

Integrated Green Building Assessment Approach for the Next Decade



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About Singapore

**Small Island City State
(about 720 sq km)**

High-Rise, High-Density

**About 2/3 the land size of
Hong Kong**

Population of 5.6 million

**Per capita GDP of
~HK\$400,000**

No Natural Resources

**27 to 35°C, 80% Relative
Humidity, all year round**

**CHANGING
THE WAY WE BUILD**





Singapore's Green Building Journey

- How it all started

CHANGING
THE WAY WE BUILD



BCA GREEN MARK

2005



2006

Legislation on
Environmental
Sustainability for
New Buildings



2008



2009

Legislation on
Environmental
Sustainability for
Existing Buildings



2012



2014

1990s

- Developed energy efficiency standards for lighting and air-con systems

1979

- Incorporated the Overall Thermal Transfer Value in Building Control regulations

1960s

- Public housing designed with natural ventilation and daylighting from Day One



Singapore's Green Building Journey

CHANGING
THE WAY WE BUILD

2005



< 0.1%
Green Buildings

2010



> 13%
Green Buildings

2017



> 33%
Green Buildings

~HK\$90million

Annual Energy Savings Compared to
BAU/Code Compliance Scenario

2500 GWh

Annual Energy Savings Compared to
BAU/Code Compliance Scenario

~ 89

million m² green
GFA

~3000

Green Mark Projects





Green Mark Scheme

What is Green Mark?

- **Green building rating system** to evaluate building for its environmental impact and performance
- Sets parameters and establishes indicators to **guide the design, construction and operation of buildings towards increased energy effectiveness and enhanced environmental performance**
- Specially designed for tropical context
- Emphasises on post-completion building performance verification





A Suite of BCA Green Mark Schemes

What is Green Mark?

- BCA Green Mark for Non-Residential Buildings
- BCA Green Mark for Residential Buildings
- BCA Green Mark for Existing Schools

- BCA-NParks Green Mark for Existing Parks
- BCA-NParks Green Mark for New Parks
- BCA Green Mark for Infrastructure
- BCA Green Mark for Districts
- BCA-LTA Green Mark for Rapid Transit System

Existing Buildings

Beyond Buildings

New Buildings

- BCA Green Mark for Non-Residential Buildings
- BCA Green Mark for Residential Buildings
- BCA Green Mark for Landed Houses
- BCA Green Mark for Healthcare Facilities
- BCA-IMDA Green Mark for New Data Centres

Within Buildings

- BCA Green Mark for Office Interior
- BCA Green Mark for Restaurants
- BCA Green Mark for Supermarkets
- BCA Green Mark for Retail
- BCA-IMDA Green Mark for Data Centre
- **BCA Green Mark for Laboratories**

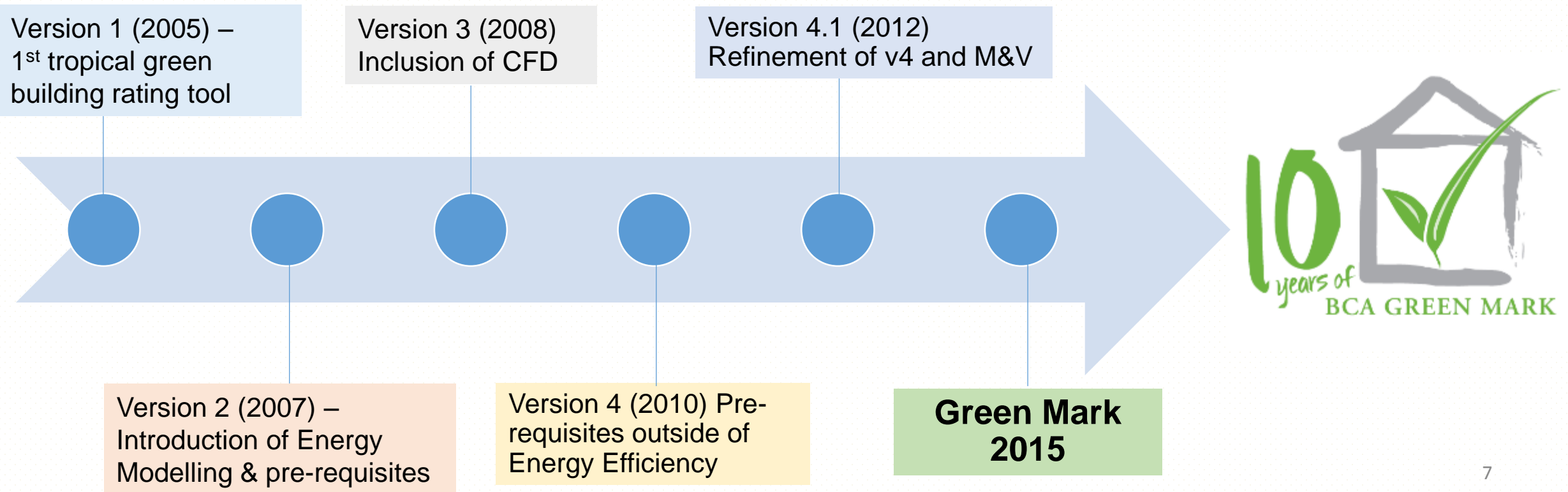


BCA GREEN MARK

Evolution of Green Mark Scheme

What is Green Mark?

- Continued enhancements to keep pace with technology development in alignment with best practices from the industry both locally and around the world





Singapore's Green Building Journey

CHANGING
THE WAY WE BUILD



< 0.1%
Green Buildings



> 13%
Green Buildings



> 33%
Green Buildings



> 50%
Green Buildings

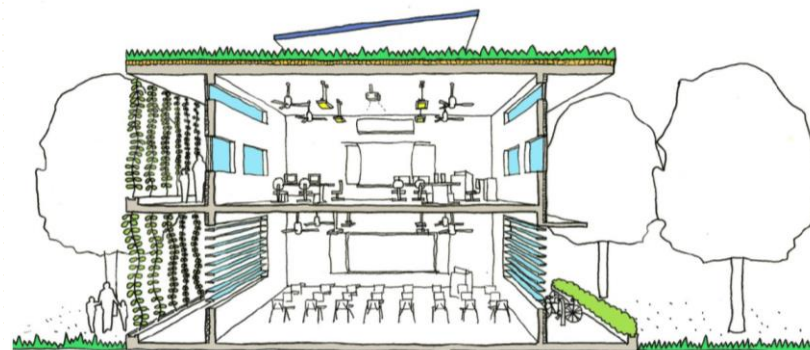


> 80%
Green Buildings

THE INTEGRATED APPROACH

GM NRB: 2015

GREEN MARK FOR NON-RESIDENTIAL BUILDINGS NRB: 2015





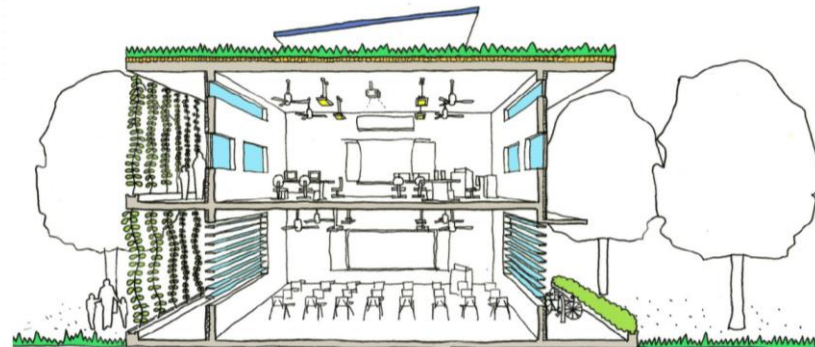
THE INTEGRATED APPROACH

CHANGING
THE WAY WE BUILD

- Working closely with industry experts
- Encouraging integrated design process
- Tying in passive design with active response systems
- **Creating a Green Mark Scheme for the industry, with the industry**

GM NRB: 2015

GREEN MARK FOR NON-RESIDENTIAL BUILDINGS NRB: 2015





Assembling The 'Green' Team

Co-developed and Co-owned by the industry

- Specialist technical taskforces set up to map directions, review standards and map practical pathways for the new GM criteria development
- Facilitated a practical dimension to the scheme but also empowered ownership and drive among industry professionals

HVAC Air-side Measurement Taskforce

Energy Modelling Taskforce

Natural Ventilation Taskforce

14



Architectural Taskforce

Envelope Taskforce

Noise & Acoustics Taskforce

Industry taskforces
Co-chaired by the BCA and leading industry experts

District Cooling Taskforce

Green Product and Materials Taskforce

Lighting Taskforce

Solar PV Taskforce

Comprising

>130

SLTDC Taskforce

IEQ Taskforce

Smart Control Taskforce

Sustainable Construction & Carbon Taskforce

external industry experts



Sustainability Goals of Green Mark

Setting the end
in mind



**4 OUTCOMES
OF GREEN MARK 2015**



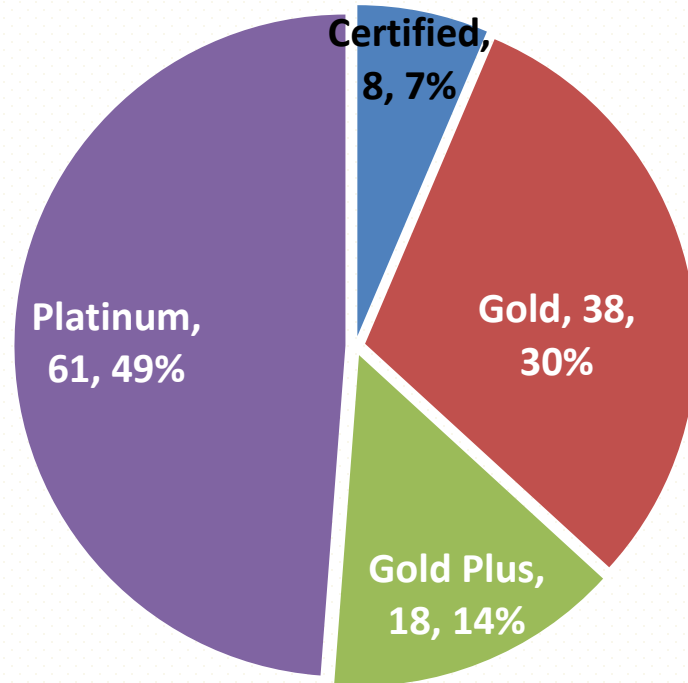


Criteria Setting

Learning from the Past and Present

- Statistical analysis of past certified projects
- Industry norm for buildings with central cooling systems to be equipped with high-performance air-conditioning system

Break down of Awarded Ratings

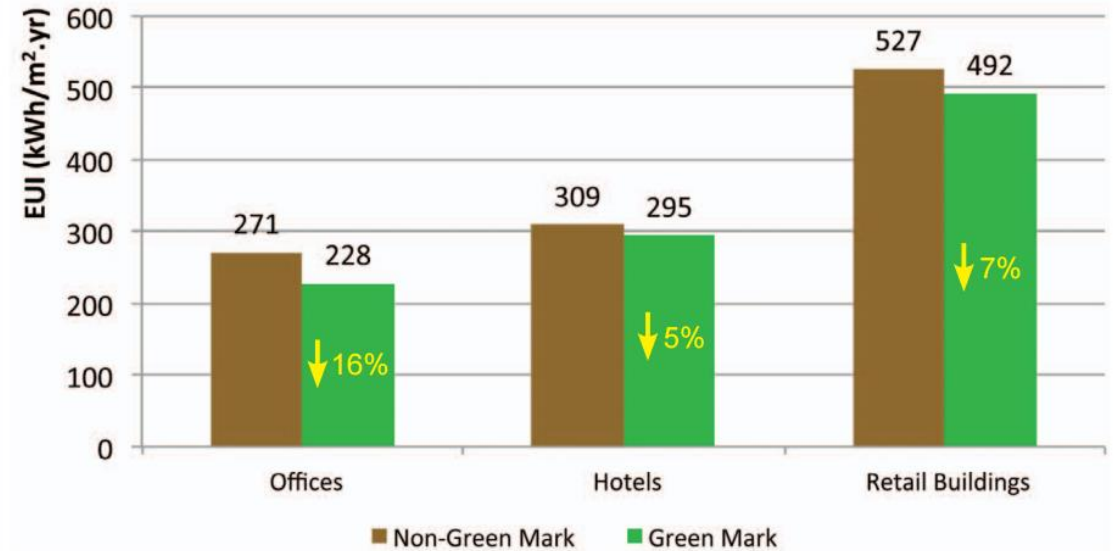


Data taken from

125

Green Mark for
New Non-Residential
Projects

Average EUI of Green Mark & Non-Green Mark





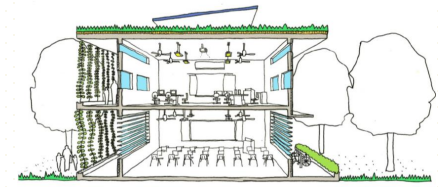
Criteria Setting

Fine-tuning the Criteria with Industry Briefing & Feedback

- GM NRB: 2015 was launched for piloting in September 2015
- Worked closely with industry stakeholders to pilot the new criteria with actual projects
- Briefings to various industry associations and government agencies, as well as consultations with the Green mark Advisory Committee
- Full implementation on 1 December 2016



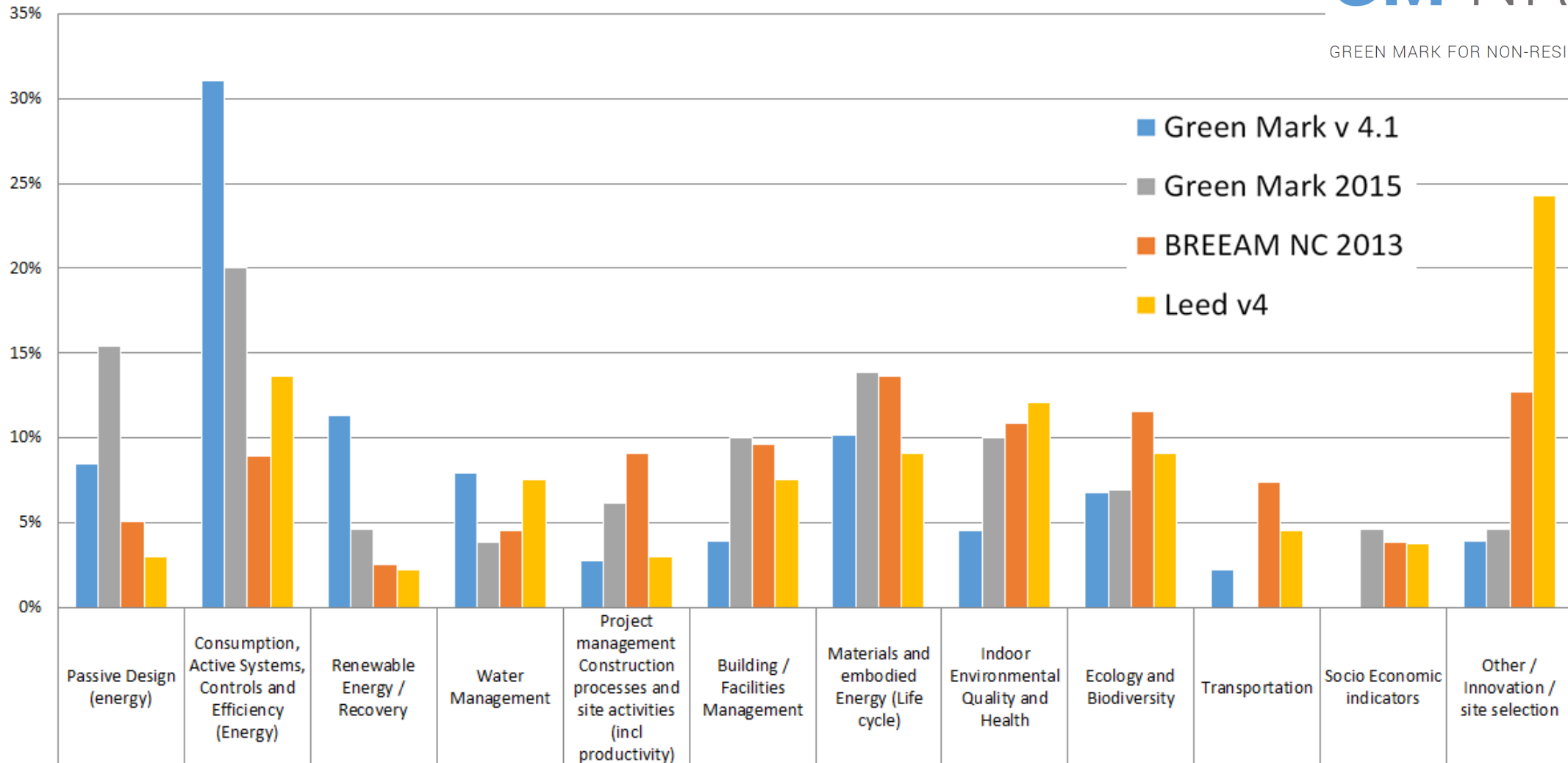
Holistic Approach – address sustainable parameters



Distribution of Credit Allocation

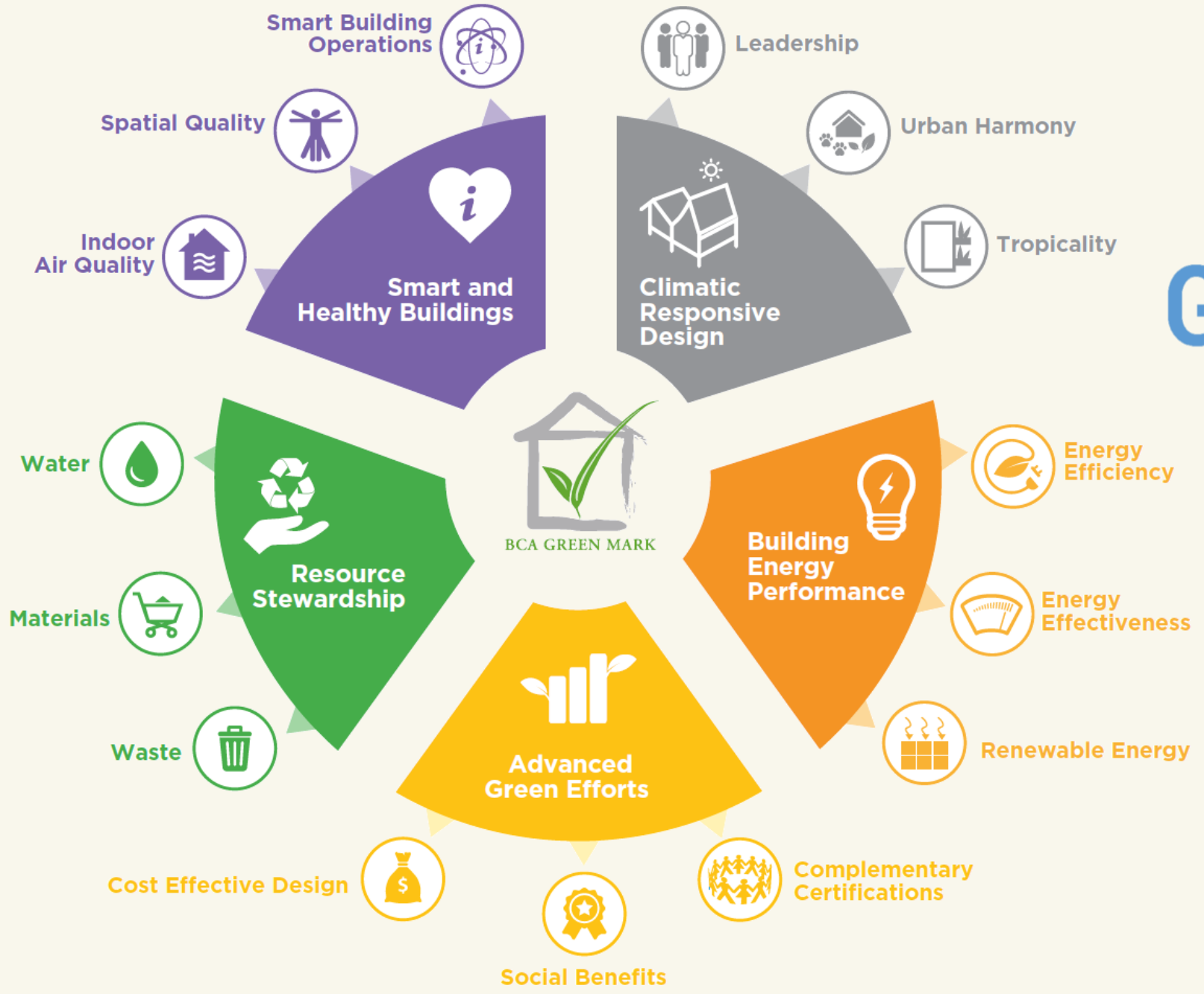
GM NRB: 2015

GREEN MARK FOR NON-RESIDENTIAL BUILDINGS NRB: 2015





GM NRB: 2015



Points Required	Green Mark Rating
70 and above	Green Mark Platinum
60 to < 70	Green Mark Gold ^{PLUS}
50 to < 60	Green Mark Gold



Climatic Responsive Design

Leadership



Effective leadership and collaborative teamwork to influence and drive improvements to the overall environmental credentials of projects, throughout the various project stages.

Urban Harmony



Consideration of the building's human centricity and whether it is in sync with its surrounding context with respect to its immediate locale.

Tropicality



Shaping building passive design in consideration of the climatic context to enhance effective thermal comfort for its occupants.

Energy Efficiency



Optimising the efficiency of high consumption mechanical and electrical systems.

Energy Effectiveness



Holistic consideration of the effectiveness of energy systems' performance usage and consumption.

Renewable Energy



Driving the creation of opportunities for generation and utilisation of renewable energy.



Building Energy Performance



Water



Encouraging responsible use of water in buildings through water efficient, monitoring and potable water replacement strategies.

Materials



Reducing the carbon footprint emerging from construction activities by promoting sustainable material and practices via a life cycle approach.

Waste



Responsible management of the building construction and operational waste.



Smart and Healthy Buildings



Resource Stewardship



Indoor Air Quality



Ensuring good air quality within building functional spaces.

Spatial Quality



Ensuring quality spaces that are acoustically and visually comfortable, inclusive, and connect occupants to the natural environment.

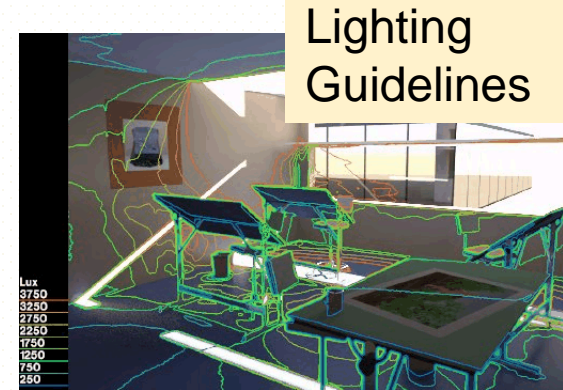
Smart Building Operations



Optimising equipment and related processes for energy reduction and comfort requirements through the use of automation and data and behavioural science.

Ready Tools and Guidelines for GM NRB: 2015

Analysis templates, rules of thumb matrices and online simulation tools for industry use



Lighting Guidelines

Advanced Green Efforts



Cost Effective Design



Recognising projects that demonstrate high levels of environmental performance without an increased capital expenditure.

Complementary Certifications

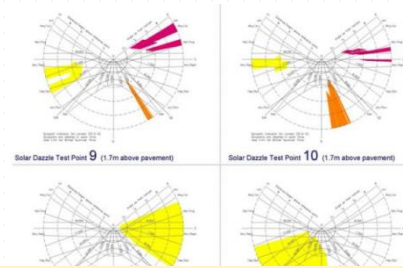


Recognising the use of rating tools that rate environmental sustainability beyond the built environment.

Social Benefits



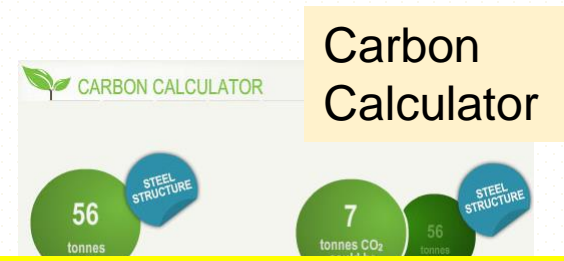
This criterion rewards projects that are able to demonstrate that their project



Solar Feasibility Studies Guidelines

COMMON AREAS - INPUT DATA		
Common Areas	Area (m ²)	Mode of Ventilation
Toilets	3000	NV
Staircases	2000	MV
Corridors	5000	[Select from drop-down list]
Lift Lobbies	2000	NV
Atriums	1000	AC
Carparks	18600	NV
M & E Spaces	500	MV

Energy Calculator



Carbon Calculator

Table 3: Example of ES Summary table showing relative weights given to significance of impacts (Note: Only a selection of key issues is given)

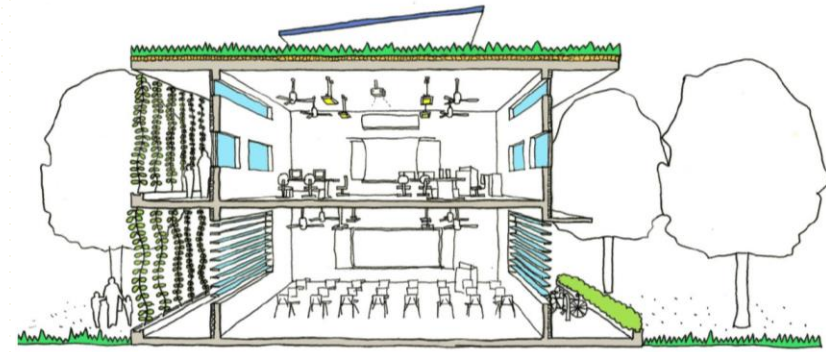
Topic area	Description of Impact	Geographical Level of Issue Importance					Impact	Nature	Significance	Mitigation Measure
		I	N	R	D	L				
Human Beings	Disturbance to existing properties from traffic & noise				*		Adverse	St, R	Major	Provision of double glazing for affected properties
	Coalescence of existing settlements			*			Adverse	Lt, R	Major	Additional screen planting
Flora & Fauna	Loss of grassland of local nature conservation value				*		Adverse	Lt, R	Minor	Creation of new habitats
	Creation of new habitats			*			Beneficial	Lt, R	Minor	
Soil & Geology	Increased recreation pressure on SSSI		*							
	Loss of 100 ha agricultural soils			*						
Water	Increased rates of surface water runoff			*						
	Reduction in groundwater discharge			*						

EIA Template



GM NRB: 2015

GREEN MARK FOR NON-RESIDENTIAL BUILDINGS NRB: 2015



Weaves together the different sustainable elements and presents a more refined and comprehensive slew of measures to address the evolution of green buildings



Co-development and Co-owned with the industry





What's Next?

GM NRB:
2015

Launched

Sep 2015

Implemented

Dec 2016

Singapore Green Building Week 2017



IGBC - The Premier Green Building Event in Asia

12 – 14 September 2017
Marina Bay Sands, Singapore



Build Green: **Be The Change**

IGBC 2017 seeks to catalyse behavioral change, at individual, interpersonal and community level.

What to anticipate at IGBC 2017:

- Positive/Zero/Super Low Energy Buildings
- Changing Behaviour towards Sustainability
- Building Healthy Spaces
- Outstanding Green Projects
- A Bird's Eye View of the Sustainable Built Environment
- Green Mark Tours

For More Info

<http://bit.do/IGBC2016>



<https://www.bca.gov.sg/events/sgbw/en.html>

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