Greening the Built Environment:

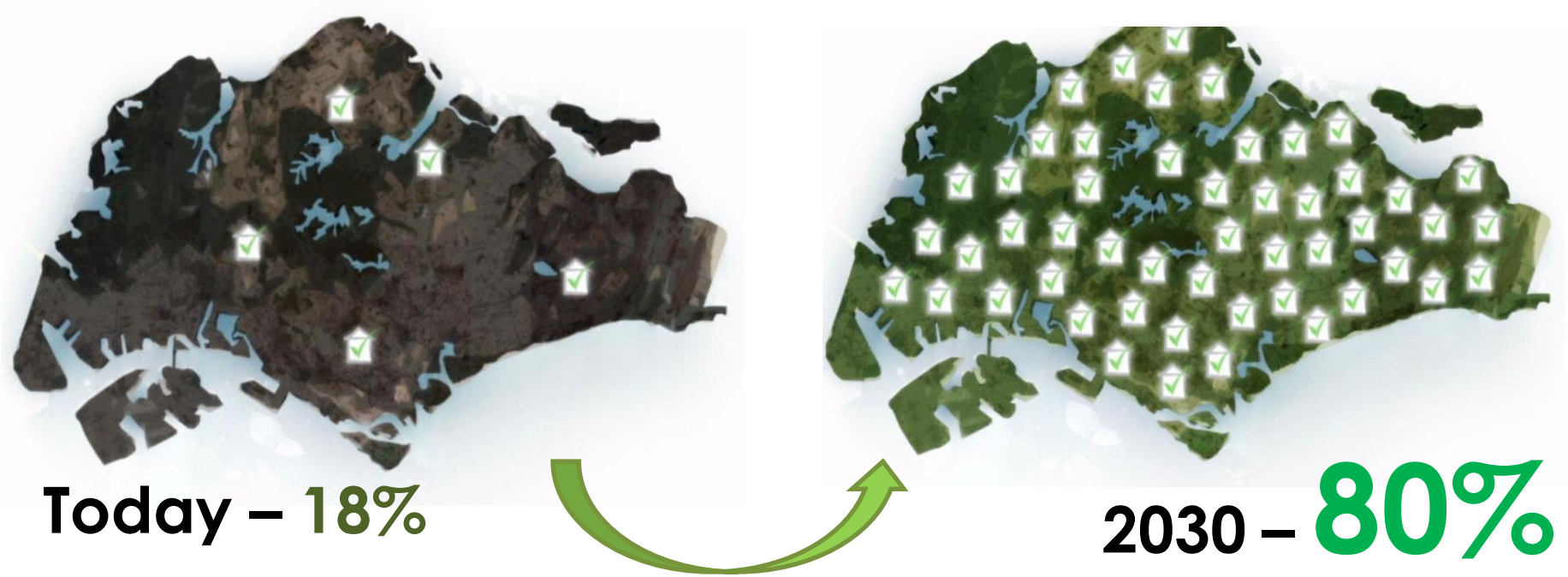
an update on BCA Green Mark for new developments



Dr Gao Chun Ping
Deputy Director
Technology Development Group/
Green Mark Dept (ND)
Building and Construction Authority

Building and Construction Authority

Sustainable Development Blueprint 2009



At least 80% of building stock to meet Green Mark Standards by 2030

Singapore's Green Building Journey

Envelop Thermal Transfer Value (ETTV)

CP24:1999 EE Standard for Bldg Services and equipment

BCA GREEN MARK

1st GREEN BUILDING MASTERPLAN



80's – 2005
(Energy conservation)

2005
(green buildings)

2006

- Offered $20 million cash incentive
- $50 million R&D funds
- Govt to take lead in green buildings
- Legislation
- Comprehensive industry training
- Public outreach

2009

- Offered $100million cash incentive
- Govt to take stronger leadership
- Offered bonus Gross Floor Area
- Higher energy standard
- Singapore – Green hub in region



Incentives/Assistance to Existing Buildings









Imposing Minimal Standard



Legislation – New Bdgs (April 08)

Minimum EE Standards for New Building and Existing Buildings undergoing major retrofitting (GFA of >2000m^2)

Incentive Scheme (April 09)

GMIS (Existing Buildings) scheme co-fund upgrading for energy improvement. Building owners to declare relevant energy data

Energy Data Submission

Yearly **submission** on **energy consumption** to BCA.
Building owners to submit **energy related building information**.

Legislation – Existing Buildings

Minimum EE standards for Existing Buildings and meet GM Certified

New and retrofitted existing buildings – **3 yearly system efficiency audit**

Implemented

Continual Efforts

3-Pronged Legislative Approach

Amendments to Building Control Act



- **Min. GM standard** for existing buildings



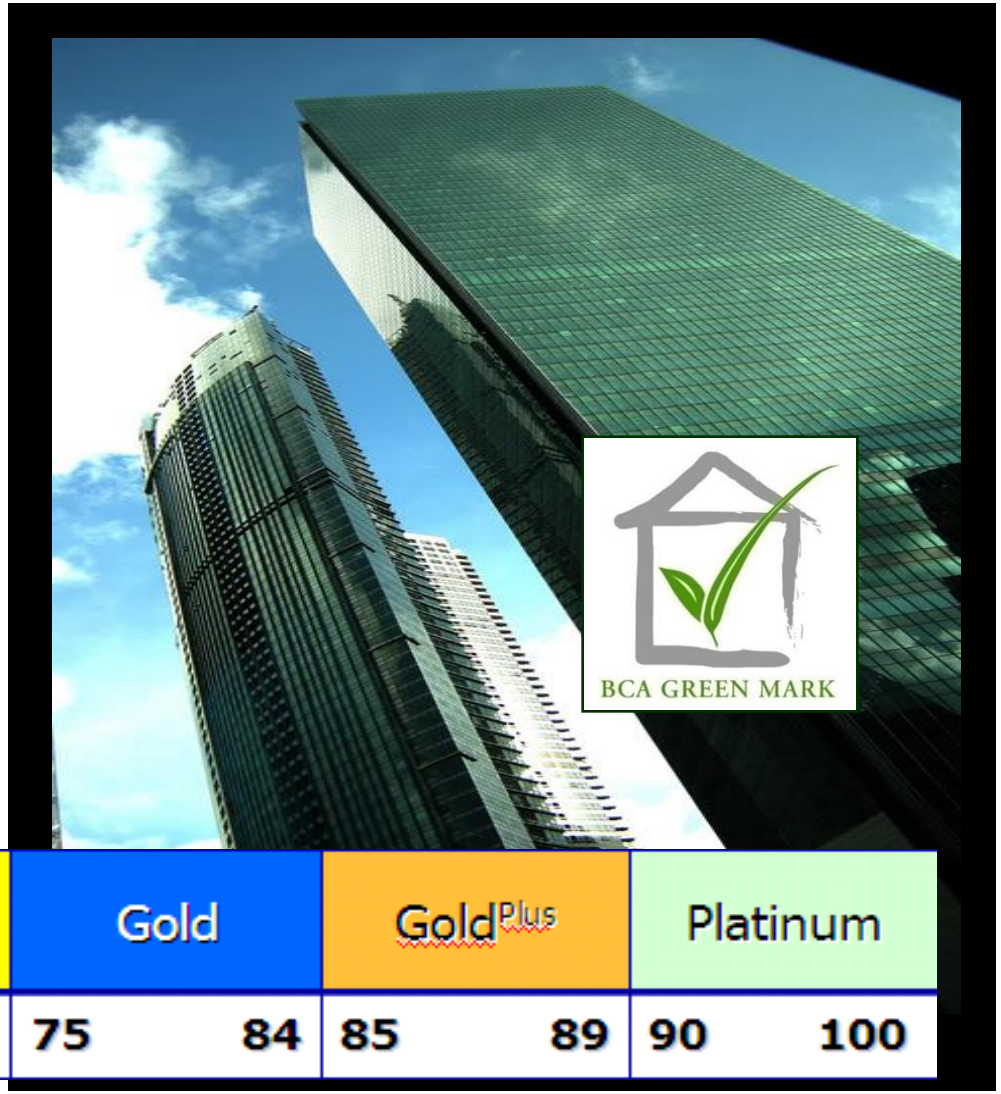
- **Three-yearly energy audit** on cooling system



- **Annual submission** of building info & energy consumption data

BCA Green Mark Scheme

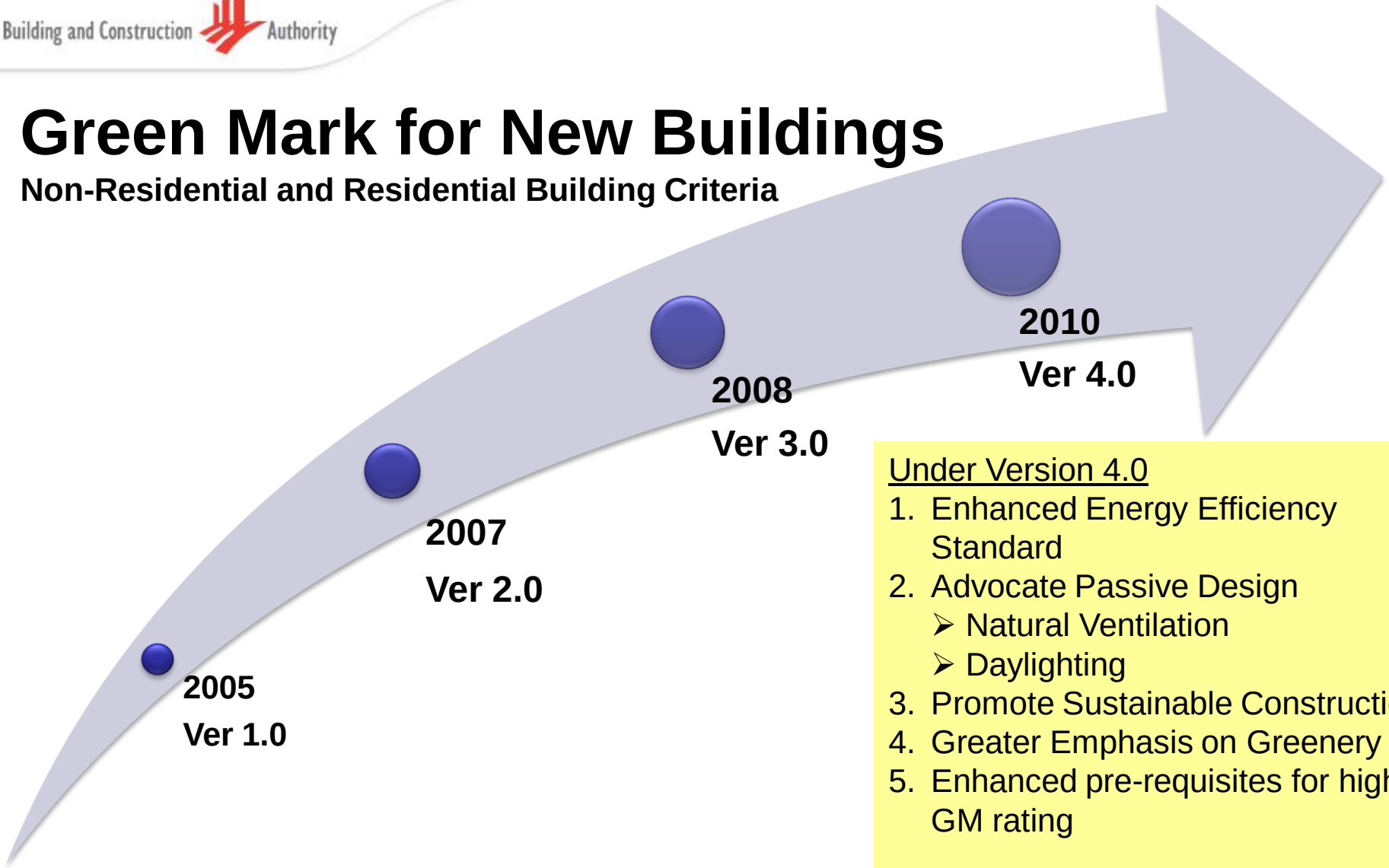




Green Mark	Try Again	Certified	Gold	Gold Plus	Platinum
Score	0 – 49	50 – 74	75 – 84	85 – 89	90 – 100
Estimated Energy Savings		10% to 15%	15% to 25%	25% to 30%	> 30%

Green Mark for New Buildings

Non-Residential and Residential Building Criteria



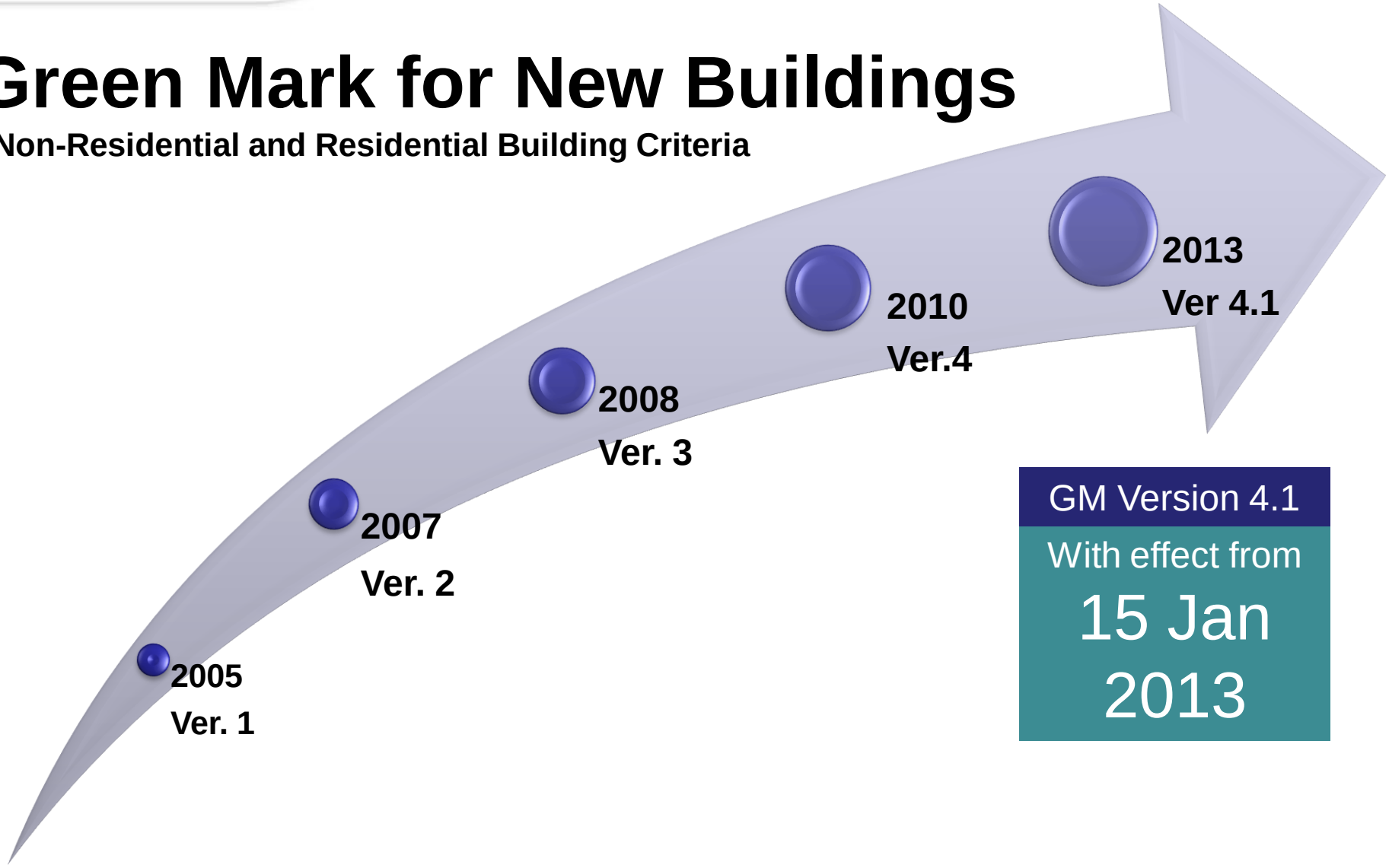
Under Version 4.0

1. Enhanced Energy Efficiency Standard
2. Advocate Passive Design
   - Natural Ventilation
   - Daylighting
3. Promote Sustainable Construction
4. Greater Emphasis on Greenery
5. Enhanced pre-requisites for higher GM rating

From Prescriptive to Performance Based Framework

Green Mark for New Buildings

Non-Residential and Residential Building Criteria



GM Version 4.1

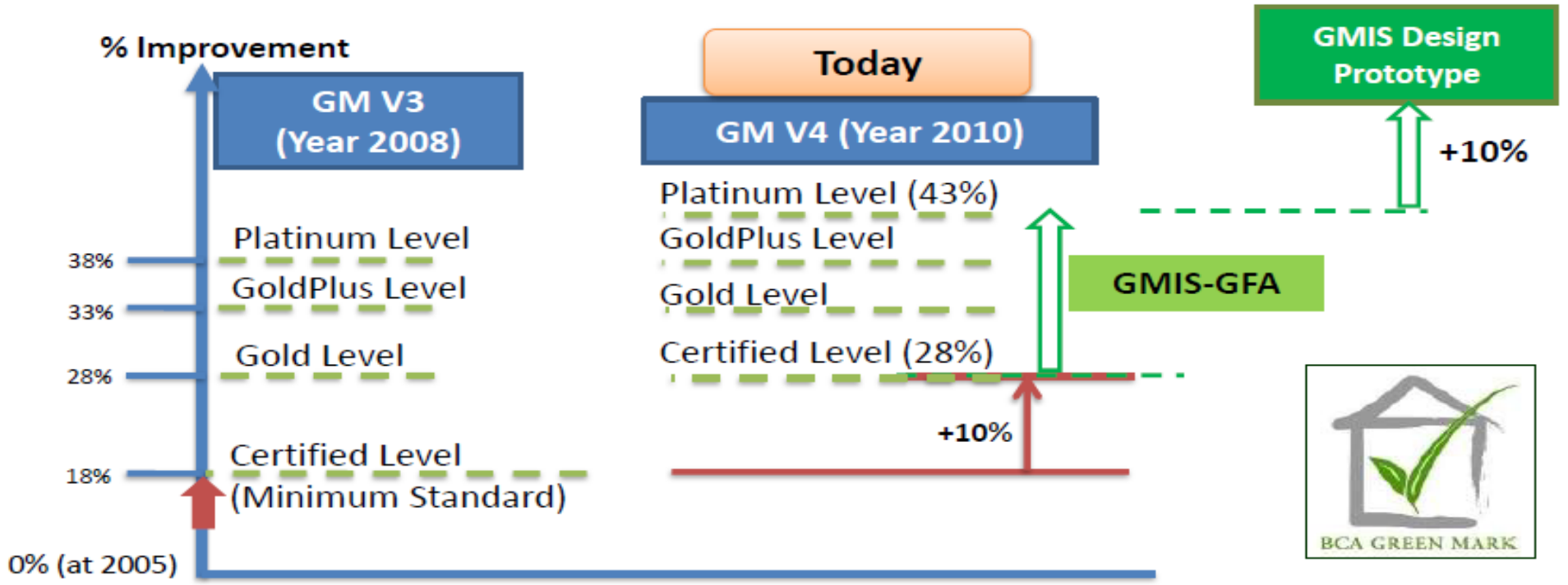
With effect from

15 Jan 2013

BCA Green Mark Scheme

Raising Energy Efficiency Standard over 2005 design codes

Overview of Energy Improvement





Energy Efficiency

Green Mark NRB Version 4.1

For Non-Residential Building Criteria

- Revised Methodology – Air-Conditioning System Efficiency and Scoring
- Baseline for Air Distribution System
- Enhancement to Energy Modelling Framework
- Certified Energy Efficient Products / Equipment

Energy Efficiency

Green Mark RB Version 4.1

For Residential Building Criteria

- Ventilation Simulation Requirement
- Energy efficient products / equipment

Resource Efficiency

For Non-Residential and Residential Building Criteria

- Sustainable Construction
- Sustainable Product

Energy Efficiency

Green Mark NRB Version 4.1

For Non-Residential Building Criteria

- Revised Methodology - Air-conditioning System Efficiency and Scoring
- Baseline for Air Distribution System
- Enhancement to Energy Modelling Framework
- Certified Energy Efficient Products/Equipment

Background
Methodology - Air-Conditioning System Efficiency

- Point Scoring to be based on the air-conditioning system efficiency of simulated building load profile for defined building operation hours for the design day

Office Buildings: ▪ Monday to Friday: 9 am to 6 pm **Retail Malls:** ▪ Monday to Sunday: 10 am to 9 pm	**Hotels:** ▪ Monday to Sunday: 24 hours **Other building types:** ▪ To be determined based on the operating hours

Current Methodology

Method A - Full Load Condition

Method B - Part Load Condition

Revision #1
Methodology - Air-Conditioning System Efficiency

- Removed METHOD A – where point scoring based on full load condition and efficiency of the full installed air-con plant capacity

- Revised METHOD B – where point scoring based on part load condition to better reflect the operating efficiency of the air-con plant and to be in line with the upcoming periodic audit requirement

Determine the design system efficiency of air-con system for point scoring

Time	Total Average Cooling load (RT)	Chiller (kW)	Chilled Water Pump (kW)	Condensed Water Pump (kW)	Cooling Tower (kW)	Total Power Input (kW)
0900	2000 RT					1300
1000	2000 RT					1300
1100	2100 RT					1386
1200	2100 RT					1386
1300	2100 RT					1386
1400	2100 RT					1386
1500	2200 RT					1474
1600	2200 RT					1474
1700	2200 RT					1474
1800	2200 RT					1474
Total Average Cooling Load (0900 - 1800 hrs)	21200 RT			**Total Power Input (0900 - 1800 hrs)**		14040 kW

Design the air-con plant configuration and determine the kW from various components

Design System Efficiency (DSE)

Total Power Input/Total Cooling Load = 0.66 kW/RT

Revision #1

Methodology - Air-Conditioning System Efficiency

- For Green Mark GoldPlus and Platinum Projects

  For consistency, point scoring will be based on the system efficiency of the air-conditioning plant obtained from the energy simulation.

Periodic Audit of Energy Efficiency of Building Cooling System

Impending Requirement :

- New buildings with centralised chilled-water building cooling system (exclude Residential and Industrial)
- Building owners will have to conduct their first audit within one year from the date of the first TOP/CSC (whichever is earlier)
- Thereafter at intervals of not less than 3 years after the date of the last audit

Energy Efficiency

Green Mark NRB Version 4.1

For Non-Residential Building Criteria

- Revised Methodology - Air-conditioning System Efficiency and Scoring
- Baseline for Air Distribution System
- Energy Modelling Framework
- Energy Efficient Products/Equipment

Revision #2
Baseline for Air-Distribution System

- CURRENT : No baseline and consideration for small fan systems with motor nameplate power of < 4kW
- REVISED : A baseline of 0.17 W/CMH or 0.6 $kW/m^3/s$ for small fan systems

Revision #2
Baseline for Air-Distribution System

- REVISED : For fan systems with motor nameplate power of ≥ 4 kW
  Alternative option using allowable fan system input power as a baseline was introduced

Option 2 – Fan System Input Power

Baseline : ASHRAE 90.1:2010 Clause 6.5.3.1 and as prescribed below :

Baseline Air Distribution System Type	Allowable Fan System Input Power*	
	($kW/m^3/s$)	(W/CMH)
AHUs/FCUs ≥ 4kW (Constant Volume)	1.5	0.42
AHUs ≥ 4kW (Variable Volume)	2.1	0.58
Fan systems with nameplate motor power < 4 kW	0.6	0.17

* Applicable pressure drop adjustments can be considered based on ASHRAE 90.1 Table 6.5.3.1.1B and are subject to BCA's evaluation

Energy Efficiency

Green Mark NRB Version 4.1

For Non-Residential Building Criteria

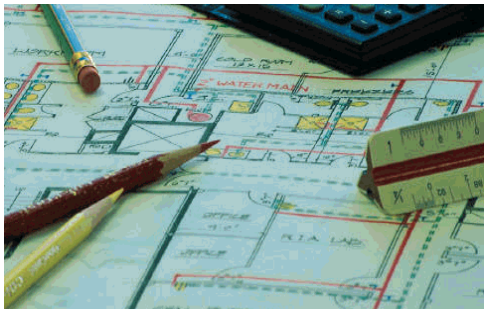
- Revised Methodology - Air-conditioning System Efficiency and Scoring
- Baseline for Air Distribution System
- Enhancement to Energy Modelling Framework
- Energy Efficient Products/Equipment

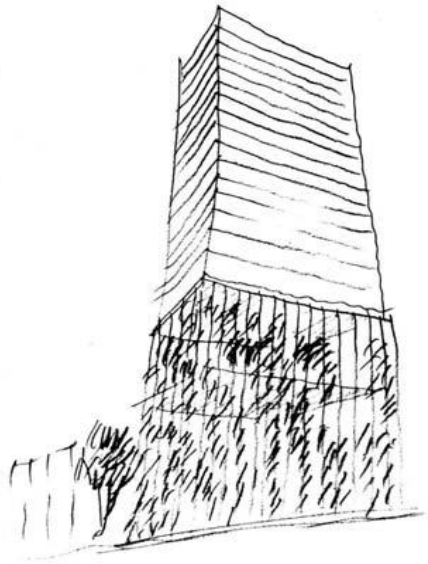
Revision #3
Energy Modelling Framework

- The revision for the baseline for fan systems also apply to the energy modelling framework

- NEW PROVISION - **Passive Design Enhancement**
  Up to 2% of energy savings over its referenced model can be considered.

Provision does not apply to areas that would normally be non air-conditioned.





Energy Efficiency

Green Mark NRB Version 4.1

For Non-Residential Building Criteria

- Revised Methodology - Air-conditioning System Efficiency and Scoring
- Baseline for Air Distribution System
- Enhancement to Energy Modelling Framework
- Certified Energy Efficient Products/Equipment

Revision #4
Certified Energy Efficient Products/Equipment

- NEW PROVISION : Products that are certified by approved local certification bodies are eligible for consideration of points for Green Mark Scheme in NRB1-10 are as follows:

  - Mechanical Systems
  - Electrical Systems
  - Renewable Energy Systems



Same for Residential Building Criteria under RB1-7

Implementation Timeline

All new GM applications are based on GM V4.1

For BCA Green Mark Certification

Implementation timeline for the adoption of GM V4.1 is based on the date of GM application

15 Jan 2013

15 Oct 2013

GM applications submitted **before 15 Jan 2013** will be assessed under GM V4.0

Projects where GM applications were submitted **before 15 Jan 2013** will be assessed under GM V4.1 from 15 Oct 2013 onwards

GM applications submitted **on or after 15 Jan 2013** will be assessed under GM V4.1

BCA GREEN MARK

For Public Sector Taking the Lead

Implementation timeline for the adoption of GM V4.1 is based on **the date of tender notices for consultancy or design and build contract**

Projects with tenders for design that are called before 15 Jan 2013 will be assessed and certified using the BCA Green Mark Criteria for new Buildings (GM V4.0)



Projects with tenders for design that are called on or after 15 Jan 2013 will be assessed and certified using the BCA Green Mark Criteria for new Buildings (GM V4.1)

For GLS Programmes in Strategic Areas

Implementation timeline for the adoption of GM V4.1 is based on **the GLS tender closing date for the land sold**

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

On or after 15 Jan 2013

- To comply with Green Mark Gold^{Plus} or Platinum Rating
- BCA Green Mark Assessment and Certification based on GM V4.1

For BCA Green Mark GFA Incentive Scheme

Implementation timeline for the adoption of GM V4.1 is based on the **submission date of BCA GM-GFA application**



Thank you

