiers' green product ratings system
10. Enhancement of scoring on greenery provision, environmental management practice and public transport accessibility
11. Additional new criteria on stormwater management
12. Revision of weightage allocation for use of low-VOC paints and naturally ventilated wet areas

Criteria for Residential Buildings RB/4.0

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To achieve Green Mark Certified 50 points

Minimum requirements

Pre-Requisite Requirement

All relevant pre-requisite requirements for the specific Green Mark Rating are to be complied with

Energy Related Requirements Min 30 points

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

~~(Max 50 points)~~

Additional requirements

Part 1 - Energy Efficiency

1-1 Thermal Performance of Building Envelope- RETV
1-2 Naturally Ventilated Design and A/C System
1-3 Daylighting
1-4 Artificial Lighting
1-5 Ventilation in Carparks
1-6 Lifts
1-7 Energy Efficient Features
1-8 Renewable energy

Points allocated 87

Other Green Requirements Min 20 points

Elective Requirement from other areas (Combination of the following items to meet 20 points)

~~(Max 50 points)~~

Part 2 - Water Efficiency

Part 3 – Environmental Protection

Part 4 - Indoor Environmental Quality

Part 5 – Other Green Features

Points allocated ~~68~~ 39

Additional pre-requisite requirements for Goldplus and Platinum projects

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Pre-requisite Requirements

1. **Building envelope design with Envelope Thermal Transfer value (RETV) of**

   Gold^{PLUS} ≤ 22 W/m^2

   Platinum ≤ 20 W/m^2

2. **Natural ventilation requirements for Platinum rating**

   - **Use of ventilation simulation software to identify most effective building design and layout – at least 80% of typical units should have an area weighted average wind velocity of 0.6m/s**
   - **Common areas like staircases and lobbies should be naturally ventilated**

3. **Air-conditioners for both Gold^{PLUS} and Platinum projects should be 4-ticks**

4. **Minimum Sustainable Construction**

   GoldPLUS ≥ 3 points

   Platinum ≥ 5 points

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Category	Version 3	Version 4
(I) Energy Related Requirements		
Part 1 : Energy Efficiency		
1-1 Building Envelope – Thermal Performance	15	15
1-2 Natural Ventilation and A/C Design - Option 1 (max 22 points) - Option 2 (max 18 points)	16	22
1-3 Day Lighting (RB 4)/ Lighting (RB 3)	3	6
1-4 Artificial Lignting (RB 4)/ Lighting (RB 3)	12	10
1-5 Ventilation in Carparks	8	6
1-6 Lifts	2	1
1-7 Energy Efficient Features	7	7
1-8 Renewable Energy	20	20
Category Score for Part 1 – Energy Efficiency	**65 (Cap at 50 + 20 bonus pt)**	**87 (max)**

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Category	Version 3	Version 4
(II) Other Green Requirements		
Part 2 : Water Efficiency		
2-1 Water Efficient Fittings	10	10
2-2 Water Usage	1	1
2-3 Irrigation System and Landscaping	2	3
Part 3 : Environmental Protection		
3-1 Sustainable Construction	6	10
3-2 Sustainable Products	6	8
3-3 Greenery Provision	6	8
3-4 Environmental Management Practice	9	8
3-5 Green Transport	2	4
3-6 Stormwater Management	NA	3

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Category	Version 3	Version 4
(II) Other Green Requirements		
Part 4 : Indoor Environmental Quality		
4-1 Noise Level	1	1
4-2 Indoor Air Pollutants	3	2
4-3 Waste Disposal	1	1
4-4 Indoor Air Quality in Wet Areas	1	2
Part 5 : Other Green Features		
5-1 Green Features & Innovations	7	7
Category Score for Part 2-5	**57 (Cap at 50)**	**68**
Total Points Allocated	**120**	**155 (max)**

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Part 1 – Energy Efficiency

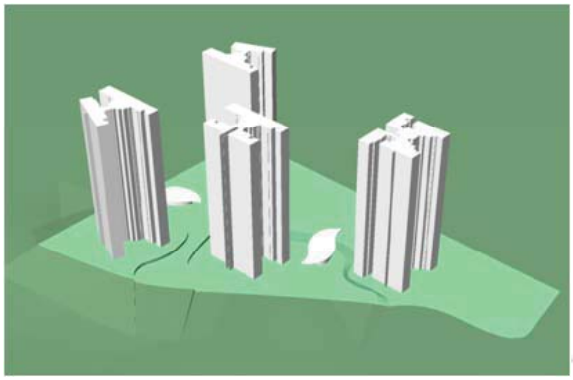
RB1-2 Naturally Ventilated Design and A/C System

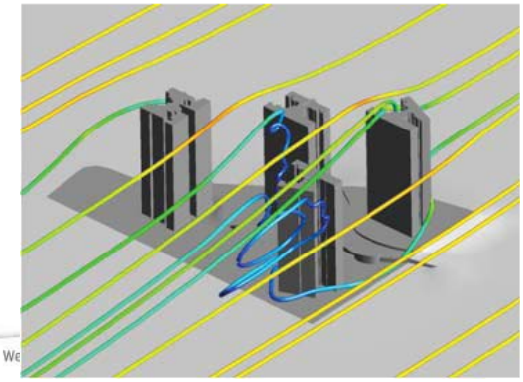
Option 1 – Ventilation Simulation Modelling

Use of ventilation simulation software to identify the most effective building design and layout to achieve good natural ventilation. (Max 20 points)

Notes:

The top 5 typical layouts with the most units should be included in the ventilation simulation. A minimum 80% of the selected typical units should have an weighted average wind velocity of 0.6m/s

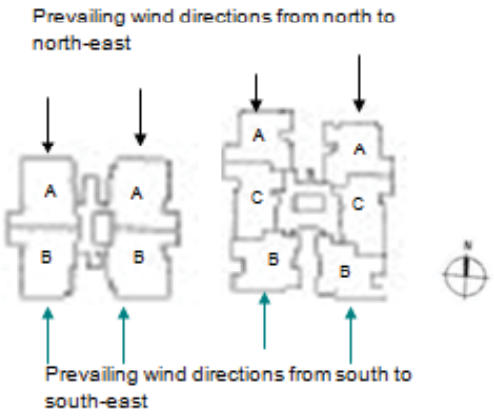




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Option 2- Ventilation Design and A/C Design

For development without use of ventilation simulation software in the design of natural ventilation.
(Max 16 points)



Option 2 (i) Ventilation Design

Building layout and units design for natural ventilation (Max 8 points)

- **Building layout design that utilises prevailing wind conditions to achieve adequate cross ventilation.**

- **Dwelling unit design that allows for true cross ventilation in the living rooms and bedrooms of the dwelling units.**



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Option 2 (ii) A/C Design

Use of the air-conditioners that are certified under the Singapore Energy Labelling Scheme based on the following rating.

Rating	Point Allocation
✓✓✓	4
✓✓✓✓	8

At least 80% of air-conditioners used in all dwelling units are energy labelled

Note: For developments where air-conditioners are not provided, points for Option 2 (ii) on A/C Design will be pro-rated according to Option 2 (i) on ventilation design.

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Part 1 – Energy Efficiency

RB 1-3 Daylighting

Version 4 – Additional Criteria

(a) Use of daylighting and glare simulation analysis to ensure ambient lighting levels meet the level stated in CP38 and SS531

- (Max 3 points)

(b) Day lighting for common areas

- Lift lobbies (1 point)
- Staircases (1 point)
- Car parks (1 point)

- At least 80% of the applicable areas



RB 1-4 Artificial Lighting

Version 3	**Version 4**
•0.3 point for every % improvement over the baseline standard •(Max 12 points)	•0.25 point for every % improvement over the baseline standard •(Max 10 points)

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Part 1 – Energy Efficiency

RB 1-5 Ventilation in Carpark

Version 3	**Version 4**
•Naturally ventilated carparks (8 points) •Use CO Sensors to regulate the demand for mechanical ventilation • Fume extract (6 points) • MV with or without supply (4 points)	•Naturally ventilated carparks (6 points) •Use CO Sensors to regulate the demand for mechanical ventilation • Fume extract (4 points) • MV with or without supply (3 points)

RB 1-6 Lifts

Version 3	**Version 4**
Energy efficient lifts with •AC variable voltage and variable frequency motor drive (1 point) •Sleep mode features (1 point)	•Energy Efficient lifts with AC variable voltage and variable frequency motor drive and sleep mode features (1 point)

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Part 1 – Energy Efficiency

RB 1-8 Renewable Energy

Version 3	**Version 4**
Use of renewable energy •1 point for every 3 KWp of solar energy • (Max 20 points)	Use of renewable energy •3 points for every 1% replacement of electricity (excluding household's usage) by renewable energy • (Max 20 points)



BCA GREEN MARK

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Part 2 – Water Efficiency

RB 2-1 Water Efficient Fittings

Version 3	**Version 4**
Use of water fittings that are certified under the Water Efficiency Labelling Scheme (WELS). Points scored based on each categories of fitting such as WCs, basin taps, sink taps, showerheads, etc • 0.5 point for Good; • 1 point for Very Good; • 2.0 points for Excellent; • At least 90% of the type of fittings (Max 10 points)	Use of water fittings that are certified under WELS. Points scored based on the number and water efficiency rating of the fitting type used.

Rating	Water Efficiency	Weightage for Point Allocation
✓✓	Very Good	8
✓✓✓	Excellent	10

(Max 10 points)

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Part 2 – Water Efficiency

RB 2-3 Irrigation System and Landscaping

Version 4 – Additional Criteria

(c) Use of plants that require minimal watering for 80% of the landscape areas.
(1 point)

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Part 3 – Environmental Protection

RB 3-1 Sustainable Construction*

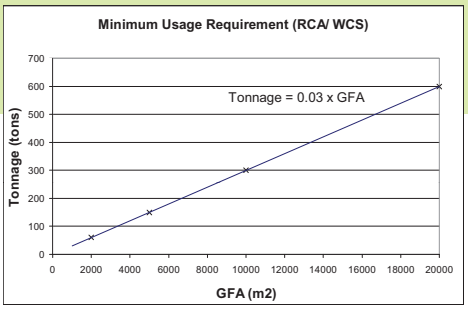
Version 4 – Additional Criteria

(a) Use of Sustainable and Recycled Materials

(i) Green Cements to replace Ordinary Portland Cement by at least 10% by mass for superstructure applications (1 point)

(ii) Use of Recycled Concrete Aggregates and Washed Copper Slag to replace coarse and fine aggregates above or equal to the minimum usage requirements (2 points each)

(Max 5 points)



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Part 3 – Environmental Protection

RB 3-1 Sustainable Construction*

Version 3

(a) Concrete Usage Index (CUI)

Category	CUI Limit (m^3/m^2)
RB (≤15 Storey)	0.55
RB (>15 Storey)	0.60

- 0.1 point for every % reduction in the CUI limit
- (Max 4 points)

Version 4

(b) Concrete Usage Index (CUI)

Project CUI (m^3/m^2)	Points
≤ 0.70	1
≤ 0.60	2
≤ 0.50	3
≤ 0.40	4
≤ 0.35	5

*Pre-requisite Requirement:
Min. Points to be scored under RB 3-1
Green Mark Gold^{plus} ≥ 3 points
Green Mark Platinum ≥ 5 points

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Part 3 – Environmental Protection

RB 3-1 Sustainable Construction

Version 3

(a)Use of sustainable materials and products in building construction:

(i) SGLS certified products

(ii) Products with 30% recycled content by weight or volume.

- ***1 point*** for high impact item
- ***0.5 point*** for low impact item

(Max 6 points)

RB 3-2 Sustainable Product

Version 4

Use of environmental friendly products that are certified by approved local certification body

Applicable for non-structural building components

- ***1 point*** for high impact item
- ***0.5 point*** for low impact item

Higher weightage for products classified to be more environmental friendly

Good	Very Good	Excellent
1	1.5	2

(Max 8 points)

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Part 3 – Environmental Protection

RB 3-2 Greenery	RB 3-3 Greenery Provision
Version 3	**Version 4**
(a) Greenery Provision (GnP) is calculated by considering the 3D volume covered by plants using the Green Area Index (GAI)	Green Plot Ratio (GnPR) is calculated by considering the 3D volume covered by plants using the Leaf Area index (LAI) *Ref: http://floraweb.nparks.gov.sg*

GnP	Points
2.0 to < 3.0	1
3.0 to < 3.5	2
3.5 to < 4.0	3
≥ 4.0	4

GnP	Points
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

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1) Key Changes – Version 3 Vs Version 4

Part 3 – Environmental Protection

RB 3-4 Environment Management Practice
Version 4 – Additional Criteria
(b) Main builder that has track records in the adoption of sustainable, environmentally friendly practices during the construction such as Green and Gracious Builder Award (1 point)

RB 3-4 Environment Management Practice	
Version 3	**Version 4**
(d) Project team comprises of one Certified GM Manager (GMM) and/or GM Professional (GMP) • GMM (1 point) • GMP (2 points) (Max 3 points)	(e) Project team comprises of one Certified GMM , Green Mark Facility Manager (GMFM) and GMP • GMM (0.5 point) • GMFM (0.5 point) • GMP (1 point) (Max 1 point)

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Part 3 – Environmental Protection

RB 3-5 Green Transport	
Version 3	**Version 4**
(d) Provide adequate bicycle parking lots (1 point)	(d) Provide sheltered bicycle parking lots – At least 5% of dwelling units (0.5 point) – At least 10% of dwelling units (1 point)

RB 3-5 Green Transport
Version 4 – Additional Criteria
(b) Provide covered walkway to facilitate connectivity and use of public transport. (1 point) (c) Provide hybrid/electric vehicle recharge stations within the development. (1 point)

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Part 3 – Environmental Protection

RB3-6 Stormwater Management
Version 4 – Additional Criteria
Encourage the treatment of stormwater run-off before discharge to public drains. Points scored based on treatment of run-off: ➢more than 35% of the total site area or paved area (3 points) ➢10% to 35% of the total site area (2 points) ➢up to10% of the total site area (1 point) Note : The treatment of stormwater runoff shall be through provision of infiltration features or design features as recommended in PUB's ABC Water design Guidelines, refer to http://www.pub.gov.sg/abcwaters/abcwatersdesignguidelines/Pages/default.aspx

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Part 4 – Indoor Environmental Qaulity

RB 4-2 Indoor Air Pollutants	
Version 3	**Version 4**
(a) Use of low volatile organic compounds (VOC) paints for at least 90% of the internal wall areas (2 points)	(a) Use of low volatile organic compounds (VOC) paints for at least 90% of the internal wall areas (1 point)

RB 4-4 Indoor Air Quality in Wet Areas	
Version 3	**Version 4**
Provide adequate natural ventilation and daylighting in wet areas •At least 90% of all applicable areas (1 point)	Provide adequate natural ventilation and daylighting in wet areas •50% to 90% of all applicable areas (1 point) •More than 90% of all applicable areas (2 points)

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Examples on achieving Green mark certified rating

Item	Criteria	Points available	Actual points score	Remarks
Part 1	**Energy Efficiency**			
1-1	RETV	15	1.5	•RETV 24.5W/m2
1-2	Naturally ventilated design and A/C system	22	14	•4 ticks A/C(8) •40% North South Orientation & 40% units with cross ventilation (4) •cross ventilation in common areas such as lift lobbies and staircase (2)
1-3	Daylighting	6	2	•Using daylighting at staircase and lift lobbies (2)
1-4	Artificial lighting	10	8	•using PLC at lobbies and T8 lighting at car park (8)
1-5	Ventilation in carparks	6	3	•car park with CO (3)
1-6	Lifts	1	1	•VVVF lift with sleep mode

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Examples on achieving Green Mark certified rating

Item	Criteria	Points available	Actual points score	Remarks
1-7	Energy efficient features	7	1	•Use ductless fans for basement carpark (0.5) •Calculating EEI(0.5)
1-8	Renewable energy	20	0	Nil
	Sub-total for Energy Efficiency	**87 (max)**	**30.5**	

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Examples on achieving Green Mark certified rating

Item	Criteria	Points available	Actual points score	Remarks
Part 2	**Water Efficiency**			
2-1	Water efficient fitting	10	0	•Water fittings with WELS good rating
2-2	Water usage	1	1	•Provision of private metering to major water usage such as irrigation and swimming pool
2-3	Irrigation system and landscaping	3	1	•Use of plants that require little watering
Part 3	**Environment Protection**			
3-1	Sustainable construction	10	1	•CUI of 0.7

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Examples on achieving Green Mark certified rating

Item	Criteria	Points available	Actual points score	Remarks
3-2	Sustainable products	8	4	•Use of environmentally friendly products that are certified by approved local certification body for water proofing for internal wet areas, internal doors, drywalls partitions and wardrobe
3-3	Greenery provision	8	3	•Green Plot Ratio of 2.1 (2) •Use of compost recycled from horticulture waste (1)
3-4	Environmental management practice	8	4	•Tender specified monitoring of energy & water use and construction waste (1) •CONQUAS project (1) •Building user guide (1) •Provision of recycling bin at 1st basement lobby (1)

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Examples on achieving Green Mark certified rating

Item	Criteria	Points available	Actual points score	Remarks
3-5	Green transport	4	2	•Within 500m from bus stop (1) •Provision of bicycle parking lots for 10% of units(1)
3-6	Stormwater management	3	0	
Part 4	**Indoor Environmental Quality**			
4-1	Noise level	1	1	•Tender specified design noise level
4-2	Indoor air pollutants	2	1	•Use of low VOC paint
4-3	Waste Disposal	1	1	•Locating refuse chute at service balcony
4-4	Indoor air quality in wet areas	2	1	•Provision of window opening at 50% of the unit's kitchen, bathroom and toilets

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Examples on achieving Green Mark certified rating

Item	Criteria	Points available	Actual points score	Remarks
Part 5	**Other Green Features**			
5-1	Other green features	7	0	
	Sub-total for other green requirements	**68 (max)**	**20**	
	Total Scores		**50.5**	

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Examples on achieving Green Mark Gold^{PLUS} rating

Item	Criteria	Points available	Actual points score	Remarks
Part 1	**Energy Efficiency**			
1-1	RETV	15	13.5	•RETV 20.5W/m2
1-2	Naturally ventilated design and A/C system	22	14	•4 ticks A/C(8) •40% North South Orientation & 40% units with cross ventilation (4) •cross ventilation in common areas such as lift lobbies and staircase (2)
1-3	Daylighting	6	5	•Daylight simulation (3) •Using daylighting at staircase and lift lobbies (2)
1-4	Artificial lighting	10	10	•using PLC at lobbies and T5 lighting at car park (10)
1-5	Ventilation in carparks	6	3	•car park with CO (3)
1-6	Lifts	1	1	•VVVF lift with sleep mode

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Examples on achieving Green Mark Gold^{PLUS} rating

Item	Criteria	Points available	Actual points score	Remarks
Part 1	**Energy Efficiency**			
1-7	Energy efficient features	7	5.5	•Use ductless fans for basement carpark (0.5) •Calculating EEI(0.5) • Motion sensors at staircases landing (1) • Use lift with gearless drive (1) • Units with gas water heaters (1) • Provide 10 sun pipes (1) • Use of heat recovery at clubhouse (0.5)
1-8	Renewable energy	20	0	Nil
	Sub-total for Energy Efficiency	**87 (max)**	**52**	

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Examples on achieving Green Mark Gold^{PLUS} rating

Item	Criteria	Points available	Actual points score	Remarks
Part 2	**Water Efficiency**			
2-1	Water efficient fitting	10	4	•Water fittings with very good rating for WCs and basin taps (4)
2-2	Water usage	1	1	•Provision of private metering to major water usage such as irrigation and swimming pool
2-3	Irrigation system and landscaping	3	1	•Use of plants that require little watering
Part 3	**Environment Protection**			
3-1	Sustainable construction	10	3	•CUI of 0.5 (3)

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Examples on achieving Green Mark Gold^{PLUS} rating

Item	Criteria	Points available	Actual points score	Remarks
3-2	Sustainable products	8	8	•Use of environmentally friendly products that are certified by approved local certification body for water proofing for internal wet areas, internal doors, drywalls partitions, wardrobe , ceiling board, playground equipment & flooring, drainage, road kerb, timber decking and club house carpets
3-3	Greenery provision	8	5	•Green Plot Ratio of 4 (4) •Use of compost recycled from horticulture waste 1)
3-4	Environmental management practice	8	5	•Tender specified monitoring of energy & water use and construction waste (1) •CONQUAS project (1) •Building user guide (1) •Provision of recycling bin at 1st basement lobby (1) • Project team with GMP (1)

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Examples on achieving Green Mark Gold^{PLUS} rating

Item	Criteria	Points available	Actual points score	Remarks
3-5	Green transport	4	2	•Within 500m from bus stop (1) •Provision of bicycle parking lots for 10% of units(1)
3-6	Stormwater management	3	0	
Part 4	**Indoor Environmental Quality**			
4-1	Noise level	1	1	•Tender specified design noise level
4-2	Indoor air pollutants	2	1	•Use of low VOC paint
4-3	Waste Disposal	1	1	•Locating refuse chute at service balcony
4-4	Indoor air quality in wet areas	2	1	•Provision of window opening at 50% of the unit's kitchen, bathroom and toilets

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Examples on achieving Green Mark Gold^{PLUS} rating

Item	Criteria	Points available	Actual points score	Remarks
Part 5	**Other Green Features**			
5-1	Other green features	7	0	
	Sub-total for other green requirements	**68 (max)**	**33**	
	Total score	**155 (max)**	**85**	

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THANK YOU

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BCA GREEN MARK

Industry Briefing

BCA Green Mark for New Non – Residential Buildings Version NRB/ 4.0



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Agenda

1. Summary of Key Changes
2. Green Mark for New Non – Residential Building Version NRB/ 4.0
3. Case Study on Achieving Certified and Gold^{plus} Rating

Green Mark	Try Again		Certified		Gold		Gold^{plus}		Platinum	
Score	0	49	50	74	75	84	85	89	90	>90

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Summary of Key Changes – Part 1 Energy Related Requirements:

1)**Removal of Max. 50 points Caps** for both "Energy Related Requirements" and "Other Green Requirements"

2) Pre-requisite Requirement - Min. prescribed air-conditioning system efficiency

3) Pre-requisite requirement - Permanent instrumentation for monitoring of the water-cooled chilled-water plant efficiency

4) Additional Criteria – Heat balance substantiating test for water-cooled chilled-water plant

5) Additional Criteria – NRB 1-5 Daylighting

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Summary of Key Changes – Other Green Requirements:

1) Pre-requisite requirement - Min. points to be scored for NRB 3-1 Sustainable Construction for higher awards

2) Enhance scoring on sustainable construction materials to support **'Multi-tiers'** Green product ratings system

3) Green Plot Ratio (GnPR) computed using **prescribed Leaf Area Index (LAI)**

4) Additional Criteria – NRB 4-4 IAQ Management

5) Additional Criteria - NRB 3-7 Stormwater Management

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To achieve Green Mark Award

Pre-requisite Requirement

All relevant pre-requisite requirements for the specific Green Mark Rating are to be complied with

Energy Related Requirements
Min 30 points

+

Other Green Requirements
Min 20 points

Elective Requirement for Energy Improvement (Combination of the following items to meet 30 points)
~~**(Max 50 points** *see note 1 **)**~~

Part 1 - Energy Efficiency
1-1 Building Envelope - ETTV
1-2 Air-Conditioning System
1-3 Building Envelope – Design/Thermal Parameters
1-4 Natural Ventilation / Mechanical Ventilation
1-5 Daylighting
1-6 Artificial Lighting
1-7 Ventilation at Common Areas and Carparks
1-8 Ventilation for Common areas
1-9 Lifts and Escalators
1-10 Energy Efficient Features
1-11 Renewable/Clean energy

Elective Requirement from other areas (Combination of the following items to meet 20 points)

~~**(Max 50 points)**~~

Part 2 - Water Efficiency

Part 3 – Environmental Protection

Part 4 - Indoor Environmental Quality

Part 5 – Other Green Features

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Points Allocation – BCA Green Mark for New NRB

Category	Version 3 Points	Version 4 Points
(I) Energy Related Requirements		
Part 1 : Energy Efficiency		
1-1 Building Envelope – Thermal Performance –ETTV	15	12
1-2 Air-Conditioning System	27	30
Sub-Total - NRB 1-1 to 1-2	**42**	**42**
1-3 Thermal Performance of Building Envelope (non a/c)	29	35 ↑
1-4 Natural Ventilation and/or Mechanical Ventilation (exclude carparks)	13	20 ↑
Sub-Total - NRB 1-3 to 1-4	**42**	**55**

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Points Allocation – BCA Green Mark for New NRB

Category	Version 3 Points	Version 4 Points
(I) Energy Related Requirements		
Part 1 : Energy Efficiency		
1-5 Daylighting	-	6
1-6 Artifical Lighting	12	12
1-7 Ventilation in Carparks	5	4
1-8 Ventilation in Common Areas	5	5
1-9 Lift and Escalators	3	2
1-10 Energy Efficient Practices & Features	12	12
1-11 Renewable Energy	20	20
Sub-Total - NRB 1-5 to 1-11	**57**	**61**
Total Category Score for Part 1:	**99**	**116 (Max)**

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Points Allocation – BCA Green Mark for New NRB

Category	Version 3 Points	Version 4 Points
(II) Other Green Requirements		
Part 2 : Water Efficiency		
2-1 Water Efficient Fittings	8	10
2-2 Water Usage and Leak Detection	2	2
2-3 Irrigation System and Landscaping	2	3
2-4 Water Consumption of Cooling Towers	2	2
Category Score for Part 2 – Water Efficiency	**14**	**17**
Part 3 : Environmental Protection		
3-1 Sustainable Construction	14	10
3-2 Sustainable Materials	-	8
3-3 Greenery	6	8
3-4 Environmental Management Practice	8	7
3-5 Green Transport	2	4
3-6 Refrigerants	2	2
3-7 Stormwater Management	-	3
Category Score for Part 3 – Environmental Protection	**32**	**42**

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Points Allocation – BCA Green Mark for New NRB

Category	Version 3 Points	Version 4 Points
Part 4 : Indoor Environmental Quality		
4-1 Thermal Comfort	2	1
4-2 Noise Level	2	1
4-3 Indoor Air Pollutants	2	2
4-4 Indoor Air Quality Management (IAQ)	-	2
4-5 High Frequency Ballasts	2	2
Category Score for Part 4 – Indoor Environmental Quality	**8**	**8**
Part 5 : Other Green Features		
5-1 Green Features & Innovations	7	7
Category Score for Part 5 – Other Green Features	**7**	**7**
Total Green Mark Score:	**160**	**190 (Max)**



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Version 3 and Version 4 – Pre-requisite Requirements

- BCA Green Mark Gold^{plus} and Platinum Rating

❑ Air-Conditioned Buildings



Projects should achieve:

- At least **25% energy savings** to qualify for GM Gold^{plus} rating
- At least **30% energy savings** to qualify for GM Platinum rating

Projects should achieve:

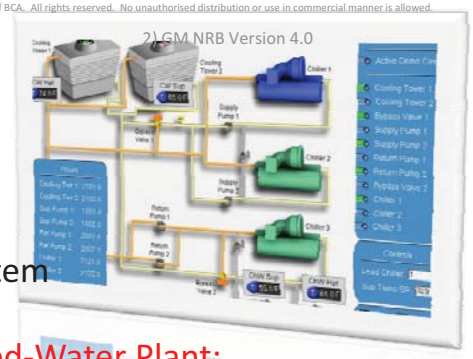
- ETTV of **42 W/m^2** to qualify for GM Gold^{plus} rating
- ETTV of **40 W/m^2** to qualify for GM Platinum rating

❑ Non Air-Conditioned Buildings

- Simulation or wind tunnel testing to ensure good natural ventilation



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Version 4 – Additional Pre-requisite Requirements

❑ Air-Conditioned Buildings

1) Prescribed min efficiency of air-conditioning system

(i)For Buildings using Water-cooled Central Chilled-Water Plant:

Green Mark Rating	Peak Building Cooling Load (ton)	
	< 500	≥ 500
	Efficiency (kW/ton)	
Certified	0.80	0.70
Gold	0.80	0.70
Gold^{Plus}	0.70	0.65
Platinum	0.70	0.65

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2) Prescribed min efficiency of air-conditioning system

(ii) For Buildings using Air-cooled Chilled-Water Plant or Unitary Air-Conditioners:

Green Mark Rating	Peak Building Cooling Load (ton)	
	< 500	≥ 500
	Efficiency (kW/ton)	
Certified	0.90	0.80
Gold	0.90	Not applicable *
Gold^{plus}	0.85	
Platinum	0.78	

3) Permanent Instrumentation for Monitoring of Central Chilled-Water Plant Efficiency

4) Minimum points to be scored under NRB 3-1 Sustainable Construction

- Green Mark Gold^{Plus} ≥ 3 points
- Green Mark Platinum ≥ 5 points

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❑ Non Air-Conditioned Buildings

1) Platinum Rating

- Use of ventilation simulation and analysis to identify the most effective building design and layout
- Implement the simulation result and recommendations

2) Minimum points to be scored under NRB 3-1 Sustainable Construction

- Green Mark Gold^{Plus} ≥ 3 points
- Green Mark Platinum ≥ 5 points

BCA GREEN MARK

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Part 1 – Energy Efficiency

NRB 1-1 Building Envelope – ETTV*	
Version 3	**Version 4**
• Maximum Permissible = 50 W/m^2	• Maximum Permissible = 50 W/m^2
• **42.5 W/m^2** for max. **15 points**	• **40W/m^2** for max.**12 points**

*Pre-requisite Requirement:
Min. Points to be scored under NRB 3-1
Green Mark Gold^{plus} ≥ 42 W/m^2
Green Mark Platinum ≥ 40 W/m^2

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Part 1 – Energy Efficiency

NRB 1- 2 Air-conditioning System – Air-Conditioned Plant (Water-Side)*	
Version 3	**Version 4**
(a) Air-conditioned Plant OR **(b) Unitary Air-Conditioners e.g. VRF system** • Baseline efficiency as per code requirements •Air-con system efficiency assessed basing on full-installed capacity	***(a) Water-Cooled* Chilled-Water Plant** OR ***(b) Air-Cooled* Chilled-Water Plant/ *Unitary Air-Conditioners*** • **Prescribed** Min. air-con system efficiency

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Part 1 – Energy Efficiency NRB 1-2 Air-Conditioning System

The efficiency of the Air-con system can be computed basing on:

1) **Full installed** capacity (exclude standby) OR

2) **Expected operating efficiency** of the system at part-load condition

* most frequent occurring part-load condition during the normal building operating hours as defined:

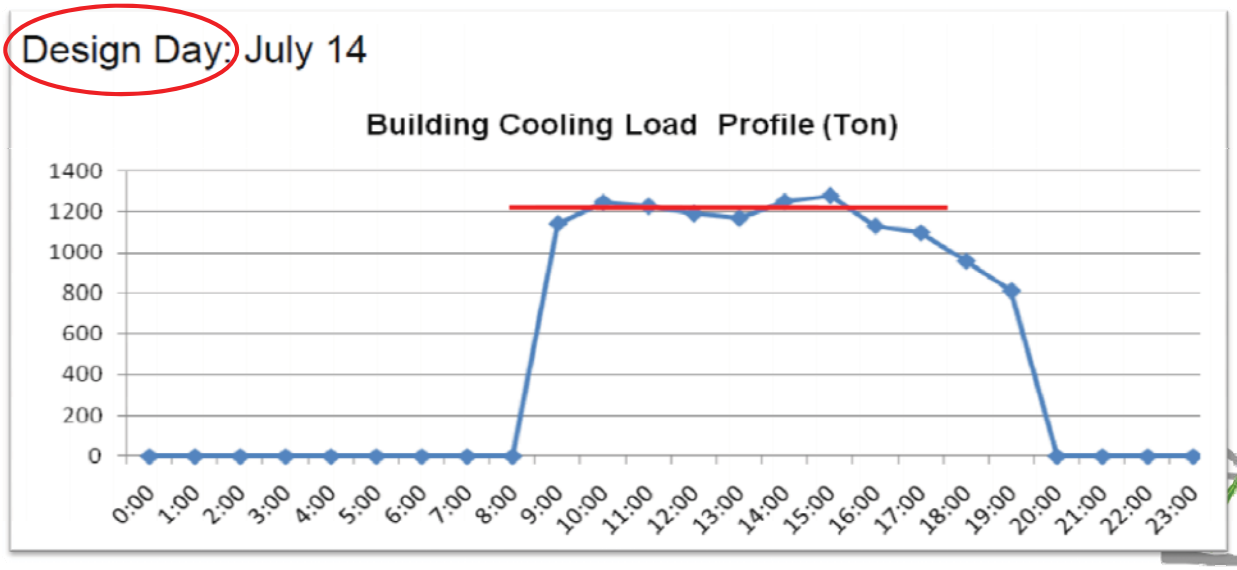
Office Buildings: ▪ Monday to Friday : 9 am to 6 pm ▪ Saturday : 9 am to 11 am Institutional: ▪ Monday to Friday : 9 am to 6 pm	Retail Malls : ▪ Monday to Sunday : 10 am to 10 pm Hotel and Hospital : ▪ Monday to Sunday : 24 Hours Industrial and other Building Types ▪ To be determined based on operating hours

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Part 1 – Energy Efficiency NRB 1-2 Air-Conditioning System

Expected operating efficiency of the system at part-load condition

Determine the most frequent occurring part-load condition



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Part 1 – Energy Efficiency

NRB 1- 2 Air-conditioning System – Air-Conditioned Plant*

Version 4 – Additional Criteria

(d) Instrumentation for Monitoring of Central Water-Cooled Chilled-Water Plant Efficiency, in terms of **kW/RT,** in accordance to ASHRAE Guide 22 and AHRI 550/590
– ***1 Pre-requisite point***

•The installed instrumentation shall have the capability of calculating a resultant plant efficiency, kW/RT, within 5% of the true value.



*Pre-requisite Requirement:
Instrumentation for monitoring of water-cooled chilled water plant efficiency

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NRB 1- 2 Air-conditioning System – Air-Conditioned Plant*

Version 4 – Additional Criteria

The instrumentation and installation are required to comply with:

1) Location and installation of the measuring devices to meet the manufacturer's recommendation.

2) Data acquisition system shall have a minimum resolution of 16-bit.

3) Data Logging Software interval: All Data should be trended at 1 minute sampling time interval.



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NRB 1- 2 Air-conditioning System – Air-Conditioned Plant*

Version 4 – Additional Criteria

The instrumentation and installation are required to comply with:

4) Flow meters for chilled- water and condenser water loop shall be ultrasonic /full bore magnetic type or equivalent in terms of accuracy.

5) Temperature sensors with min . accuracy of ± 0.05ºC @ 0ºC.

6) Provision of two spare thermo-wells located at both side of the temperature sensor for verification.

7) All thermo-wells shall be installed to ensure the sensors can be in direct contact with fluid flow.



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NRB 1- 2 Air-conditioning System – Air-Conditioned Plant*

Version 4 – Additional Criteria

(d) Instrumentation for Monitoring of Chilled-Water Plant Efficiency

Methodology for determining total uncertainty of measurement:

$$Error_{rsm} = \sqrt{\left(\sum (U_N)^2\right)}$$

Where U_N = individual uncertainty of variable N (%)

N = mass flow rate, electrical power input or ΔT

- **Additional 1% is to be included to the uncertainty by flow meters**

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NRB 1- 2 Air-conditioning System – Air-Conditioned Plant*

Version 4 – Additional Criteria

(d) Instrumentation for Monitoring of Chilled-Water Plant Efficiency

Instrumentation Accuracy Consideration:

Item	Description	Measurement Error
01	Temperature Sensors - 10K/30K Thermistor - Platinum Resistance Thermometers	± 0.03°C – 0.05°C @ 0°C
02	Flow Sensor / Meter - Ultrasonic - Full bore magnetic	± 0.5 - 1% over entire measurement range
03	Power Meter	ANSI C12.1-2008, Class 1 ± 1%

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Part 1 – Energy Efficiency

NRB 1- 2 Air-conditioning System – Air-Conditioned Plant* (*Heat Balance*)

Version 4 – Additional Criteria

(e) Heat balance – substantiating test for water-cooled chilled-water plant – ***1 point;***

The heat balance is represented by the following equation:

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

where $q_{condenser}$ = heat rejected
$q_{evaporator}$ = cooling load
W_{input} = measured electrical power input to compressor

$$\text{Percent Heat Balance} = \left| \frac{(q_{evaporator} + W_{input}) - q_{condenser}}{q_{condenser}} \right| \times 100\% \leq 5\%$$

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Part 1 – Energy Efficiency

NRB 1-4 Mechanical Ventilation

Version 4 – Additional Criteria

(b) Encourage energy efficient mechanical ventilation system design as preferred ventilation mode to air-conditioning in buildings.

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

0.6 points for every % improvement in air distribution system efficiency.

Up to ***15 points***

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Part 1 – Energy Efficiency

RB 1-8 Renewable Energy

Version 3	**Version 4**
EEI ≥ 30 kWh/m^2/year •**5 points** for every 1% replacement of electricity (include tenant's usage) •**3 points** for every 1% replacement of electricity (exclude tenant's usage)	
	EEI < 30 kWh/m^2/year •**3 points** for every 1% replacement of electricity (include tenant's usage) •**1.5 points** for every 1% replacement of electricity (exclude tenant's usage)

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Part 2 – Water Efficiency

NRB 2-4 Water Consumption of Air-conditioning Equipment

Version 3	**Version 4**
(a) Use of cooling tower treatment system to achieve as least **6 cycles of concentration**	(a) Use of cooling tower treatment system to achieve as least **7 cycles of concentration**

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Part 3 – Environmental Protection

NRB 3-5 Green Transport	
Version 3	**Version 4**
(d) Provision of adequate bicycle parking lots	(d) Provision of sheltered bicycle parking lots with shower and changing facilities. • 0.5 point for 1.5% x [GFA/10] • 1 point for 3% x [GFA/10] Min. 10 lots; Cap @ 50 lots



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Part 4 – Indoor Environmental Quality

NRB 4-4 Indoor Air Quality (IAQ) Management
Version 4 – Additional Criteria
(a) Provision of filtration media and Differential Pressure monitoring for filters in AHU as per SS 554 Clause 4.3.4.5 – ***1 point***
(b) Implement effective IAQ management plan after construction inclusive of internal surface condition testing – ***1 point*** • Deposit thickness test OR • Vacuum test



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GM Criteria – Certified Rating

(I) Energy Related Requirements	Points Allocation	Points Scored	Remarks
Part 1 : Energy Efficiency			
1-1 Building Envelope – ETTV	12	0	• ETTV = 50 W/m^2
1-2 Air-Conditioning System	30	19	• Chiller plant efficiency of 0.80 kW/RT **(12)** • 20% improvement in air systems **(4)** •Instrumentation for monitoring of chiller plant efficiency **(1)** •VSD controls for chilled-water pumps and CT fans **(1)** •CO_2 sensors for regulating the outdoor air flow rate **(1)**

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GM Criteria – Certified Rating

(I) Energy Related Requirements	Points Allocation	Points Scored	Remarks
1-5 Daylighting	6	0	
1-6 **Artificial** Lighting	12	9	• 30% improvement in lighting power budget
1-7 Ventilation in Car parks	4	0	
1-8 Ventilation in Common Areas	5	1	• Mode of ventilation for toilets & Staircases : **MV**
1-9 Lift and Escalators	2	0	• Development w/o lift and escalator
1-0 Energy Efficient Practices & Features	12	1	• Computation of EEI
1-11 Renewable Energy	20	0	
Category Score for Part 1 – Energy Efficiency		30	

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GM Criteria – Certified Rating

(II) Other Green Requirements	Point Allocations	Points Scored	Remarks
Part 2 : Water Efficiency			
2-1 Water Efficient Fittings	10	0	• Water fittings with WELS good rating
2-2 Water Usage and Leak Detection	2	1	• Provision of private metering to major water usage
2-3 Irrigation System and Landscaping	3	1	•Use of plants that requir little watering
2-4 Water Consumption of Cooling Tower	2	1	• Cooling tower water treatment able to achieve 7 Cycle of Concentration
Category Score for Part 2 – Water Efficiency		3	

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GM Criteria – Certified Rating

Part 3 : Environmental Protection	Point Allocations	Points Scored	Remarks
3-1 Sustainable Construction	10	1	•CUI = 0.7 m^3/m^2
3-2 Sustainable Materials	8	2	• Environmentally friendly water proofing membrane (0.5) & internal partition (1) • Use of precast concrete road kerbs (0.5)
3-3 Greenery Provision	8	3	• GnPR = 0.5 (1) •Restoration of trees onsite (1) •Use of horticulture waste (1)

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GM Criteria – Certified Rating

Part 3 : Environmental Protection	Point Allocations	Points Scored	Remarks
3-4 Environmental Management Practice	8	4	• Effective environmental friendly programmes (1) •CONQUAS project (1) •Building user guide (1) • Provision of recycling bin (1)
3-5 Green Transport	4	1	• Within 500m from bus stop (1)
3-6 Refrigerants	2	2	•Refrigerant with 0 ODP (1) • Refrigerant leak detection system (1)
3-7 Stormwater Management	3	0	
Category Score for Part 3 – Environmental Protection		13	

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GM Criteria – Certified Rating

(II) Other Green Requirements	Point Allocations	Points Scored	Remarks
Part 4 : Indoor Environmental Quality			
4-1 Thermal Comfort	1	1	•Design for thermal comfort
4-2 Noise Level	1	1	•Design occupied spaces as per SS 553 recommended ambient sound level
4-3 Indoor Air Pollutants	2	0	
4-4 IAQ Management	2	0	
4-5 High Frequency Ballasts	2	2	• Use of high frequency ballasts
Category Score for Part 4 – Indoor Environmental Quality		4	

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GM Criteria – Certified Rating

(II) Other Green Requirements	Point Allocations	Points Scored	Remarks
Part 5 : Other Green Features			
5-1 Green Features & Innovations	7	0	
Category Score for Part 5 – Other Green Features		**0**	

(II) Other Green Requirements	Points Scored
Category Score for Part 2 – Water Efficiency	**3**
Category Score for Part 3 – Environmental Protection	**13**
Category Score for Part 4 – Indoor Environmental Quality	**4**
Sub-total for Other Green Requirements	**20**

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GM Criteria – Goldplus Rating

(I) Energy Related Requirements	Points Allocation	Points Scored	Remarks
Part 1 : Energy Efficiency			
1-1 Building Envelope – ETTV	12	**9.6**	• ETTV = 42 W/m2
1-2 Air-Conditioning System	30	**24.8**	• Chiller plant efficiency of 0.65 kW/RT **(16.8)** • 20% improvement in air systems **(4)** • Instrumentation for monitoring of chiller plant efficiency **(1)** • Heat Balance **(1)** • VSD controls for chilled-water pumps and CT fans **(1)** • CO2 sensors for regulating the outdoor air flow rate **(1)**

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GM Criteria – Goldplus Rating

(I) Energy Related Requirements	Points Allocation	Points Scored	Remarks
1-5 Daylighting	6	3.5	• Daylighting simulation (3) • Daylighting in staircases (0.5)
1-6 Artificial Lighting	12	9	• 30% improvement in lighting power budget
1-7 Ventilation in Car parks	4	0	•Development w/o car park
1-8 Ventilation in Common Areas	5	1	• Mode of ventilation for toilets & staircases: MV
1-9 Lift and Escalators	2	0	• Development w/o lift and escalator
1-0 Energy Efficient Practices & Features	12	2.5	• EEI (1) • Photosensors (1.5)
1-11 Renewable Energy	20	0	
Category Score for Part 1 – Energy Efficiency		50.4	

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GM Criteria – Goldplus Rating

(II) Other Green Requirements	Point Allocations	Points Scored	Remarks
Part 2 : Water Efficiency			
2-1 Water Efficient Fittings	10	8	• Water fittings with WELS Very Good rating
2-2 Water Usage and Leak Detection	2	2	• Provision of private metering to major water usage (1) • Meters linked to BMS (1)
2-3 Irrigation System and Landscaping	3	1	• Use of plants that require little watering
2-4 Water Consumption of Cooling Tower	2	1	• Cooling tower water treatment able to achieve 7 Cycle of Concentration
Category Score for Part 2 – Water Efficiency		12	

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GM Criteria – Gold^{plus} Rating

Part 3 : Environmental Protection	Point Allocations	Points Scored	Remarks
3-1 Sustainable Construction	10	4	• CUI = 0.7 m^3/m^2 (1) • Use of green cement (1) •Use of RCA to replace coarse aggregate (2)
3-2 Sustainable Materials	8	2	• Environmentally friendly water proofing membrane (0.5) & internal partition (1) • Use of precast concrete road kerbs (0.5)
3-3 Greenery Provision	8	4	• GnPR = 1.0 (2) •Restoration of trees onsite (1) •Use of horticulture waste (1)

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GM Criteria – Gold^{plus} Rating

Part 3 : Environmental Protection	Point Allocations	Points Scored	Remarks
3-4 Environmental Management Practice	8	4	• Effective environmental friendly programmes (1) • CONQUAS project (1) • Building user guide (1) • Provision of recycling bin (1)
3-5 Green Transport	4	2	• Within 500m from bus stop (1) •Bicycle parking lots (1)
3-6 Refrigerants	2	2	• Refrigerant with 0 ODP or GWP < 100 • Refrigerant leak detection system
3-7 Stormwater Management	3	0	
Category Score for Part 3 – Environmental Protection		18	

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GM Criteria – Goldplus Rating

(II) Other Green Requirements	Point Allocations	Points Scored	Remarks
Part 4 : Indoor Environmental Quality			
4-1 Thermal Comfort	1	1	• Design for thermal comfort
4-2 Noise Level	1	1	• Design occupied spaces as per SS 553 recommended ambient sound level
4-3 Indoor Air Pollutants	2	0	
4-4 IAQ Management	2	0	
4-5 High Frequency Ballasts	2	2	• Use of high frequency ballasts
Category Score for Part 4 – Indoor Environmental Quality		4	

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GM Criteria – Goldplus Rating



85.4

(II) Other Green Requirements	Point Allocations	Points Scored	Remarks
Part 5 : Other Green Features			
5-1 Green Features & Innovations	7	1	• Carbon footprint of development
Category Score for Part 5 – Other Green Features		1	

(II) Other Green Requirements	Points Scored
Category Score for Part 2 – Water Efficiency	12
Category Score for Part 3 – Environmental Protection	18
Category Score for Part 4 – Indoor Environmental Quality	4
Category Score for Part 5 – Other Green Features	1
Sub-total for Other Green Requirements	35

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Building and Construction Authority

Thank you.



BCA GREEN MARK

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Topics:-

1) **Daylighting & Glare Simulation Methodology** (RB 1-3 & NRB 1-5)

2) **Sustainable Construction** (RB 3-1 & NRB 3-1)

3) **Sustainable Products** (RB 3-2 & NRB 3-2)

4) **Carbon Footprint** (RB 5-1 & NRB 5-1)



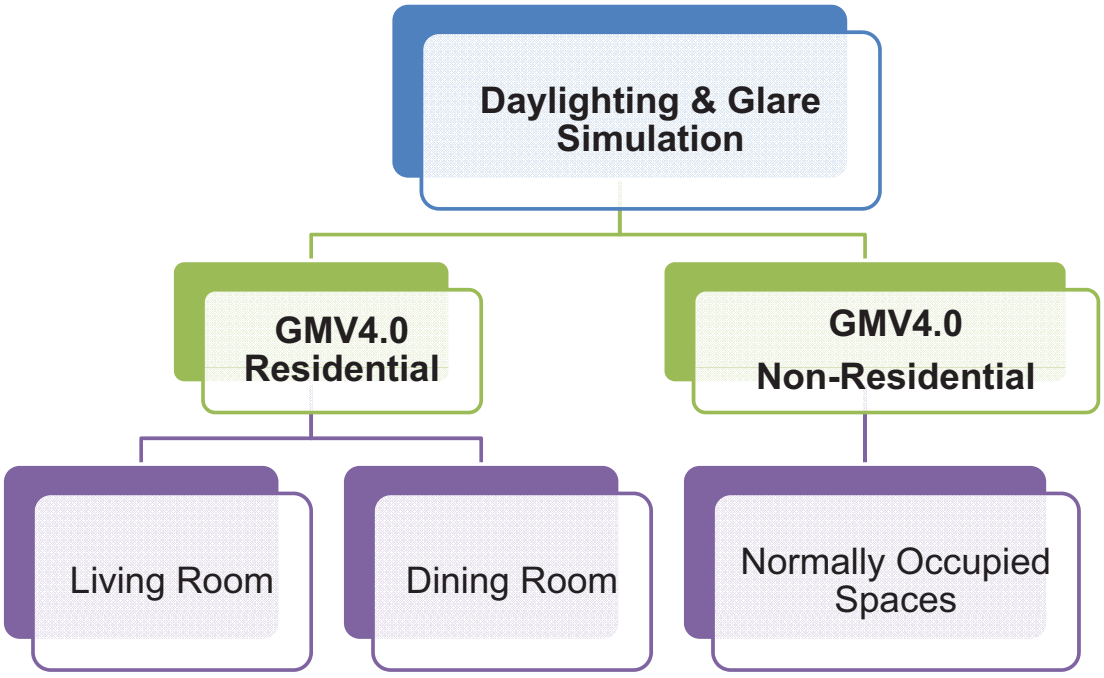
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Daylighting & Glare Simulation Methodology



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Residential Buildings

RB 1-3 Daylighting

Encourage design that optimises the use of effective daylighting to reduce energy use for artificial lighting.

(a) Use of daylight and glare simulation analysis to verify the adequacy of ambient lighting levels in all dwelling unit's living and dining areas. The ambient lighting levels should meet the illuminance level and Unified Glare Rating (UGR) stated in SS CP 38 – Code of Practice for Artificial lighting in Buildings and SS 531:Part 1:2006 – Code of Practice for Lighting of Work Places.

Extent of coverage: At least 80% of the units with daylighting provisions meet the minimum illuminance level and are within the acceptable glare exposure.

Points scored based on the extent of perimeter daylight zones

Distance from the Façade Perimeters (m)	Points Allocation
≥ 3.0	1
4.0 – 5.0	2
> 5.0	3

(Up to 3 points)

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Non-Residential Buildings

NRB 1-5 Daylighting

Encourage design that optimises the use of effective daylighting to reduce energy use for artificial lighting.

(a) Use of daylighting and glare simulation analysis to verify the adequacy of ambient lighting levels in meeting the illuminance level and Unified Glare Rating (UGR) stated in SS 531:Part 1:2006 – Code of Practice for Lighting of Work Places.

Extent of coverage: At least 75% of the units with daylighting provisions meet the minimum illuminance level and are within the acceptable glare exposure.

Points scored based on the extent of perimeter daylight zones

Distance from the Façade Perimeters (m)	Points Allocation
≥ 3.0	1
4.0 – 5.0	2
> 5.0	3

(Up to 3 points)

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Simulation Software

Minimum capability to capture the following components into consideration:-

Component	Parameters
Direct Sky	• Relative direct illuminance and angle of that particular sky • Visible transmittance of each glazing material through which daylight travels
Externally Reflected	• Reflectance of materials assigned to all external objects, such as ground and other buildings • Relative surface angle of materials and glazing transmittances
Internally Reflected	• Reflectance of materials assigned to all interior objects, such as walls, doors, ceilings and partitions • Relative surface angle of materials
Multiple Light Reflections	• Inter-reflections of light off multiple surfaces • Relative surface angle of materials

Software Tool Examples

Radiance, Autodesk Ecotect, Integrated Environmental Solutions (IES) etc.

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Simulation Methodology for Daylighting Analysis

Components	Parameters
Computation domain	Development of interest, immediate surroundings and buildings
Computation coverage	All storey levels of each building tower
Selected date	22nd for the month of Dec, Mar, June & Sept
Sky condition	Overcast sky
Time	1300 hours
Computation grid	0.7m off the ground
Illuminance scale range	0 lux to 500 lux, with interval of 50 lux

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Simulation Methodology for Glare Analysis

Components	Parameters
Computation domain	Development of interest, immediate surroundings and buildings
Computation coverage	All storey levels of each building tower
Selected date	22nd for the month of Dec, Mar, June & Sept
Sky condition	Sunny sky
Time	1000 hours & 1600 hours
No. of computation viewpoint	Determine through Sunpath analysis; at least one viewpoint for each building façade orientation
Viewpoint location	1.25m off the ground

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Computation Formula

Residential & Non-Residential Buildings

The percentage of units achieving effective daylighting is given by:

$$\frac{\text{Units achieving minimum required illuminance level}}{\text{Total number of units}} \times 100\%$$

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Non-Residential Buildings – Working Example

Proposed development comprises a 30 storey office block with 60 office units. Daylight and glare simulation has been conducted for the development. Based on simulation, 75% of all office units (i.e. 45 units) can achieve effective daylighting at a distance of 4.5m from building façade perimeters and meet the acceptable Unified Glared Rating .

Unit Type	No. of Unit Types	Average Distance from Façade Perimeters (m)
1	10	4.6
2	20	5.3
3	15	5.1
4	15	2.8

75% of units achieve effective daylighting

Meet requirement: At least 75% of units

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Unit Type	No. of Unit Types	Average Distance from Façade Perimeters (m)
1	10	4.6
2	20	5.3
3	15	5.1
4	15	2.8

Weighted average distance (m)

$$= \frac{(10)(4.6) + (20)(5.3) + (15)(5.1) + (15)(2.8)}{60}$$

= 4.5m

Distance for 4.5m from building perimeters ⇨

Distance from Façade Perimeters (m)	Points Allocation
≥ 3.0	1
4.0 - 5.0	2
> 5.0	3

Points scored for 1-5(a) = 2.0 points

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Sustainable Construction



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Residential & Non-Residential Buildings

GMV4.0 Criteria	Category	Point Allocations
RB	3-1 Sustainable Construction	10
NRB		10

Prerequisite Requirement:

Minimum score under this criterion:

Green Mark Gold^{Plus} ≥ 3 points

Green Mark Platinum ≥ 5 points

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Sustainable Construction

Residential & Non-Residential Buildings

Encourage recycling and the adoption of building designs, construction practices and materials that are environmentally friendly and sustainable.

(a) Use of Sustainable and Recycled Materials

(i) Green Cements with approved industrial by product (such as Ground Granulated Blastfurnace Slag (GGBS), silica fume, fly ash) to replace Ordinary Portland Cement (OPC) by at least 10% by mass for superstructural works.

1 point

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Sustainable Construction

Residential & Non-Residential Buildings

(ii) Recycled Concrete Aggregates (RCA) and Washed Copper Slag (WCS) from approved sources to replace coarse and fine aggregates for concrete production of main building elements.

Note (3) : For structural building elements, the use of RCA and WCS shall be limited to maximum 10% replacement by mass of coarse/fine aggregates respectively or as approved by the relevant authorities.

Extent of Coverage : The total quantity used (in tonnage) for replacement of coarse or fine aggregates must not be less than the minimum usage requirement that is [0.03 x Gross Floor Area (GFA in m^2)]

2 points for the use of RCA to replace coarse aggregates

2 points for the use of WCS to replace fine aggregates

Where the total quantity used (in tonnage) for replacement of coarse or fine aggregates is at least two times (2x) that of the minimum usage requirement.

4 points for the use of RCA

4 points for the use of WCS

(Up to 5 points for RB 3-1(a)(i) & (a)(ii))

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Sustainable Products



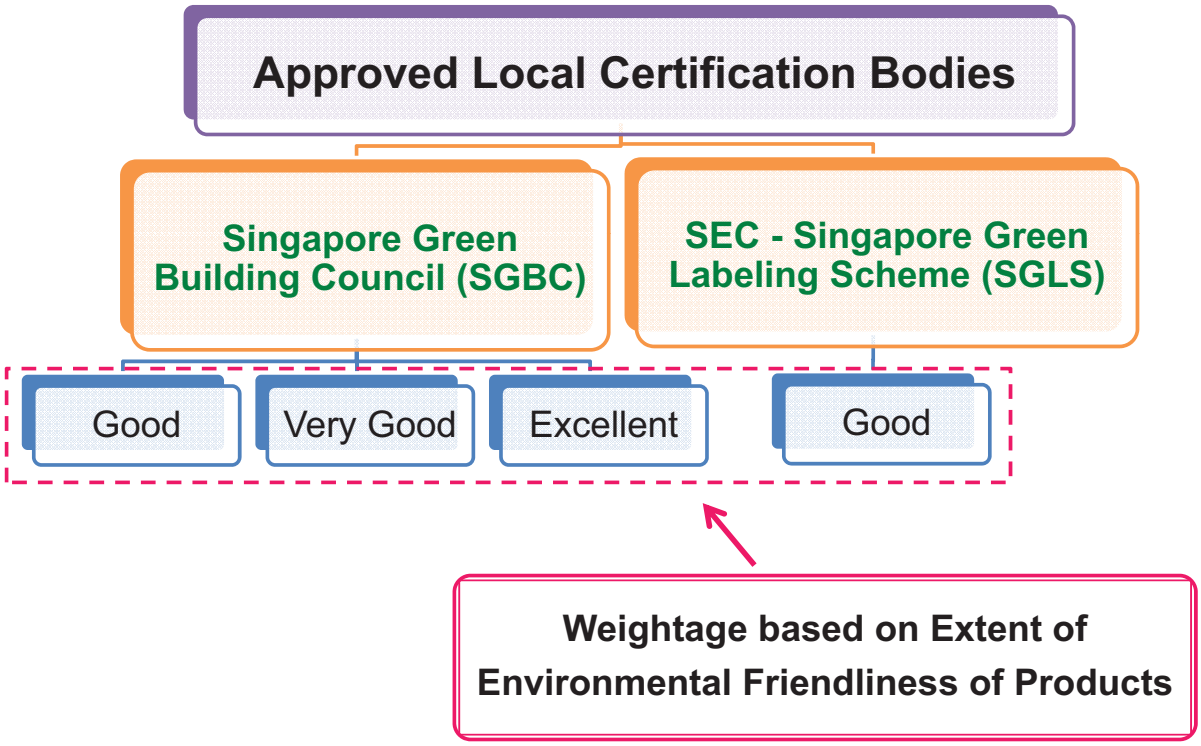
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Sustainable Products

Residential & Non-Residential Buildings

RB 3-2 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.	Weightage based on the extent of environmental friendliness of products			Points scored based on the weightage and the extent of coverage & impact 1 point for high impact item 0.5 point for low impact item (Up to 8 points)
	Good	Very Good	Excellent	
	1	1.5	2	

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Weightage based on Extent of Environmental Friendliness of Products

1. Singapore Green Building Council (SGBC)
-- focuses on building products

Score (Based on SGBC methodology)

50-60%.....	✓	**Good**
61-75%.....	✓✓	**Very Good**
76-85%.....	✓✓✓	**Excellent**
85% & above...	✓✓✓✓	**Leader**

Weightage based on the extent of environmental friendliness of products		
Good	Very Good	Excellent
1	1.5	2

SGBC Green Product label Classification ✓✓✓

Note:- Scale may vary with specific to product categories

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Weightage based on Extent of Environmental Friendliness of Products

Singapore Green Building Council (SGBC)

8 Building product groups:

1. Mechanical
2. Electrical
3. Façade & Envelope
4. Concrete & Structure
5. Interior Works
6. Interior Finishes
7. Recycled Materials
8. Renewable Energy



Product listing:

http://www.sgbc.sg/index.php/listing/products/

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Sustainable Products – Example

Example of a proposed development with the following provisions:

(a) Use of carpets for all office spaces. Product is not certified.

(b) Use of panel boards as internal partitions for more than 50% of the office spaces and the product is rated to be 'Very Good' by the approved certification body.

(c) Precast concrete road kerbs. Product is rated as 'Good' by approved local certification body.

(d) Use of roof waterproofing coating. Product is rated as 'Very Good' by approved local certification body.

(e) Use of wooden doors for all areas. Product is rated as 'Excellent' by approved local certification body.

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Sustainable Products – Example

Products and Extent of coverage		With approved certification	Points allocated based on impact (A)	Weightage based on rating (B)	Points scored (AxB)
(a)	Carpets for all office spaces	No	NA	NA	0
(b)	Panel boards as internal partition for more than 50% of office spaces	Yes	1	1.5	1.5
(c)	Precast road kerbs	Yes	0.5	1	0.5
(d)	Roof waterproofing	Yes	0.5	1.5	0.75
(e)	Wooden doors for all areas	Yes	1	2	2

Therefore, points scored for 3-2 (ii) = 1.5 +0.5+0.75+2 = 4.75 points

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Carbon Footprint



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Residential & Non-Residential Buildings

RB 5-1 Green Features and Innovations

Encourage the use of other green features which are innovative and have positive environmental impact.

Examples :

- Pneumatic waste collection system
- Carbon footprint of development
- Dual chute system
- Self cleaning façade system
- Conservation of existing building structure
- Water efficient washing machines with Good rating and above.
- etc

2 points for high impact item

1 point for medium impact item

0.5 point for low impact item

(Up to 7 points)

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Carbon Footprint – Objective & Requirement

OBJECTIVE

To calculate the carbon emissions resulted from the associated energy used during construction and operational phase of a development.

REQUIREMENT

❖To produce a complete carbon footprinting report of the development **EITHER** by appointing an independent carbon consultant, **OR** by completing a carbon footprinting form provided by BCA.

❖A simple carbon footprinting form has been developed jointly by BCA-NUS to capture the overall energy used from the construction and building operation phase of a development.

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Carbon Footprint – Point Allocations

1 POINT will be awarded for submission of:-

❖COMPLETE carbon footprinting REPORT which include embodied and operational carbon emissions of the project development, done by an independent and registered carbon consultant.

OR

❖COMPLETE carbon footprinting FORM (consist of 11 top common materials used in a typical project) appended in the BCA Green Mark Certification Standard for New Buildings (GMV4.0).

0.5 POINT will be awarded for:-

❖PARTIAL submission of at least 4 out of 11 materials data required in the carbon footprinting form.

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ENERGY USAGE OF MATERIALS PRODUCTION AND ON-SITE CONSTRUCTION

Project Title: _____

Project GFA: _____

Section A: Materials Production											
Material	Total Energy usage per month										
	Electricity		Diesel		Petrol		Gas		Others (Pls Specify)		
	kWh	$/kWh	Litres	$/litres	Litres	$/litres	KG	$/KG	Fuel	Units	$/unit
Cement											
Sand											
Concrete											
Aggregate											
Brick											
Steel											
Aluminum											
Glass											
Paint											
Tiles: Ceramic											
Tiles: Granite											

Section B1: Material Usage (On-Site)	
Material	Total Quantity Used
Cement	
Sand	
Concrete	
Aggregate	
Brick	
Steel	
Aluminum	
Glass	
Paint	
Tiles: Ceramic	
Tiles: Granite	

Section B2: Energy Usage (On-Site)		
	Units used	$/unit
Electricity (kWh and $)		
Diesel (litres and $)		
Petrol (litres and $)		
Gas (KG and $)		
Coal (ton)		
Crude Oil (KL)		

Section C: Operational Carbon (Post-Occupancy)		
	Units used	$/unit
Electricity (kWh and $)		
Renewable Energy Sources		

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Carbon Footprint – Necessary Information & Documentation

Information Required	Source of Information
Energy used for the material production	Material suppliers
Quantity of materials used for construction	Bill of Quantities
Energy used on construction site	Contractor's book-keeping
Estimates on energy used on building operation phase	EEI value

NOTE:-

- Consultants will need to liaise closely with materials suppliers

AND

- Contractors to obtain the relevant data required in the carbon footprinting form
  (e.g. Energy involved in cement production, quantity of cement used in the project)

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Carbon Footprint – Contact Persons

BCA Contact Person:-

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  Email: edward_anggadjaja@bca.gov.sg

NUS Contact Person:-

- Dr. Evelyn Teo
  Tel: 6516 1008
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For more information on Green Mark Version 4.0, please refer:

1) Sustainable Built Environment
   http://www.bca.gov.sg/sustain/sustain.html

2) Legislation on Environmental Sustainability for Buildings
   http://www.bca.gov.sg/EnvSusLegislation/Environmental_Sustainability_Legislation.html

3) Code for Environmental Sustainability of Buildings (2nd Edition)
   http://www.bca.gov.sg/EnvSusLegislation/others/Env_Sus_Code2010.pdf

4) BCA Green Mark Certification Standard for New Buildings (GM Version 4.0)
   http://www.bca.gov.sg/EnvSusLegislation/others/GM_Certification_Std2010.pdf

5) BCA Green Mark for New Residential Buildings (Version RB/4.0)
   http://bca.gov.sg/GreenMark/others/gm_resi_v4.pdf

6) BCA Green Mark for New Non-Residential Buildings (Version NRB/4.0)
   http://bca.gov.sg/GreenMark/others/gm_nonresi_v4.pdf

