Building and Construction Authority



Green Mark for Residential Buildings GM RB: 2016
Industry Consultation
30 Jun 2016

By Lee Sui Fung, Principal Manager
Environmental Sustainable Group

Objectives of GM RB: 2016

BCA GREEN MARK

- To further **stretch outcomes of sustainability** and therefore structures the criteria around this
- To increase **end-users' engagement in sustainable lifestyle** and add **a layer of accountability and integrity** to the projects teams in aiding Developers in business sustainability reporting





11 Workgroups of GM RB: 2016

With continuity and taking advantages of experience from GM NRB:2015, 8 workgroups relevant to both non-residential building and residential building will remain unchange or consolidate.

Continuity from GM NRB: 2015 New Buildings (Non-Residential)

Envelopes & Facades
- RETV
- Tropical façade performance

IEQ (Consolidate)
- Lighting & daylighting
- Noise & acoustics

Solar PV System

Harnessing expertise of other departments' colleagues such as GMD(EB), BPM, RES, etc

Natural Ventilation & Thermal Comfort
- Good passive design
- Effective natural ventilation
- CFD & thermal comfort
- Good internal layout design

Water + Waste
- Water efficient system
- Alternative source of water
- Operational waste management
- Provision of recycling system

Smart Control and Monitoring

Green Building Materials & Products

Sustainable Construction & Carbon

3 New workgroups were formed to align with GM NRB: 2015

Energy Efficiency
- Air-conditioning system
- Lifts
- Other households equipment

Urban Harmony
- Sustainable urbanism
- Greenery
- Storm water management

BIM & leadership in design
- Climatic responsive brief
- Integrative design
- Project team leadership
- Building information modelling

- **4 GM2015 Taskforces not applicable to GM RB: 2016**
- **6 GM2015 Taskforces to advise GM RB: 2016 to take advantages of experience from GM NRB: 2015**
- **Formation of 4 GM RB: 2016 Taskforces to look into critical issues relating to residential criteria**

GM NRB: 2015 Taskforces (not applicable to GM 2016)	GM NRB: 2015 Taskforces to advise GM RB:2016	GM RB: 2016 Taskforces
Air-side Measurement Taskforce (GMAC) [Chaired by Er Vincent Han & Eng Shyan]	CUI/ Carbon Taskforce [Chaired Lim Peng & Jeffery]	**Envelope & Façade Taskforce** [Chaired by Prof CHOU Siaw Kiang & Jeffery] *inherit from GM NRB: 2015*
DCS Taskforce (GMAC) [Chaired by: Er Lee Chuan Seng & Ang Kian Seng]	GB Materials & Products Taskforce [Chaired by Yvonne Soh & Edward]	**NV Taskforce** [Chaired by Prof WONG Nyuk Hien & Jeffery] *inherit from GM NRB:2015*
Water-side Taskforce [Chaired by Er Koh Kin Teng & Eng Shyan]	Solar PV Taskforce (GMAC) [Chaired by: Er Lee Chuan Seng & Ang Kian Seng]	**IEQ - General Taskforce** [Chaired by Prof Tham Kok Wai, Edward & Eng Shyan]
GMAC Energy Modelling [Chaired by Er Lee Chuan Seng]	Noise & Acoustics Taskforce [Chaired by Prof Lee Siew Eang]	**Smart Homes Taskforce** [Chaired by Owen & Edward]
	Architectural Taskforce (SIA) [Chaired by Jaye, Siow & Su Ming]	
	Lighting Taskforce [Chaired by Yvonne Soh, Dr Gao & Su Ming]	

Industry Consultations

Developers

HDB, CDL, CapitaLand, Keppel Land, Fraser, Bukit Sembawang, Qingjian

Associations

REDAS, SIA, IES, ACES, SCAL

Leading Architects & Consultants

Architectural Firms
ADDP, DP, RSP, Architects 61, CPG, DCA, Surbana, Aedas, Ong & Ong, P&T, W Architects

M&E Consulting Firms
BECA, Meinhardt, Square Mech, CPG, J Roger Preston, Parsons Brinckernoff, Surbana, United Project, Alpha, BESCON, Rankin & Hill

Others

All certified GMPs, ESDs

SAME APPROACH AS GM NRB: 2015

1. Climatic Responsive Design
- Leadership
- Urban Harmony

2. Building Energy Performance
- Renewable Energy

3. Resource Stewardship
- Water + Waste
- Materials

4. Smart and Healthy Building
- IAQ + Spatial Quality
- Smart Building Operation

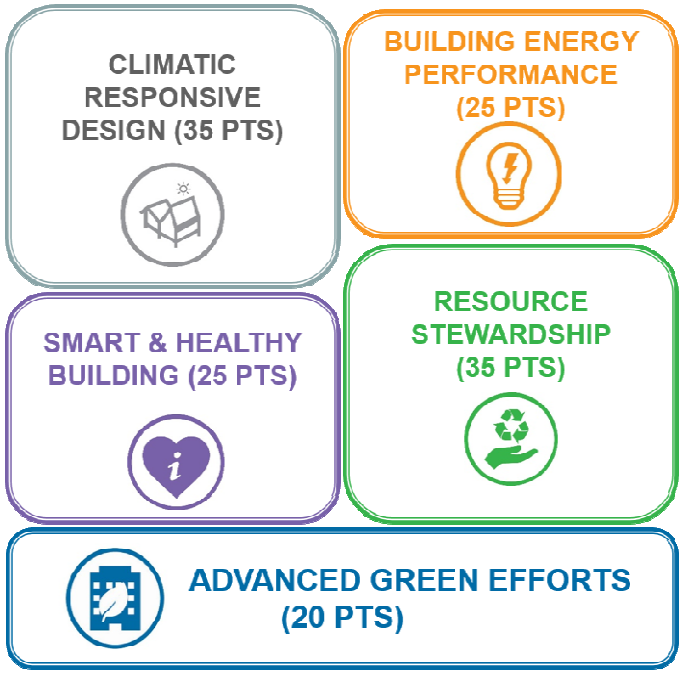
Minor points re-allocation to encourage NV and passive design

Climatic Responsive Design:
- More points allocated to emphasize and encourage good passive design and effective natural ventilation
- To encourage good façade performance
- Enhance greenery provision

Building Energy Performance:
- Simple A/C system, lighting at common areas, car park ventilation, water heater, etc

Resource Stewardship:
- More points allocated for water efficiency

Smart and Healthy Building:
- NRB mainly designed for A/C buildings which has more IEQ issues as compare with RB which design for NV



Green Mark RB V4.1	GM NRB: 2015 & GM RB: 2016
155	**140**
Certified 50 - 74	
Gold 75-84	**Gold** 50 - <60
Gold^{PLUS} 85-90	**Gold**^{PLUS} 60 - <70
Platinum 90 and above	**Platinum** 70 and above

Framework and Point Allocations for GM RB: 2016

S/N	Item	Points
1. Climatic Responsive Design		**35**
1.01	Leadership	8
1.01a	Climatic and Contextually Responsive Brief	1
1.01b	Integrative Design Process	2
1.01c	Environmental Credentials of Project Team	2
1.01d	Building Information Modelling	
1.01e	User Engagement	
1.02	Urban Harmony	
1.02a	Sustainable Urbanism	5
1.02b	Integrated Landscape and Waterscape	5
1.03	Tropicality	17
1.03a	Tropical Façade Performance	5
1.03b	Internal Organisation	2
1.03c	Ventilation Performance	10
2. Building Energy Performance		**25**
2.01	Energy Efficiency	10
2.01a	Air Conditioning System Efficiency	6
2.01b	Lighting Efficiency	4
2.02	Energy Effectiveness	7
2.02a	Building Energy	5
2.02b	Car Park Energy	2
2.03	Renewable Energy	8
2.03a	Feasibility Study	
2.03b	Solar Ready Roof	
2.03c	Replacement Energy	

Similar approach to GM NRB: 2015

Similar approach to GM NRB: 2015

Shaded area – similar to GM NRB: 2015

S/N	Item	Points
3. Resource Stewardship		**35**
3.01	Water	13
3.01a	Water Efficient Measures	9
3.01b	Water Usage Monitoring	1
3.01c	Alternative Sources of Water	3
3.02	Materials	18
3.02a	Sustainable Construction	8
3.02b	Embodied Energy	2
3.02c	Sustainable Products	8
3.03	Waste	
3.03a	Environmental Construction Management Programme	
3.03b	Operational Waste Management	2
3.03c	Provision of Recycling System for Horticultural	1
4. Smart and Healthy Building		**25**
4.01	Indoor Air Quality	8
4.01a	Occupant Comfort	2
4.01b	Contaminants	3
4.01c	Waste Disposal	1
4.01d	Indoor Air Quality in Wet Areas	2
4.02	Spatial Quality	9
4.02a	Lighting	
4.02b	Acoustics	
4.02c	Wellbeing	2
4.03	Smart Building Operations	8
4.03a	Energy Monitoring	2
4.03b	Demand Control	2
4.03c	Integration and Analytics	2
4.03d	System Handover and Documentation	2

Similar approach to GM NRB: 2015

Similar approach to GM NRB: 2015

GM RB: 2016 Criteria – Prerequisite Requirements

1. Climatic Responsive Design

1. To enhance greenery provision

<u>Option 1: Minimum points scored under Part 1.02b) Integrated Landscape and Waterscape</u>

- **GoldPlus: 2.0 points**
- **Platinum: 2.5 points**

OR

<u>Option 2: Minimum Green Plot Ratio (GnPR)</u>

- **GoldPlus: ≥ 3.5**
- **Platinum: ≥ 4.0**

2. The residential envelope thermal transmittance value (RETV) of the building shall not exceed the following:

Green Mark Gold – RETV of 25 W/m^2 or lower
Green Mark GoldPlus – RETV of 22 W/m^2 or lower
Green Mark Platinum – RETV of 20 W/m^2 or lower

The RETV of each facades of each buildings within the development should not exceed maximum RETV of 25W/m2

GM RB: 2016 Criteria – Prerequisite Requirements

1. Climatic Responsive Design

3. **To be eligible for Green Mark Platinum rating, it is a requirement to use ventilation simulation modeling and analysis to identify the most effective building design and layout. The simulation results and the recommendations derived are to be implemented to ensure good natural ventilation.**

- **A minimum 70% of the selected typical dwelling units should have a weighted average wind velocity of 0.60 m/s;**

OR

- **A minimum 70% of selected typical dwelling units with "moderate" natural ventilation (with minimum weighted average wind velocity of 0.2m/s) and comply with the thermal comfort criteria;**

Other than dwelling units, common areas like staircases and lobbies (excluding those that are located in basement areas) should also be designed to be naturally ventilated (i.e. to provide openable windows or other openings with aggregate area of not less than 5% of the space required to be ventilated).

GM RB: 2016 Criteria – Prerequisite Requirements

2. Building Energy Performance

4. All lifts shall use Variable Voltage Variable Frequency (VVVF) drives and have sleep mode features except for building typologies where such technology is not available.

5. Air-conditioners with at least the following ticks under the Singapore Energy Labelling Scheme or equivalent COP (Coefficient of Performance).

   Green Mark Gold – at least 3 ticks
   Green Mark GoldPlus – at least 5 ticks
   Green Mark Platinum –at least 5 ticks

3. Resource Stewardship

6. Minimum scores under 3.02a Sustainable Construction

   Green Mark Gold ≥ 0.5 points
   Green Mark Gold^{PLUS} ≥ 1.5 points
   Green Mark Platinum ≥ 3 points

GM RB: 2016 Criteria – Prerequisite Requirements

3. Resource Stewardship

7. Minimum scores under 3.02b Embodied Energy

Green Mark Gold^{PLUS} ≥ 1 point
Green Mark Platinum ≥ 1 point

Description	Points
Declaration of Concrete, Glass and Steel	1
Declaration of additional materials	0.25 points per material (cap at 1 point)

8. Minimum score under 3.02c Sustainable Products

Green Mark Gold ≥ 2 points
Green Mark Gold^{PLUS} ≥ 3 points
Green Mark Platinum ≥ 4 points

4. Smart and Healthy Building

9. To limit the use of high-emitting building and furnishing materials to improve indoor air quality for the health and well-being of occupants. The internal paints shall be certified by an approved local certification body. All coats of paint shall be considered, including primers, sealers, base coats and top coats.

GM RB: 2016 Criteria – Part 1 – Climatic Responsive Design

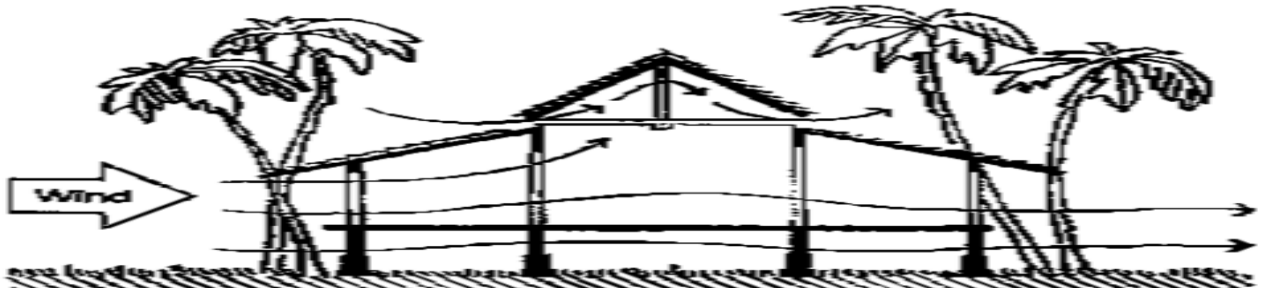
- To encourage design and leadership required to develop a sustainable building for the tropics
- Enhance Greenery Provision
- More points allocated to emphasize and encourage good passive design and effective natural ventilation
- To encourage good façade performance

1.01 – Leadership

1.02 – Urban Harmony

1.03 – Tropicality

Similar approach to GM NRB: 2015



GM RB: 2016 Criteria – Part 1 – Climatic Responsive Design

1.01: Leadership

Criteria	Points
Leadership • Create the Climatic & Culturally Responsive Brief - 1 • Integrative Design Process – 2 • Environmental credentials of the project team – 2 • Building Information Modelling (BIM) – 2 • User Guide - Building User Guide -1	8

Similar approach to GM NRB:2015

GM RB: 2016 Criteria – 1.02 Urban Harmony

Similar approach to GM NRB:2015

1.02a: Sustainable Urbanism

1.02b: Integrated Landscape & Waterscape

- Greenery Provision (GnPR)

- Tree Conservation
  - Preservation of existing trees
  - Replacement of felled trees

- Sustainable Landscape Management
  - LEAF certification
  - Adoption of native plants, landscape management plan

- Sustainable Stormwater Management
  - ABC Certification
  - Treatment of stormwater runoff through infiltration or design features before discharge to public drains

OPTION 1: Minimum score

- GoldPlus ≥ 2.0 points
- Platinum ≥ 2.5 points

OPTION 2: GnPR value

- GoldPlus – GnPR≥3.5
- Platinum - GnPR≥4.0

GM RB: 2016 Criteria – 1.03a Tropical Façade Performance

Aims

- To review GM RB version 4.1 RETV requirements and focus on 'tackling critical issues' - heat gain through western façades which highly uncomfortable for residents

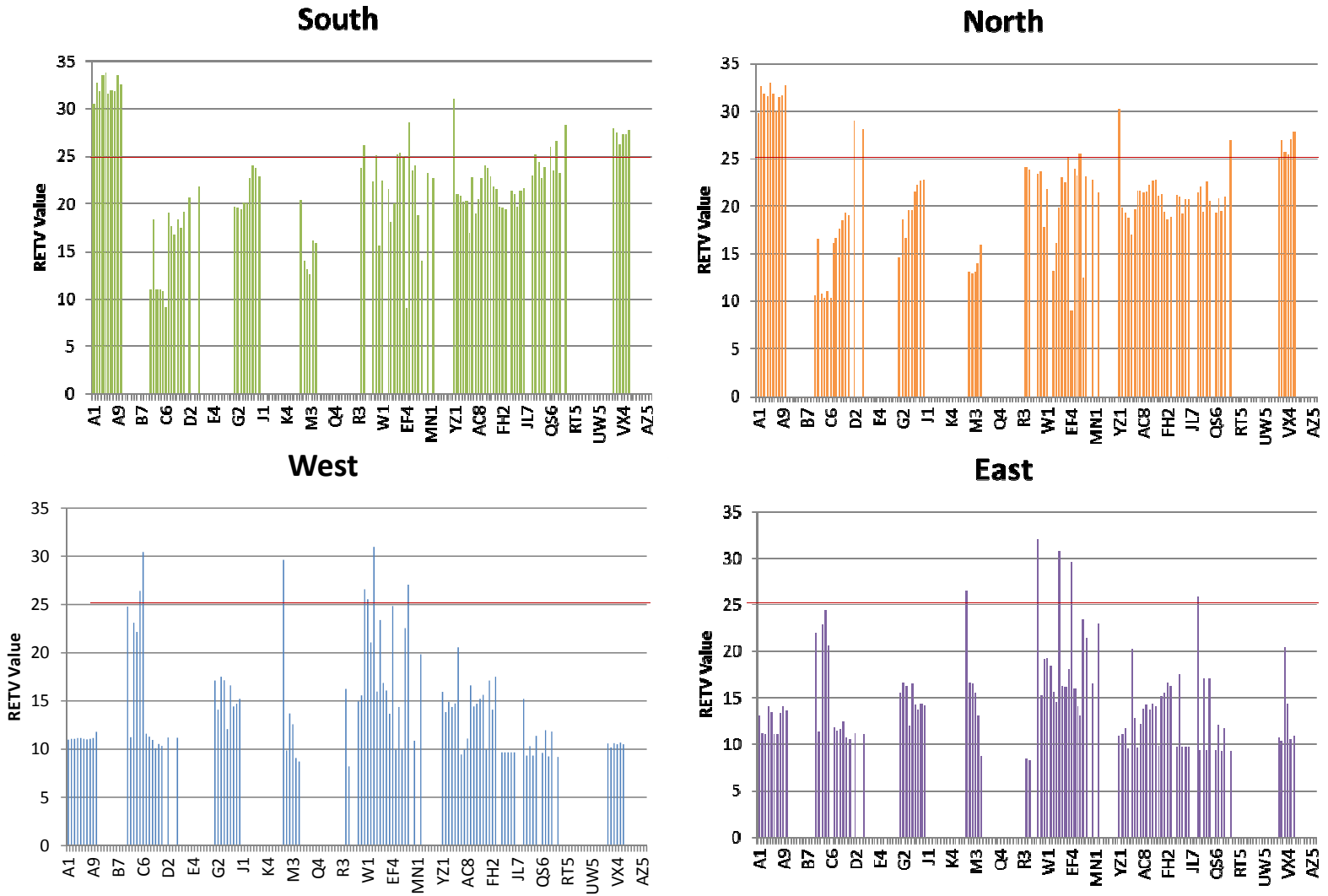
Data Analysis of RETV submissions

- 223 private development buildings (including both GM submission and regulation submissions)
- 177 HDB buildings (including both GM submission and regulation submissions)

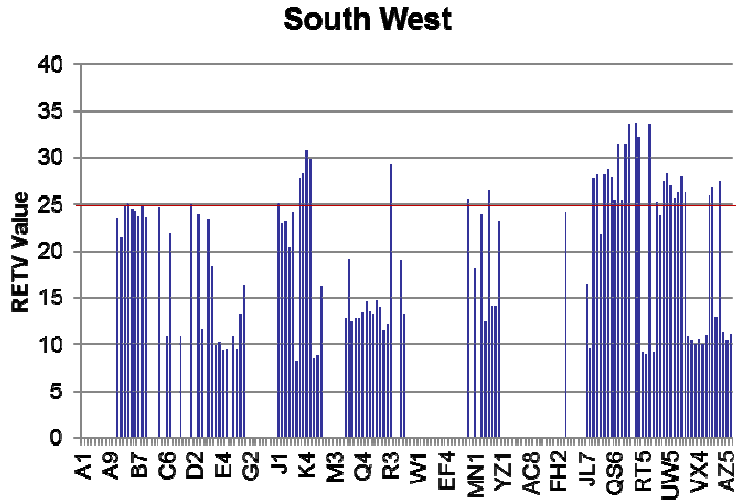
Results of Analysis

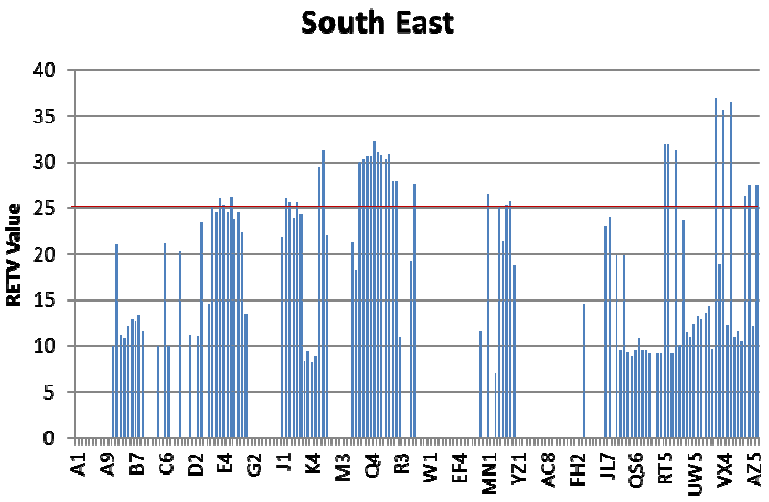
- Additional Pre-requisite requirements of
  - The RETV of each facades of each buildings within the development should not exceed maximum RETV of 25W/m^2

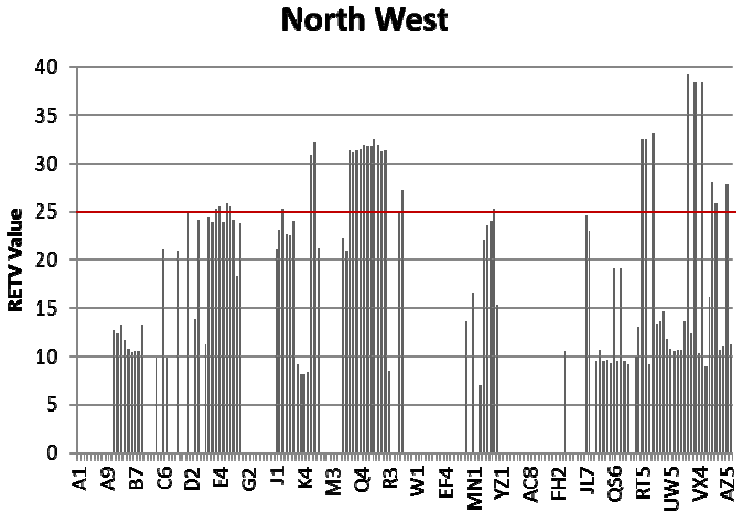
Review of previous RETV submission (both GM and regulation private projects submission)

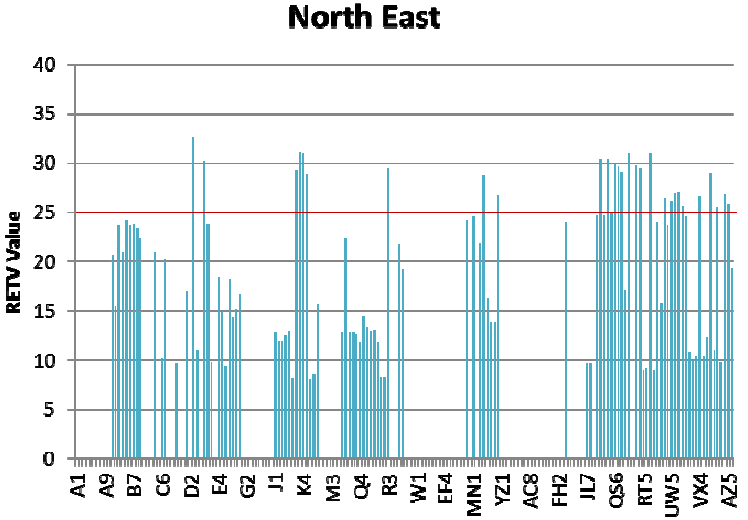


Review of previous RETV submission (both GM and regulation private projects submission)









GM RB: 2016 Criteria – 1.03a Tropical Façade Performance

Current

As determined in accordance with the formula set out in the "Code on Envelope Thermal Performance for Buildings", the RETV shall not exceed: Table on Maximum RETV

Level of Award	Maximum RETV
Gold	25W/m^2
GoldPlus	22W/m^2
Platinum	20W/m^2

Additional Pre-requisite requirement

The RETV of each facades of each buildings within the development should not exceed maximum RETV of 25W/m^2

44% of analysis projects meet the additional pre-requisite requirements
56% of projects – one or more façade exceed RETV of 25W/m2

Orientation	Window Thickness	Window U-Value	Window SC	WWR	R(ETTV)	Remark
N-S NW-SE	6mm 6mm	5.7 5.7	0.67 0.67	0.5 0.44	26.03 25.41	Relatively low WWR
N-S	6mm	4.2	0.52	0.71	25.68	low-e glazing with 0.5m wide shading device
NE-SW	6mm - 12.75mm	6.25 - 6.02	0.67 - 0.63	0.48	25.65	
N-S	10.8mm	5.6	0.72 - 0.71	0.47	25.07	
NEE-SWW						
NE-SW						low-e double glazing
NW-SE						
NW-SE	6mm	5.89	0.62	0.44	22.88	
N-S	8mm	5.83	0.6	0.32	17.08	Good orientation & low WWR
NNE-SSW	5mm	5.93	0.75	0.29	19.7	Quite good orientation & low WWR
N-S NE-SW	5mm - 12.76mm 5mm - 12.76mm	5.93-5.68 5.93-5.68	0.75 0.75	0.22 0.17	18.3 17.6	Good orientation & low WWR

If WWR more than 0.7, either external shading such as balcony or sun shading or low-e glazing required to achieve RETV of 25w/m^2 or lower

GM RB: 2016 Criteria – 1.03 Tropicality

1.03b Internal Organisation

To encourage design for natural ventilation in the following areas

- Lift lobbies and corridors (1 point)
- Staircases (1 point)

1.03c Ventilation Performance

(ii) Effective building layout design and unit design

To ensure effective building layout design and unit design reduce the needs of using air-conditioning. (up to 7 points)

- Building layout design: Proper design of building layout that utilizes prevailing wind conditions to achieve adequate cross ventilation.
- Dwelling unit design: Good ventilation in indoor units through sufficient openings.

Similar to RB V4.1

GM RB: 2016 Criteria – 1.03c Ventilation Performance

Tier 1. Current CFD Methodology

Ventilation methodology to show good natural ventilation

- i.e. 70% of typical units with minimum average wind velocity of 0.6m/s

Tier 2. Use of Thermal Comfort Model and Simulation Methodology

- Adopt flexibility in CFD requirements for developments in urban areas where surrounding are blocked

CFD Methodology – to inline with GM NRB:2015

Tier 1 Ventilation methodology to show good natural ventilation

Use of ventilation simulation modelling and analysis or wind tunnel testing to identify the most effective building design and layout to ensure good natural ventilation.

The simulation results and the recommendations derived are to be implemented to ensure at least 70% of naturally ventilated occupied space can achieve:

- **"*Good" natural ventilation performance*** (with minimum weighted average wind velocity of 0.6 m/s)

If only "moderate" natural ventilation performance (with minimum weighted average wind velocity of 0.2 m/s) can be achieved. Go to Tier 2…

GM RB: 2016 Criteria – 1.03c Ventilation Performance

Tier 2. Use of thermal comfort model and simulation methodology

The simulation results and the recommendations derived are to be implemented to ensure at least at least 70% of naturally ventilated occupied space can achieve ***"moderate" natural ventilation performance*** or ***70% of units with cross ventilation***

Perform thermal comfort modelling base on the PMV* equation and to comply with the thermal comfort criteria for naturally-ventilated spaces in tropical climate as set out below:

$$PMV = -11.7853+0.4232T-0.57889V$$

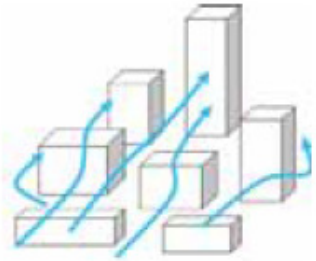
PMV Range	PPD
-0.5<PMV<+0.5*	<10*

where PMV is Predicted Mean Vote
PPD is Predicted Percentage Dissatisfied

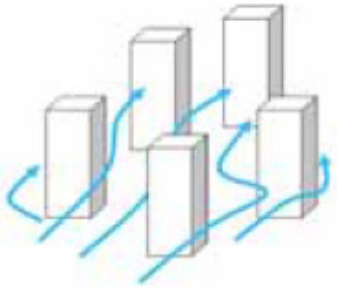
GM RB: 2016 Criteria – Advanced Green Effort

Proposed new items to encourage passive design strategies (Bonus Point)

- For development with multiple blocks
  - stagger blocks such that the blocks behind are able to receive wind penetrating through the gaps between the blocks in the front row
  - Arrange building according to ascending height with lower height in front and towards the direction of prevailing wind.



Increasing height of buildings to allow wind to reach blocks behind.



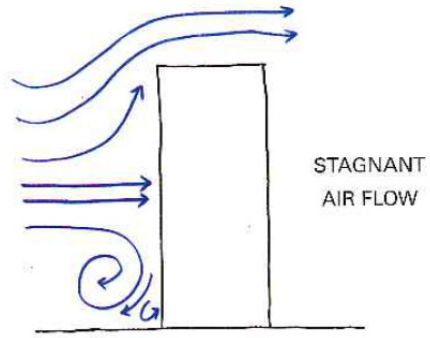
Staggered arrangement of blocks with sufficient spacing between blocks.

GM RB: 2016 Criteria – Advanced Green Effort

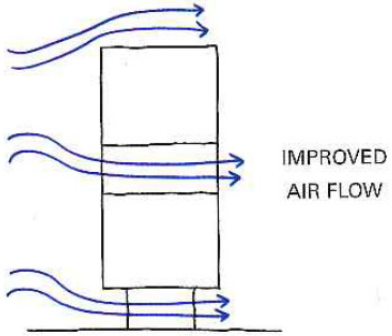
Proposed new items to encourage passive design strategies (Bonus Point)

- Provision of either void decks at the ground floor or void spaces in between buildings to encourage air flow through and around buildings

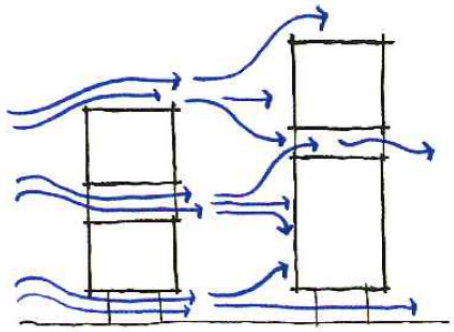
TYPICAL BUILDING: SOLID MASSING



BUILDING WITH VOID DECKS



MULTIPLE BLOCK CONFIGURATION:
STAGGER BUILDING HEIGHTS AND
VOID DECKS FOR BETTER AIR FLOW



- To encourage macro simulation to check block layout to ensure passive design been considered from the early stage

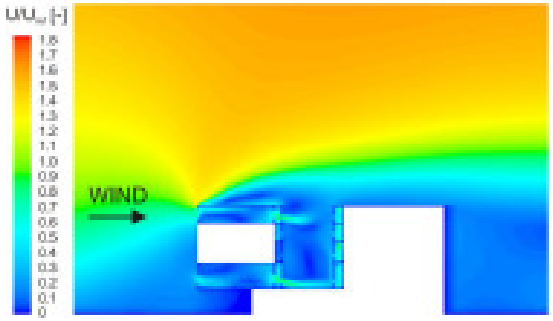
To adopt GM NRB:2015 Methodology

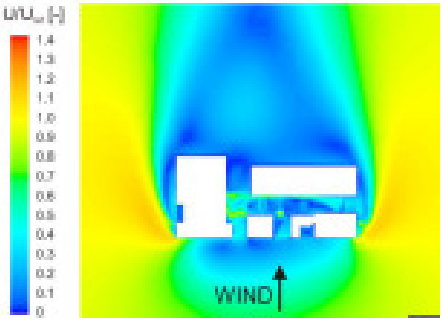
GM RB: 2016 Criteria – Advanced Green Effort

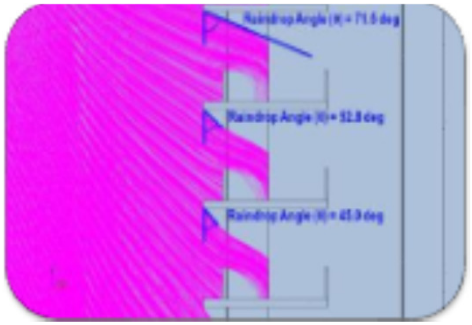
Climate responsive passive design – wind driven rain simulation

- Bonus point to encourage project to carry out wind driven rain (WDR) simulation methodology to avoid rain penetration in corridors
- Using WDR simulation methodology and evaluation criteria developed by Tu/E and BSD – Prof. Bert Blocken (engaged for development of GM NRB:2015)

Similar approach to GM NRB:2015







GM RB: 2016 Criteria – Part 2 – Building Energy Performance

- To inline with NEA's Singapore Energy Labelling Scheme
- Requirements on condenser units clearance
- To encourage use of energy efficient lighting at common areas, car park ventilation, etc
- To encourage renewable energy

2.01 – Energy Efficiency

2.02 – Energy Effectiveness

2.03 – Renewable Energy



GM RB: 2016 Criteria – Part 2 – Building Energy Performance

2.01a Air Conditioning System Efficiency

- Encourage the use of energy efficient air-conditioners that are certified under the Singapore Energy Labelling Scheme

  4 Ticks – 3 points

  5 Ticks – 5 points

- Adequate distance between the condenser units (CU) and free area of the screen to be provided for the (CU) to allow for proper air circulation of the air-conditioning system. Design to ensure the heat circulation from the condenser units is not obstructed and the efficiency performance of the air-conditioning selected can be achieved. (1 points)

For developments where air-conditioners are not provided, points will be scored and prorated under **1.03c (ii) Ventilation Performance**

GM RB: 2016 Criteria – Part 2 – Building Energy Performance

2.01a Air Conditioning System Efficiency

•Air-conditioners with 5 ticks- currently low market adoption

•4 brands currently with products certified with 5 ticks. By 2Q 2017, there will be 6 air con suppliers with more model selection of 5 ticks air con available

•Cost Premium of 5 ticks is around ~20%, payback period depending on individual usage can range from 1.5 to 3 years.

Cost premium	Payback period
~ 20%	1.5 to 3 years

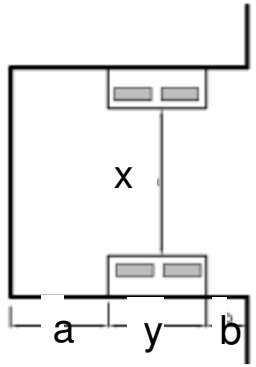
Based on NEA standard calculations. Operating hrs 8hrs/day . tariff 20 cents/kWh

Consulted 8 air conditioning suppliers

DAIKIN LG MITSUBISHI ELECTRIC Changes for the Better AIJO DENKI SAMSUNG Panasonic FUJITSU MITSUBISHI HEAVY INDUSTRIES, LTD.

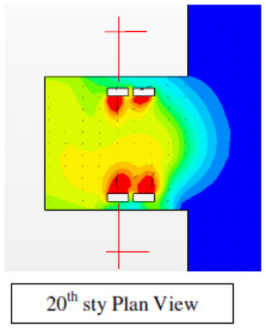
GM RB: 2016 Criteria – 2.01a Air Conditioning System Efficiency

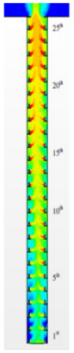
Adequate distance for the condenser units (**CU) or CFD simulation AND <u>70% free area of the screen</u>** (through flow of the air) to ensure the efficiency of the air-conditioner can be achieved.



Achieved recommended distance
x ≥ 2y
a ≥ y
b < 1m

OR





CFD simulation to ensure the efficiency performance of the air-conditioning claimed can be achieved

AND

Provide screens for CU with **≥70% free area** (through flow of the air) to ensure the efficiency of the air-conditioner can be achieved.



GM RB: 2016 Criteria – Part 2 – Building Energy Performance

2.01b Lighting Efficiency

- Encourage the use of energy efficient lighting in common areas to minimise energy consumption from lighting usage while maintaining proper lighting level

  0.1 point for every % improvement (up to 4 points)

2.02a Energy Efficiency Features

- Encourage the use of energy efficient features which are innovative and have positive environmental impact such as gas water heater, heat pump, heat recovery system, regenerative lift, Energy labelled appliances such as 4 ticks refrigerator, etc (up to 5 points)

2.02b Car Park Energy

- Encourage the use of energy efficient design and control of ventilation systems in car parks (up to 2 points)
  - Natural ventilated car park
  - Mechanical ventilated car parks with CO sensors installed to regulate the ventilation required

Similar to RB V4.1

GM RB: 2016 Criteria – Part 2 – Building Energy Performance

2.03 Renewable Energy

- Encourage the use of renewable energy
  - Feasibility study (0.5 point)
  - Solar ready roof (0.5 point)
  - 1 point for every 1% replacement of electricity by renewable energy (up to 7 points)

3.03a Feasibility Study

3.03b – Solar Ready Roof

3.03c – Replacement Energy

Similar approach to GM NRB:2015

Part 5 – Advanced Green Efforts

- To encourage additional replacement of electricity (based on building electricity consumption) by renewable energy. (up to 10 points)
  - 1 point for every 10% replacement of electricity (exclude household's usage) by renewable energy

GM RB: 2016 Criteria – Part 3 – Resource Stewardship

- To encourage responsible use of water through water efficiency measures and strategies
- To encourage sustainable construction and resource recovery
- To promote embodied energy
- To encourage use of green products
- To minimise the need for landfill disposal and encourage segregate waste

3.01 – Water

3.02 – Materials

3.03 – Waste

Similar approach to GM NRB:2015



GM RB: 2016 Criteria – Part 3 – Resource Stewardship

Similar to RB V4.1

3.01 Water

To encourage responsible use of water through water efficiency measures and strategies

- 3.01a – Water Efficiency Measures
- 3.01b – Water Usage Monitoring
- 3.01c – Alternative Water Sources



GM RB: 2016 Criteria – 3.01 Water under Resource Stewardship

3.01a Water Efficiency Measures

Reduce the potable water consumption through the use of water efficient products and systems

(i) Provision of water efficient fittings with prescribed minimum WELS ratings for common areas (1 pt)

Type of Water Fittings	Prescribed Minimum WELS ratings
(i) Basin taps & mixers	Excellent
(ii) Sink taps	Very Good
(iii) Shower taps, mixers or showerheads	Very Good
(iv) Dual Flush Low Capacity Flushing Cisterns for WCs	Very Good
Important notes : All other water fittings that are not listed are to comply with the mandatory standards stipulated in the Singapore Standard CP 48 – Code of Practice for Water Services	

GM RB: 2016 Criteria – 3.01 Water under Resource Stewardship

3.01a Water Efficiency Measures

(ii) Provision of water efficient products with WELS ratings for dwelling units (Up to 6 points)

Type of Products
Shower taps and mixers or showerheads, basin taps and mixers, sink taps and mixers, dual-flush low capacity flushing cisterns and clothes washing machines.

Up to 6 points can be scored based on the number and water efficiency rating of the product type used.

WELS Rating	Water Efficiency	Weightage for Point Allocation
✓✓	Very Good	5
✓✓✓	Excellent	6



GM RB: 2016 Criteria – 3.01 Water under Resource Stewardship

3.01a Water Efficiency Measures

Similar to RB V4.1

3.01a(ii) Landscape Irrigation

- Provision of water efficient automated irrigation system for at least 50% of landscape areas (1 point)
- Use of drought tolerant plants for at least 20% of landscape areas (1 point)

3.01b Water Usage Monitoring

- Provision of private water meters to facilitate continual monitoring of major water uses such as irrigation, swimming pools and other water features (1 point)

3.01c Alternative Sources of Water

- Encourage the use of alternative water sources to reduce potable water consumption for general application such as landscape irrigation, toilet flushing, general area washing & water features
  - NEWater Supply (1 point)
  - Rainwater Harvested (1 point)
  - On-site recycled water (1 point)

GM RB: 2016 Criteria – Advanced Green Effort

5.01(d) Water Usage Portal and Dashboard

Provision of water usage portal, dashboard or other equivalent forms for monitoring and trending of water consumption and usage pattern

- Common facilities (1 point)
- Individual households (2 points)

GM RB: 2016 Criteria – Part 3 – Resource Stewardship

3.02: Materials

Criteria		Points
• Sustainable Construction	- 8	
• Resource Efficient Building Design (CUI)		
• Resource Recovery		
• Sustainable Construction Resource Usage		18
• Embodied Energy	– 2	
• Sustainable Products	– 8	

Similar to GM NRB:2015

GM RB: 2016 Criteria – Part 4 – Smart and Healthy Building

- To encourage greater user-centricity such as
  - Health & Well-being
  - Indoor Environmental Quality
- To encourage smarter building through integration of technology and automation

4.01 – Indoor Air Quality

4.02 – Spatial Quality

4.03 – Smart Building Operations



GM RB: 2016 Criteria – 4.01 Indoor Air Quality

4.01a Occupant Comfort

- Encourage the use of assisted mechanism to achieve thermal comfort for (up to 2 points)
  - living room
  - bedroom

4.01b Contaminants

- Encourage the use of low VOC emitting interior finishes that are certified by approved local certification bodies such as adhesives & sealants, floor/wall/ceiling covering, varnish, etc (up to 3 points)

4.01c Waste Disposal

- To minimize airborne contaminants from waste by locating refuse chutes or waste disposal areas at open ventilated areas such as service balconies or common corridors (1 point)

4.01d Indoor Air Quality in Wet Areas

- To encourage provision of adequate natural ventilation and daylighting in wet areas such as kitchens and toilets (up to 2 points)

Similar to RB V4.1

GM RB: 2016 Criteria – 4.02 Spatial Quality

Similar to GM NRB:2015

4.01a Lighting

4.01a (i) Daylight in residential units

- To encourage effective daylighting and potential for visual discomfort mitigation strategies in residential units; in bedrooms, living room, family room and study room. (up to 3 points)

4.01a (ii) Potential Glare and daylight control measures

- Simple strategies to allow building occupants to adjust their environment to reduce discomfort glare during certain times of the day, whilst allowing effective daylight to enter functional areas (0.5 point)

4.01a (iii) Daylighting in common areas

- To encourage effective daylighting to the following areas (up to 1.5 points)
  - Staircases
  - Corridors & lift lobbies
  - Car parks

GM RB: 2016 Criteria – 4.02 Spatial Quality

Similar approach to GM NRB:2015

4.01b Acoustics

(i) Acoustics planning (1 point)

Architectural design to avoid windows of living rooms and bedrooms to be in immediate proximity/facing to noise sources within site boundary and 100m away from site boundary perimeter.

(ii) Acoustics Design (1 point)

Acoustic design and verification report meeting NEA requirement.

4.01c Wellbeing

- To encourage Biophilic Design which including elements of nature in comfortable spaces to nurture the human-nature relationship which is important for the health and happiness of the occupants (1 points) (additional 1 point under Advanced green efforts)
- To encourage adopting user-centric philosophy in design, operations and maintenance (1 points)

GM RB: 2016 Criteria – 4.03 Smart Building Operations

A three-level taxonomy is defined to classify the maturity of smartness as a framework to help building professionals review the best 'Smart Green' Technology options for their buildings.

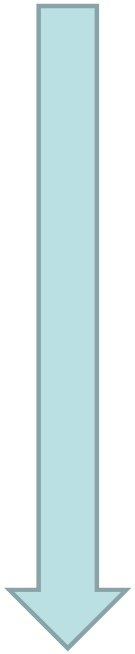
To encourage tracking of a building and residents' energy use

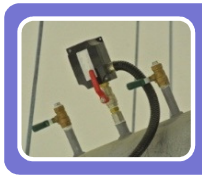
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To encourage adoption of automated controllers in managing energy consumption

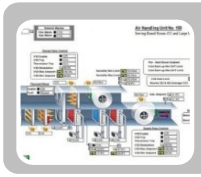
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To encourage innovative and integrative use of sensor and motion data for optimizing





Level I - Monitoring



Level II - Demand Controls



Level III - Analytics & User Engagement

GM RB: 2016 Criteria – 4.03 Smart Building Operations

4.03a Energy Monitoring

- To encourage tracking a building and residents' energy use with data presented in a relevant manner to engage occupants to be involved in managing energy consumption (up to 2 points)
  - Controllers/Timers
  - ESS monitoring (with open-protocol)
  - ELCB design separation of plug, lighting, kitchen/AC points

4.03b Demand Control

- To encourage adoption of automated controllers in managing energy consumption in the common areas of residential developments (up to 2 points)
  - Timer sensors / controls in community spaces
  - Car park guidance system
  - Irrigation sensors
  - Bi-level motion sensors in >80% of the common areas

GM RB: 2016 Criteria – 4.03 Smart Building Operations

4.03c Integration Analytics

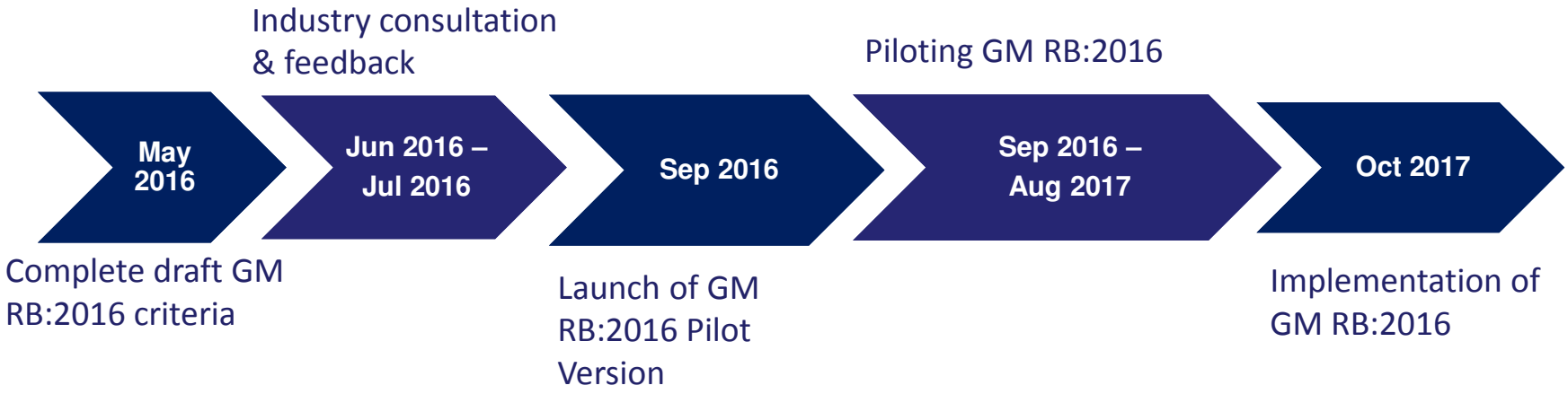
- To encourage innovative and integrative use of sensor and motion data for optimizing or attaining persistence of high performance and energy efficiency of the residential development (up to 2 points)
  - Website / Monthly per building information readout, engagement
  - Energy Portal & Dashboard

4.03d System Handover/ Documentation

- To encourage systems verification and to ensure operational continuity from construction to building maintenance and operation (up to 2 points)

SmartBuildings

GM RB: 2016 TIMELINE



- Aside from collating feedback, the GM RB: 2016 Pilot Version will be launched at International Green Building Conference (IGBC) 2016.
- A period of 12 months of piloting will be conducted after the launch before full implementation in October 2017.
- Projects can be assessed either under Green Mark Residential Building V4.1, GM RB: 2016, or both.