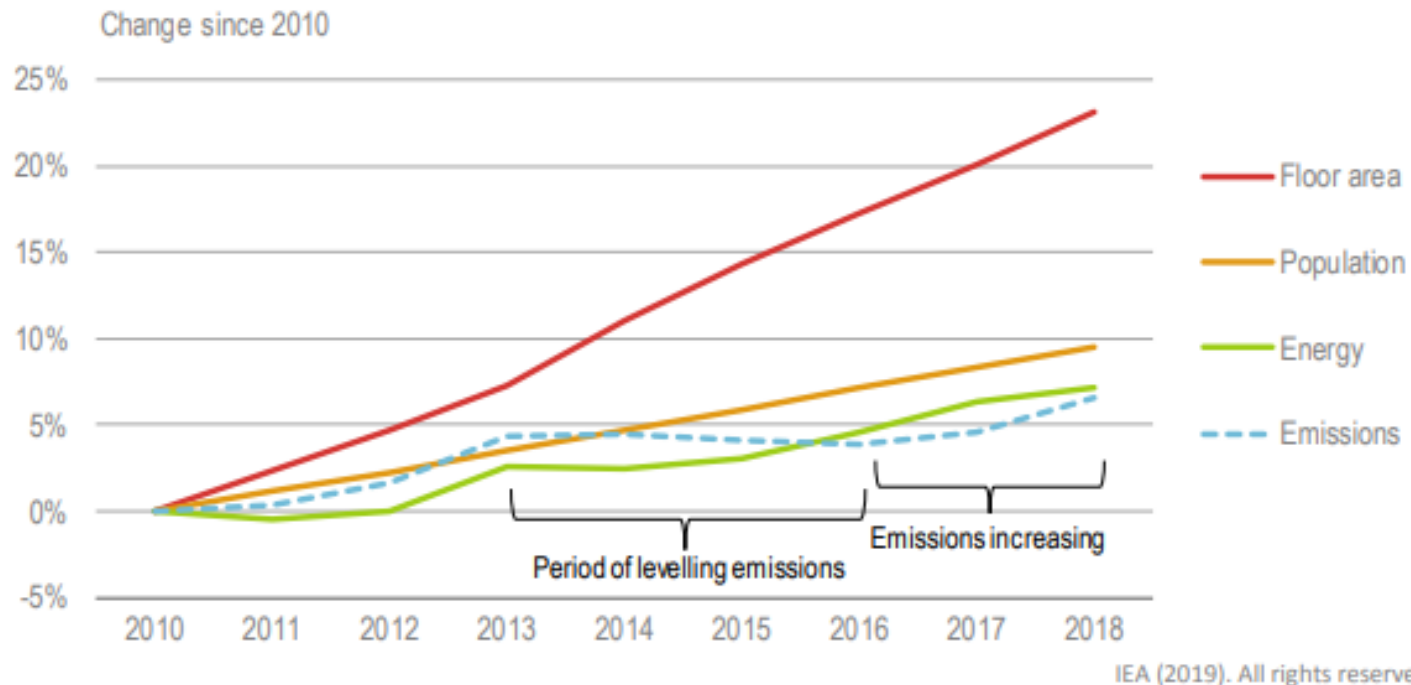# Future Proofing Our Cities With Green Spaces

Juanita Lourdes

Changes in floor area, population, buildings sector energy use & energy-related emissions globally, 2010-2018

Change since 2010

Floor area
Population
Energy
Emissions

Period of levelling emissions

Emissions increasing

IEA (2019). All rights reserved.

Source: Derived from IEA (2019a), *World Energy Statistics and Balances 2019*, www.iea.org/statistics and IEA (2019b) *Energy Technology Perspectives*, buildings model, www.iea.org/buildings.

CLIMATE CHANGE
- Buildings are responsible for almost **40% of energy** related global carbon emissions
- Energy demand will increase by **50% by 2050**

RESOURCE EFFICIENCY
- Buildings are responsible for **50% of global material use**
- 42.4bn tonnes of materials consumed annually

HEALTH & WELLBEING
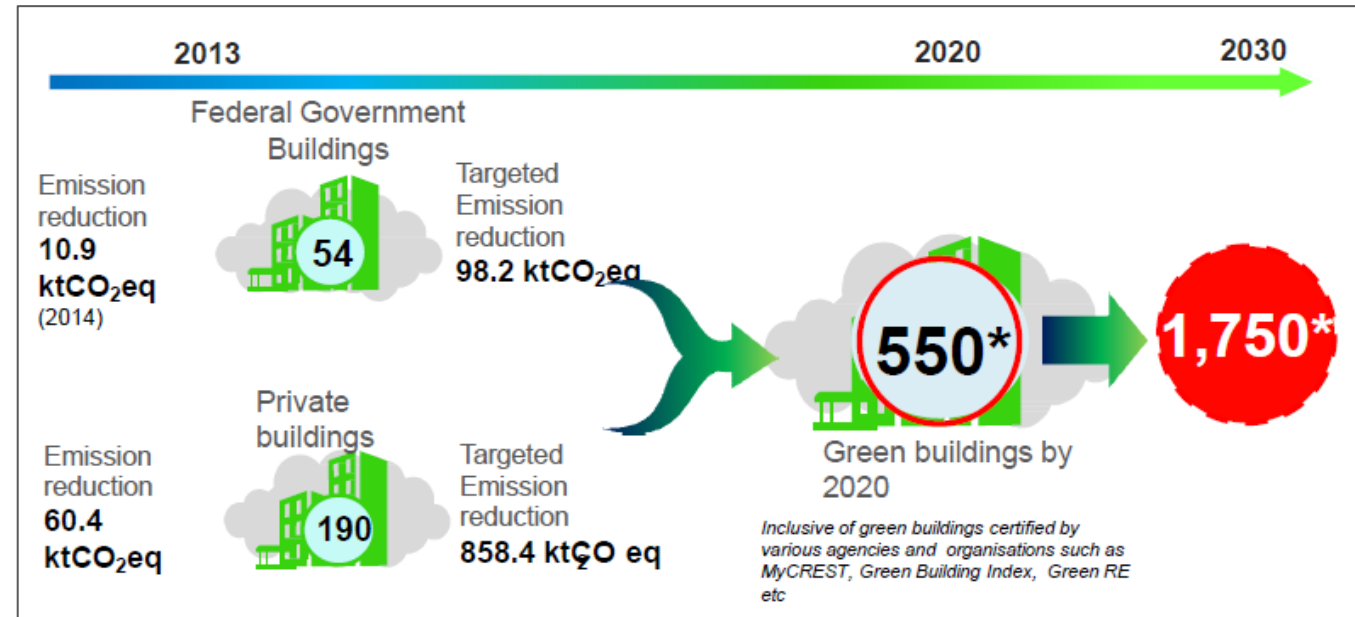- 91% of people live where air pollution levels exceed WHO limits

The Malaysian Scenario...

Green Technology Master Plan

NAPIC Data
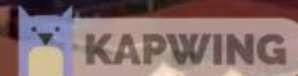
Source: The Age & Sydney Morning Herald

Green Spaces (Green Infrastructure) in our Cities

Urban Environment Common Environmental Issues:

- Urban Heat Island (UHI) Effect
- Loss of Biodiversity
- Loss of Ecosystem Services
- Flooding
- Air pollution
- Waste Management

Value of Greenery:
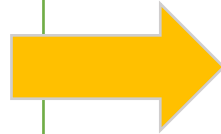
- ✓ Environmental (Ecosystem Services, ie. Rainwater management, air pollution reduction etc.)
- ✓ Ecological (Enhance Urban Biodiversity)
- ✓ Social (Aesthetic & Psychological benefits)

How much greenery do we need?

WHO recommends 9 m^2 of urban green space for each person (accessible, safe & functional). A generous allocation would be 50m^2/person

Types of Urban Green Space

1. Urban forest/urban parks
2. Allotment gardens
3. Vegetable raingardens
4. Edible green roofs
5. Detention and retention ponds/wildlife ponds
6. Street trees
7. Bioswales
8. Domestic/rain gardens
9. Building integrated vegetation (e.g., Biodiverse green roofs, green walls and climbing plants)
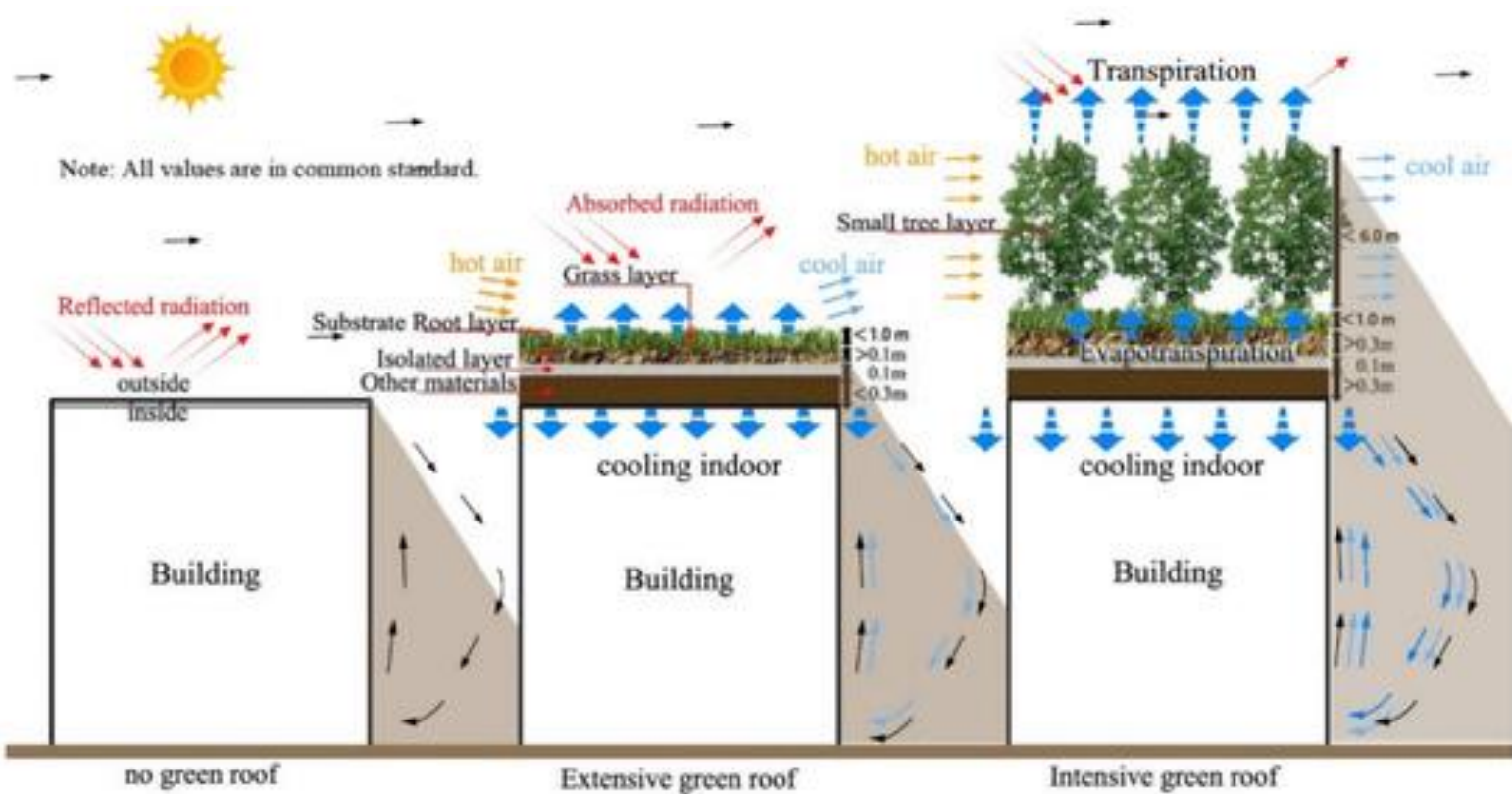
Source: Int J Environ Res Public Health. 2018 Oct; 15(10): 2180.

Benefits of Green Roofs

- **Reduces Urban Heat Island Effect & Improves Air Quality**

- **Economic Benefits**
  Reduces R-Value (Roof insulation capabilities), lessens cooling needs, resulting in energy cost savings

- **Improves Stormwater Management**
  Helps control storm water runoff and retention

- **Biodiversity Enhancement**
  Provide habitats and food sources for insects, birds and rare species of plants

- **Potential for Urban Farming & Vertical Farming**

- **Community Centre**

Water Retention for Traditional Roof vs. Green Roof		
Rainfall Retained %	**Standard Roof**	**Green Roof**
Average Retention	24%	80%
Retention at Peak Runoff	26%	74%

Source: "Green Roofs in the New York Metropolitan Region, Research Report," Rosenzweig, et. al.

Zhang, G.; He, B.-J.; Zhu, Z.; Dewancker, B.J. Impact of Morphological Characteristics of Green Roofs on Pedestrian Cooling in Subtropical Climates. Int. J. Environ. Res. Public Health 2019, 16, 179.

Benefits of Greenery in Healthcare Facilities

Biophilic Principles:

- **Sight**, visual access to greenery and water
- **Smell**, selection of scented plants
- **Sound** of falling water
- **Diversity** of plants, birds and butterflies
- **Community**, public space situated within blue-green areas

The green plot ratio of KTPH – an indicator of how much greenery there is in a development – is 3.92

✓ **8.5% reduction in hospital stays**

✓ **15% faster recovery**

✓ **22% reduction in need for pain medication**

✓ **11% reduction in secondary infections.**

15% Faster recovery rate

41% reduction in the length of patients stay in sunlit rooms

Patients feel calmer, more at ease and more comfortable

Exit

Khoo Teck Puat Hospital Singapore

Green Plot Ratio (GnPR)
a metric to quantify the amount of greenery in an area

$$GPR = \frac{Total\ Leaf\ Area}{Site\ Area} = \frac{\sum LAI \times canopy\ area}{Site\ Area}$$
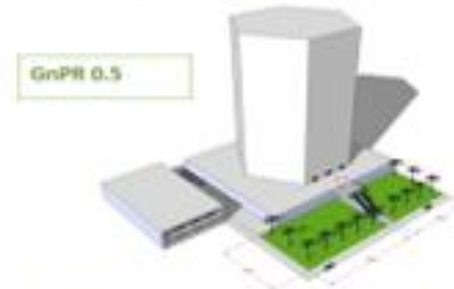
Estimate:
- amount of carbon sequestration,
- water retention and
- other environmental benefits of plants

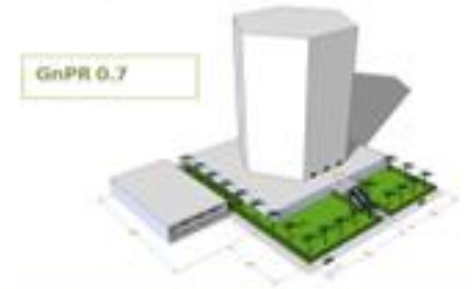***To communicate the value of greenery and to set greenery requirements for green projects***

To develop Landscape Guidelines for the Application of Green Plot Ratio

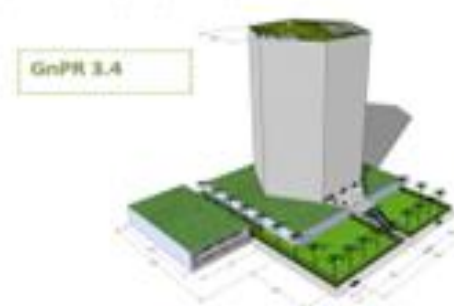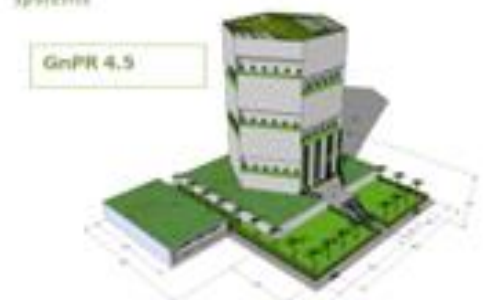**EXAMPLE OF GnPR IMPLEMENTATION**

Example 1: Existing green space — GnPR 0.5

Example 2: Enhanced ground level — GnPR 0.7

Example 3: Retrofit of the upper horizontal levels — GnPR 3.4

Example 4: Redesign of a building for vertical green systems — GnPR 4.5

Leaf Area Index (LAI)

Leaf Area Index: Is a dimensionless quantity that characterizes plant canopies. It is defined as the one-sided green leaf area per unit ground surface area

$$LAI = \frac{Leaf\ Area\ (m^2)}{Ground\ Area\ (m^2)}$$

Higher LAI = More denser canopy

A study using a CFD model indicated that the cooling effect of a 1.96 ha park is depended on its LAI. In areas where LAI is 3.16, CEI reaches -4.8 C, but in the extremities of the park, where LAI is 1.05, CEI reaches -1.2 C (Vidrih and Medved , 2013).

*CEI: Cooling Effect Intensity

Ground area = 1 m²
Leaf area = 1 m²
LAI = Leaf area: Ground area = 1:1 = **1**

Ground area = 1 m²
Leaf area = 3 m²
LAI = Leaf area: Ground area = 3:1 = **3**
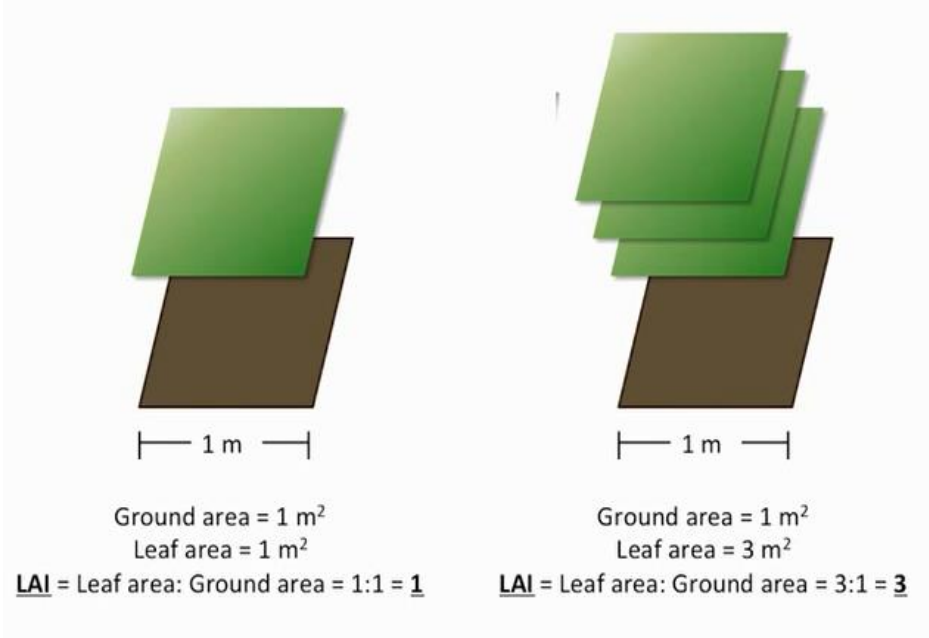
Type	Category	LAI
Tree	Open Canopy	2.5
	Intermediate Canopy	3.0
	Dense Canopy	4.0
Palms	Solitary	2.5
	Cluster	4.0
Shrubs	Monocot	3.5
	Dicot	4.5
Turf		2.0

Tree Canopy

Open

Dense

Intermediate

Palm Growth

Cluster

Solitary

Shrubs

Monocot

Dicot

GreenRE Certification Greenery Provision

NRB 3-3: Encourage greater use of greenery and restoration of existing trees to reduce heat island effect.

a. Green Plot Ratio (GnPR) is calculated by considering the 3D volume covered by plants using the Leaf Area Index (LAI).

b. Restoration of trees on site, conserving or relocating of existing trees on site. (at least 20%) **(1 CREDIT)**

| GnPR	Credit Allocation
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

GnPR Examples

Example 1: All Turf
Site Area: 2,751.84 sqm
Soft Scape Area : 339.6 sqm
Percentage of Green Area :12.5%
GnPR : 0.25

Category	Sub categorty	(A)	(B)	('C)	(A) x (B) x ('C)
		LAI value	Canopy Area	Qty	Leaf Area
Tree (no.)	Open Canory	2.5	60	0	0
	Intermediate Canopy	3.0	60	0	0
	Dense Canopy	4.0	60	0	0
Palms (no.)	Solitary	2.5	20	0	0
	Cluster	4.0	17	0	0
Shrubs (m2)	Monocot	3.5	N/A	0	0
	Dicot	4.5	N/A	0	0
Turf (m2)	Turf	2.0	N/A	339.6	679.2
				Total Leaf Area	679.2
				Total Site Area	2,715.84
				GnP = Total (Green Area/Site Area)	0.25
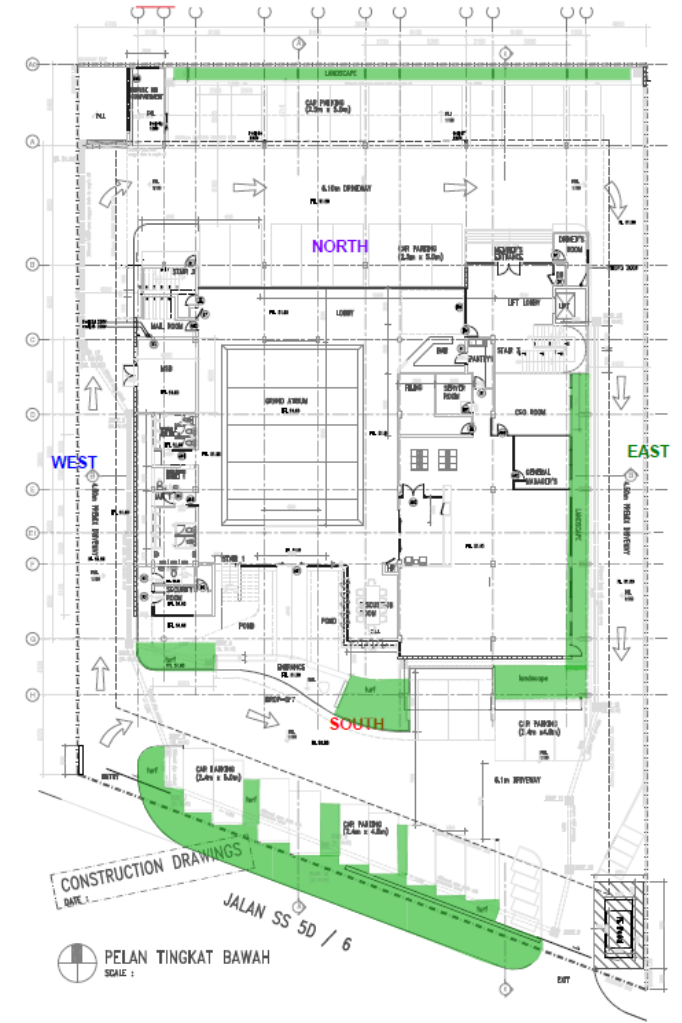
GnPR Examples

Example 2: Turf & Dense Trees

Site Area: 2,751.84 sqm

Soft Scape Area : 339.6 sqm

Percentage of Green Area :12.5%

Turf : 299.6 sqm

No of Tree :13 Nos

GnPR : 1.37

Category	Sub categorty	(A)	(B)	('C)	(A) x (B) x ('C)
		LAI value	Canopy Area	Qty	Leaf Area
Tree (no.)	Open Canory	2.5	60	0	0
	Intermediate Canopy	3.0	60	0	0
	Dense Canopy	4.0	60	13	3120
Palms (no.)	Solitary	2.5	20	0	0
	Cluster	4.0	17	0	0
Shrubs (m2)	Monocot	3.5	N/A	0	0
	Dicot	4.5	N/A	0	0
Turf (m2)	Turf	2.0	N/A	299.6	599.2
				Total Leaf Area	3719.2
				Total Site Area	2,715.84
				GnP = Total (Green Area/Site Area)	1.37

PELAN TINGKAT BAWAH
SCALE :
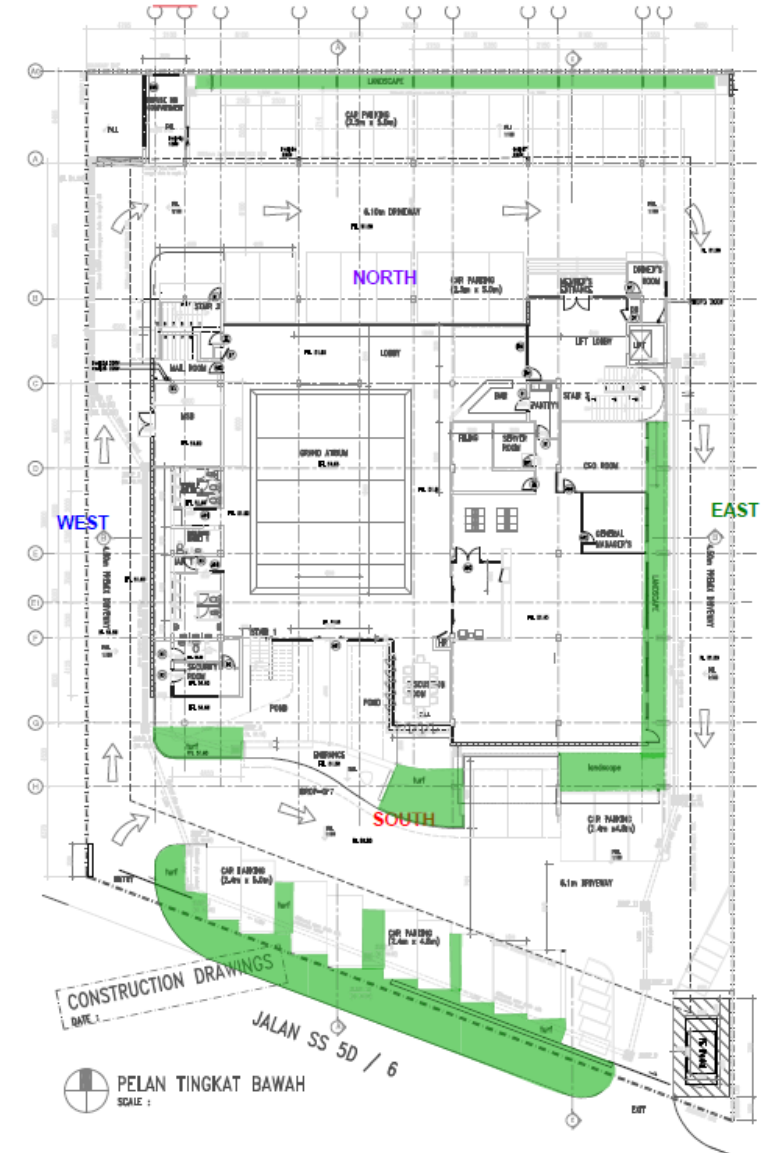
Local Authorities Landscape Requirements

Dewan Bandaraya Kuala Lumpur

10% of the development area

Majlis Bandaraya Petaling Jaya (MBPJ)

- 10-15 % of the development area
- Bunga Raya, Inai merah dan pudding merah kuning must incorporated in landscape Design

Majlis Bandaraya Shah Alam (MBSA)

- 3m perimeter landscape
- Open Space with turf (Axonopus Compressus)
- Bunga Raya dan Bunga Tanjung in Landscape Design

Majlis Perbandaran Subang Jaya

- 10% of the development area

About Us: GreenRE (Green Real Estate)

REHDA

→

GreenRE

Portfolio

Green Building Certification

| **Training Programmes** |
|---|
| GreenRE Managers Courses (GREMC) |
| Technical Seminars (GRETS) |
| Short Courses |

Collaborations (R&D & Awareness Drives)

- **Endorsed by the Federal Government for Tax Incentives (ie. MIDA, IRB etc)**
- **MGTC's MyHijau Mark**
- **Tax exemption incentives for the Iskandar Region under IRDA**
- **Recognised By Local Authorities in planning approvals e.g. DBKL, MBSA and MBPJ**

GreenRE Rating Tools

- ✓ **Established Based On Singapore BCA's GreenMark Tool**
- ✓ **Inclusive of Malaysian standards**

MS 2680

MS 1525

UBBL 1984

Green Mark

Locally Developed GreenRE Rating Tool
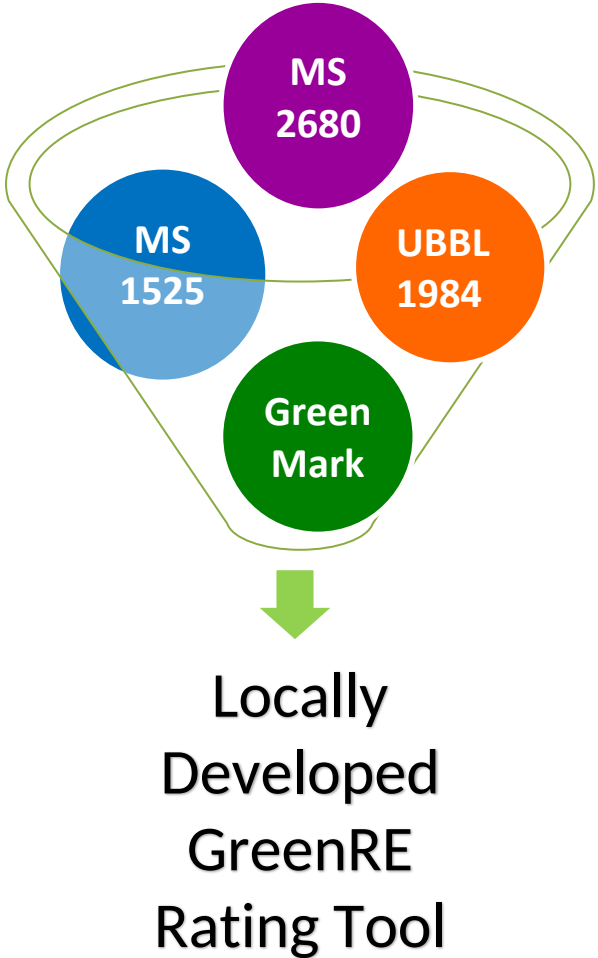
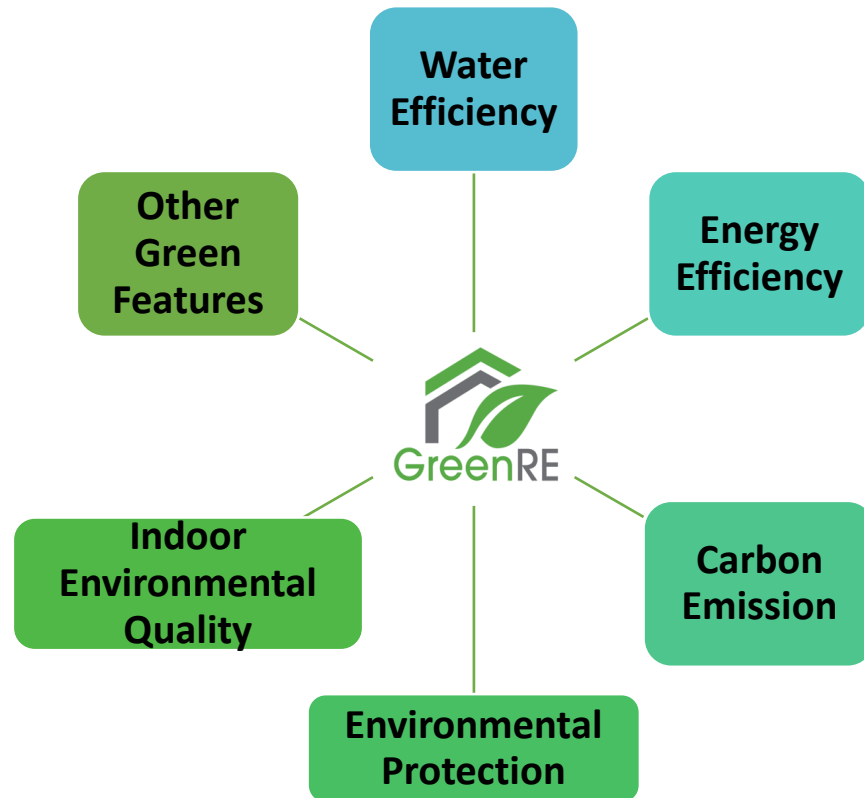| Building Tools	▪ Residential Building & Landed Home **(RES v3.1)** ▪ Non-Residential Building **(NRB v3.1)** ▪ Existing Non-Residential Building **(ENRB v3.1)** ▪ Healthcare **(HC 1.0)** ▪ Industrial Facilities **(IND 1.0)** ▪ Office Interior **(OI 1.0)** ▪ Restaurant **(PILOT)** ▪ Data Centre **(PILOT)**
Township Tools	Township **(TS 1.0)**
Infrastructure Tools	Infrastructure **(v1.0)**

Requirements for Green Certification

Water Efficiency

Energy Efficiency

Carbon Emission

Environmental Protection

Indoor Environmental Quality

Other Green Features

GreenRE

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

Part 1 – Energy Efficiency
NRB 1-1 Thermal Performance of Building Envelope -OTTV
NRB 1-2 Air-Conditioning System
NRB 1-3 Building Envelope – Design/ Thermal Parameters
NRB 1-4 Natural Ventilation/Mechanical Ventilation
NRB 1-5 Daylighting
NRB 1-6 Artificial Lighting
NRB 1-7 Ventilation in Carparks
NRB 1-8 Ventilation in Common Areas
NRB 1-9 Lift and Escalators
NRB 1-10 Energy Efficient Practices & Features
NRB 1-11 Renewable Energy

Elective Requirement for Other Areas
(Combination of the following items to meet 20 credits)

Part 2 - Water Efficiency
NRB 2-1 Water Efficient Fittings
NRB 2-2 Water Usage and Leak Detection
NRB 2-3 Irrigation System and Landscaping
NRB 2-4 Water Consumption of Cooling Tower

Part 3 – Environmental Protection
NRB 3-1 Sustainable Construction
NRB 3-2 Sustainable Products
NRB 3-3 Greenery Provision
NRB 3-4 Environmental Management Practice
NRB 3-5 Green Transport
NRB 3-6 Stormwater Management
NRB 3-7 Refrigerants

Part 4 - Indoor Environmental Quality
NRB 4-1 Thermal Comfort
NRB 4-2 Noise Level
NRB 4-3 Indoor Air Pollutants
NRB 4-4 Indoor Air Quality (IAQ) Management
NRB 4-5 High Frequency Ballasts

Part 5 – Other Green Features
NRB 5-1 Green Features & Innovations

Part 6 – Carbon Emission of Development
NRB 6-1 Carbon Emission of Development

In Every Walk with Nature One Received Far More Than One Seeks-John Muir, 19 July 1877

Thank You

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