GROWING
SINGAPORE'S
GREEN CANOPY IN THE SKY

Lok Yan Ling
Senior Manager (Skyrise Greenery)
National Parks Board, Singapore

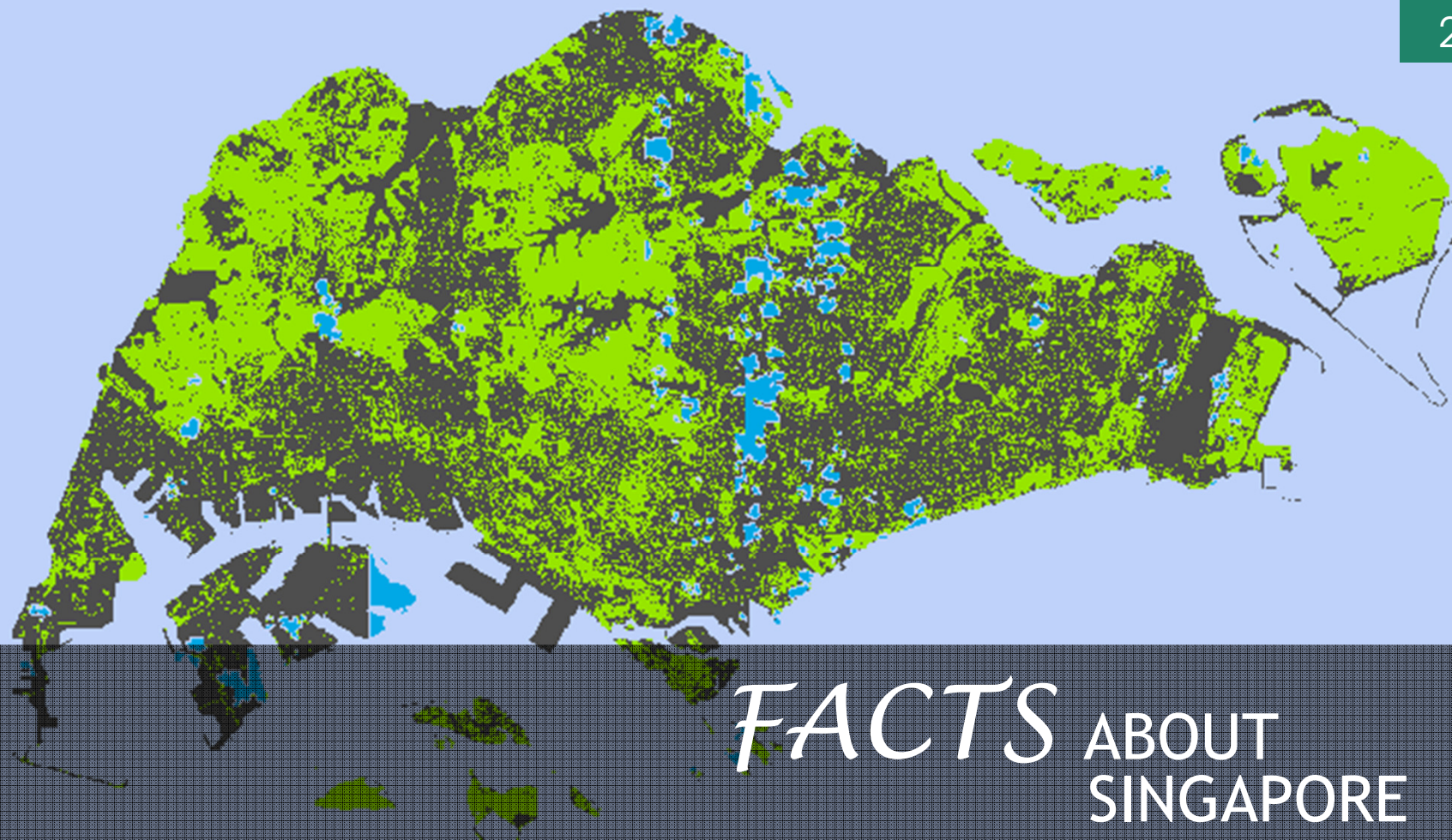NATIONAL PARKS | LET'S MAKE SINGAPORE OUR GARDEN

Outline

Skyrise Greenery in Singapore

Policies and Initiatives

Building Capacity and Outreach

Project Showcase

2015
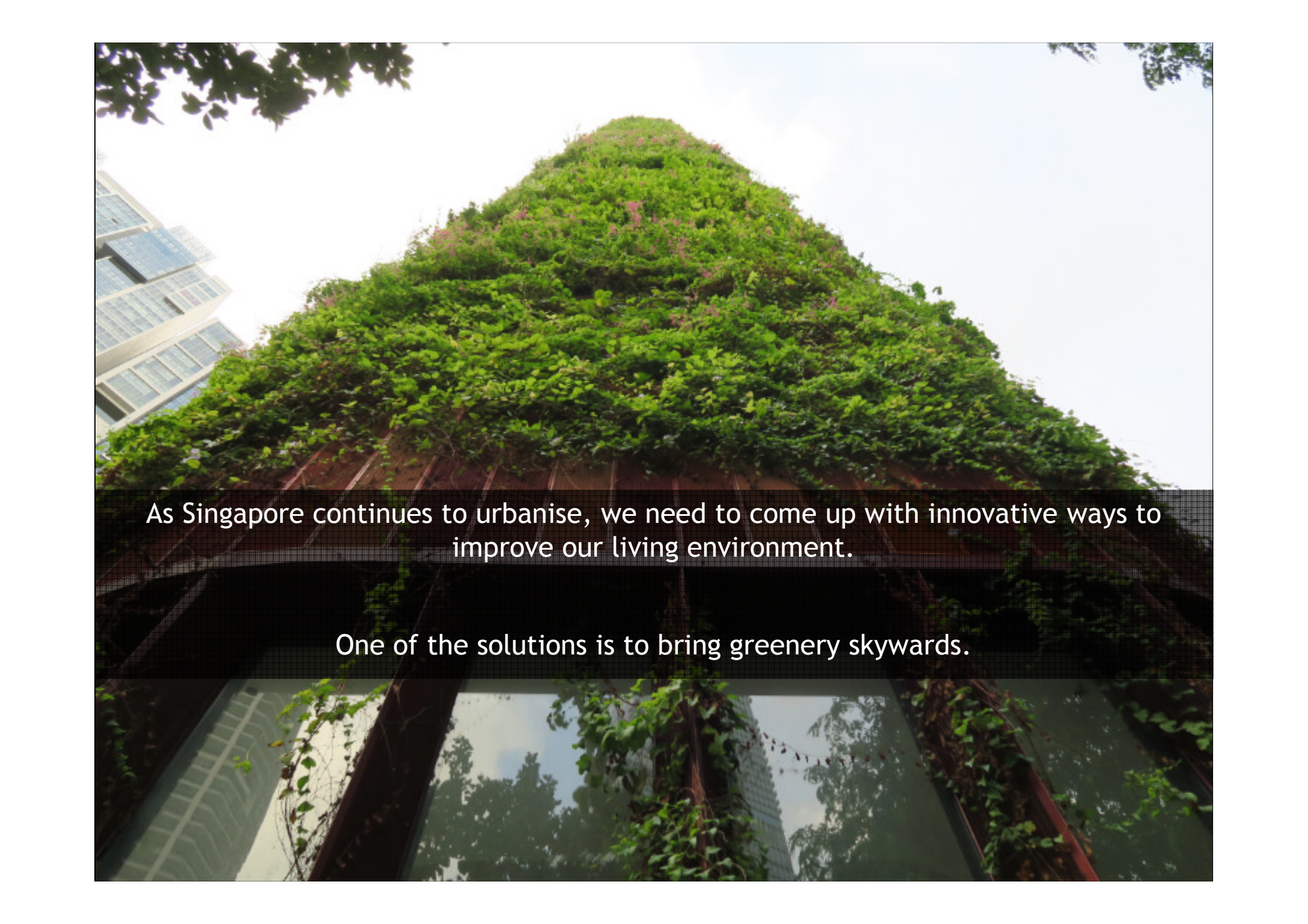
FACTS ABOUT SINGAPORE

71920 ha
Total land area

43.72%
Total Green area (2015)

5.6mil
Population

77.8 per ha
Population density

As Singapore continues to urbanise, we need to come up with innovative ways to improve our living environment.

One of the solutions is to bring greenery skywards.

WHAT IS SKYRISE GREENERY ?

Skyrise Greenery is greenery integrated into built forms.
A term coined in Singapore to refer to both rooftop greenery and vertical greenery.
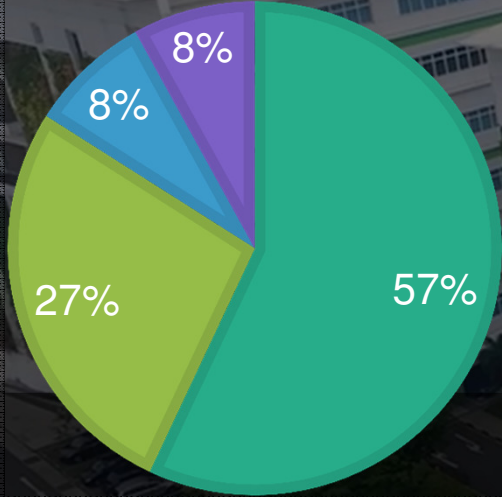
WHY IS SKYRISE GREENERY ESSENTIAL IN SINGAPORE **?**

Reduces Urban Heat Island effect, Provides thermal comfort

Limited ground level land for green spaces

Doubles up as communal and recreational spaces

SKYRISE GREENERY
COVERAGE IN SINGAPORE

Pie chart legend:
- Public Housing — 57%
- Commercial — 27%
- Government-Owned — 8%
- Institutions — 8%

Currently
80.5 ha
of Skyrise Greenery (2016)

Target of
200 ha
By 2030
Under the Sustainable Singapore Blueprint

Equivalent to
650
School fields

Policies and Initiatives

Regulations

Incentives

Recognition

REGULATIONS
ON SKYRISE GREENERY

Landscape Replacement Area Scheme (under LUSH)	Urban Redevelopment Authority
Parks & Trees Regulation	National Parks Board
HDB Greening Policy	Housing and Development Board

Landscape Replacement Area (LRA) scheme
under Landscaping for Urban Spaces and High-Risers (LUSH)

Agency: Urban Redevelopment Authority (URA)
Launched in 2009

New and re-developments located in strategic areas to provide greenery and communal areas equivalent to the development's site area (40% green, 60% communal)

→ Greenery includes ground planting + vertical and rooftop greenery
→ Building food resilience – urban farms that are communally accessible

Amendments to the Parks & Trees Regulation

Agency: National Parks Board (NParks)
Launched in: To be effective in Q3 2017
Objective: To safeguard public safety against near-edge tree planting on rooftop gardens.

Existing developments

- NParks has the power to enter premises to ascertain if any tree is a danger to public safety. (Section 37A)

Skyrise Greenery in Public Housing

Agency: Housing & Development Board

Main Skyrise Greenery initiatives:

1. New residential developments: Provision of greenery on topmost parking decks of multi-storey car parks and residential flats in public housing estates

2. Existing residential developments: HDB Greenprint → Part of HDB's "Roadmap to Better Living in HDB Towns", converting existing unused spaces into green spaces

Skyrise Greenery in Public Housing (New Developments)

SKYVILLE @ DAWSON
ROOFTOP GREENERY

Skyrise Greenery in Public Housing (New Developments)

SKYVILLE @ DAWSON

ROOFTOP GREENERY

Skyrise Greenery in Public Housing (New Developments)

SKYVILLE @ DAWSON

ROOFTOP GREENERY

Skyrise Greenery in Public Housing (New Developments)

CASA CLEMENTI MULTI-STOREY CAR PARK

ROOFTOP GREENERY

Photo credit: HDB

Skyrise Greenery in Public Housing (New Developments)

CASA CLEMENTI MULTI-STOREY CAR PARK

ROOFTOP GREENERY

Skyrise Greenery in Public Housing (Existing Developments)

SKY GARDEN @ JURONG CENTRAL

ROOFTOP GREENERY

Skyrise Greenery in Public Housing (Existing Developments)

SKY GARDEN @ JURONG CENTRAL

ROOFTOP GREENERY

INCENTIVES
FOR SKYRISE GREENERY

Skyrise Greenery Incentive Scheme	National Parks Board
Gross Floor Area (GFA) Incentive (under LUSH)	Urban Redevelopment Authority
Green Mark GFA Incentive Scheme	Building and Construction Authority

Skyrise Greenery Incentive Scheme

Agency: National Parks Board (NParks)
Launched in: October 2009

Objective: Encourage the installation of skyrise greenery on the external facades of existing buildings across Singapore using financial incentives.

Criteria: All existing buildings that are occupied.

Rooftop Greenery

Installation costs
- 50% of installation costs, up to a max of $200/m^2

Vertical Greenery

Installation costs
- 50% of installation costs, up to a max of $500/m^2

As of 2016, more than 180 projects successfully reimbursed.

Projects under the Skyrise Greenery Incentive Scheme

NANYANG POLYTECHNIC

ROOFTOP & VERTICAL GREENERY

Projects under the Skyrise Greenery Incentive Scheme

NANYANG POLYTECHNIC

ROOFTOP & VERTICAL GREENERY

Projects under the Skyrise Greenery Incentive Scheme

NANYANG POLYTECHNIC

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Projects under the Skyrise Greenery Incentive Scheme

NANYANG POLYTECHNIC

ROOFTOP & VERTICAL GREENERY

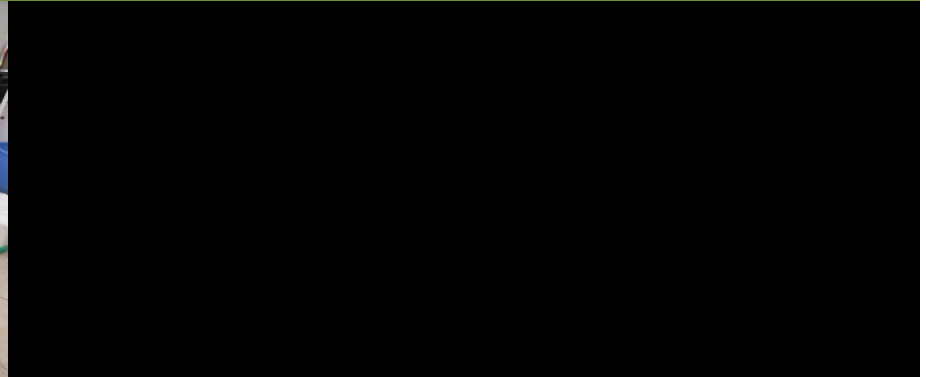# Projects under the Skyrise Greenery Incentive Scheme

NTUC HEALTH NURSING HOME (JURONG WEST)

ROOFTOP & VERTICAL GREENERY

Projects under the Skyrise Greenery Incentive Scheme

SPECTRA SECONDARY SCHOOL

ROOFTOP GREENERY

Projects under the Skyrise Greenery Incentive Scheme

To promote sustainability, the students also practice composting, upcycling and seed-saving in the garden.

SPECTRA SECONDARY SCHOOL

ROOFTOP GREENERY

Projects under the Skyrise Greenery Incentive Scheme

Students organise a Farmers' Market Garden-Based Service Learning (GBSL) curriculum at the end of the term to sell their self-grown produce to raise funds for the needy students.

Farmers' Market @ Spectra

Fund-raising for
Students on Financial Assistance

All items at minimum $2.00
Any extra amount is considered a
DONATION

Thank You Very Much
For Your Support

SPECTRA SECONDARY SCHOOL

ROOFTOP GREENERY

Projects under the Skyrise Greenery Incentive Scheme

KK WOMEN'S AND CHILDREN'S HOSPITAL

ROOFTOP GREENERY

Projects under the Skyrise Greenery Incentive Scheme

KK WOMEN'S AND CHILDREN'S HOSPITAL

ROOFTOP GREENERY

Projects under the Skyrise Greenery Incentive Scheme

KK WOMEN'S AND CHILDREN'S HOSPITAL

ROOFTOP GREENERY

URA Gross Floor Area Incentives
under Landscaping for Urban Spaces and High-Risers (LUSH)

Agency: Urban Redevelopment Authority
Launched in: October 2009, revised in 2014

GFA incentive:
1. Bonus GFA for rooftop outdoor refreshments areas in commercial and mixed-use developments that convert their existing ORA into a green roof/ rooftop garden.
   - Total 10% bonus overall GFA cap
2. GFA exemption for communal planter boxes that are more than 1 metre wide

BCA Green Mark Gross Floor Area Incentive Scheme

Agency: Building and Construction Authority
Launched in: April 2009

GFA incentive:
- Developments that attain GM platinum or Gold plus, URA will grant additional floor area over and above the Master Plan Gross Plot Ratio (GPR) control.

RECOGNITION
FOR SKYRISE GREENERY

Skyrise Greenery Awards	National Parks Board
LEAF Certification	National Parks Board
BCA Green Mark Certification	Building and Construction Authority
ABC Waters Certification Scheme	Public Utilities Board

Skyrise Greenery Awards

Agency: National Parks Board
Launched in 2008, held once every two years

Objectives of SGA:
1) Inspire creative and original landscaping ideas in skyrise greenery
2) Recognize stakeholder contribution
3) Encourage greater ownership and participation in greening up Singapore

Assessment Criteria: Design, Function, Sensitivity to surroundings, Engagement, Sustainability

Steady increase of entries from **12** in 2008 to **125** in 2015
→ indication of increasing popularity of skyrise greening

Skyrise Greenery Awards

WESTGATE (WINNER OF OUTSTANDING AWARD 2015)

ROOFTOP & VERTICAL GREENERY

Skyrise Greenery Awards

PARKROYAL ON PICKERING (WINNER OF OUTSTANDING AWARD 2013)

ROOFTOP & VERTICAL GREENERY

Landscape Excellence Assessment Framework (LEAF)

Agency: National Parks Board
Launched in: 2013

Objectives: To encourage more greenery in Singapore's urban landscape. LEAF is Singapore's first certification scheme solely dedicated to the provision and management of greenery.

Criteria: All existing and new developments can apply for LEAF.

Validity period of certification: Three years, following which a reassessment can be done.

Benefits: The LEAF logo can be used for marketing purposes. It is recognition of excellence in efforts and professionalism towards high quality urban landscapes.

42 developments are LEAF certified (updated 2016)

Projects that are LEAF Certified

OUE TWIN PEAKS

ROOFTOP & VERTICAL GREENERY

Projects that are LEAF Certified

SILOSO BEACH RESORT
ROOFTOP GREENERY

BCA Green Mark Certification

Agency: Building and Construction Authority (BCA)
Launched in: January 2005
Objective: To drive Singapore's construction industry towards more sustainable environmentally-friendly buildings.

Assessment Criteria:
- ✓ Other Green Features and innovation → Provision of Skyrise Greenery

Active, Beautiful, Clean (ABC) Waters Certification

Agency: Public Utilities Board
Launched in: July 2010
Objective: To provide recognition to developments that embrace the ABCWaters concept.

Buildings with skyrise greenery features can earn up to 10 points under the **"Beautiful"** category.

Building Capacity and Outreach Activities

Building capacity in the local industry

Community outreach

International

Recent research projects by NParks

Safe design of skyrise greenery in Singapore [Published]

By Michael Behm (East Carolina University, USA)
Poh Choon Hock (CUGE Research, NParks, Singapore)
Results published in SASBE (Smart and Sustainable Built Environment; Volume 1 Issue:2, pp.186-205, 2012; ISSN 2046-6099)

Bird and Butterfly Diversity on Skyrise Greenery [Completed, pending peer review]

By Edward L. Webb, Chloe Tan, Vivien Lee (National University of Singapore, Singapore)
James Wang, Poh Choon Hock (CUGE Research, NParks, Singapore)

Effects of Photovoltaic (PV) shading on the growth of ground covers [Completed, pending journal submission]

By Dr Chin Siew Wai, Poh Choon Hock, Rajbhandari Anisha (CUGE Research, NParks, Singapore)

Life Cycle Cost and Energy Analysis of Vertical Greenery System (VGS) [Ongoing]

By Prof. Wong Nyuk Hien (National University of Singapore, Singapore)
Rajbhandari Anisha (CUGE Research, NParks, Singapore)

CUGE publications on Skyrise Greenery

Developed by the Centre For Urban Greenery And Ecology (CUGE)
- Guidelines for good practices for Skyrise Greenery
- CS E: Skyrise Greenery series



Publications can be purchased at this link: https://www.cuge.com.sg/research/catalog.php

Skyrise Greenery Trail Maps

Objectives:

1. To showcase our unique skyrise greenery projects

2. To allow visitors to experience it up-close and personal

- Number of zones: 7

- Maps out the spatial distribution of the projects for each zone with a suggested walking route.

Download for free from our website:
www.nparks.gov.sg/skyrisegreenery
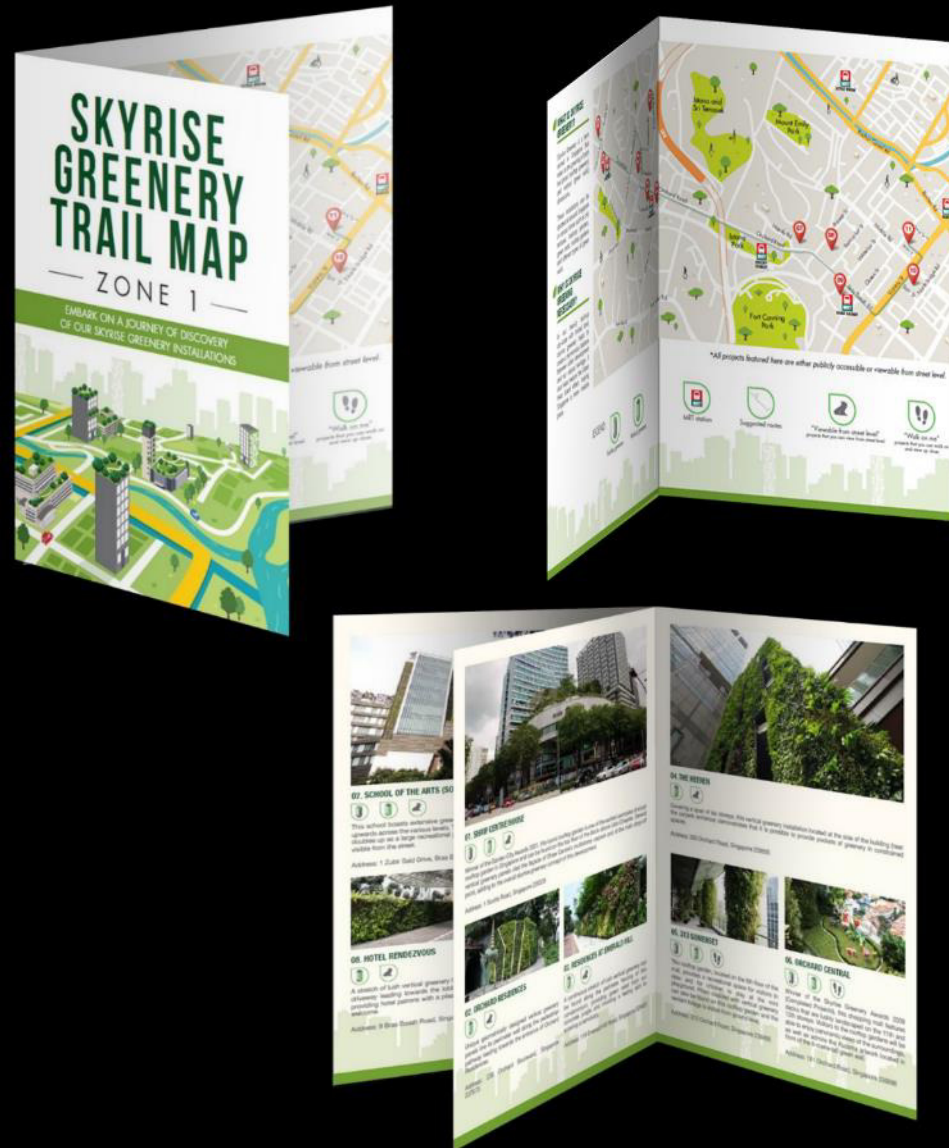
International Skyrise Greenery Conference
Held in conjunction with Greenurbanscape Asia

Held alongside

Jointly organized by LIAS, NParks and SILA.

To create avenues for multi-disciplinary knowledge sharing by engaging speakers from diverse backgrounds, both locally and internationally.

To nurture a platform for holistic exchange of ideas on skyrise greenery innovations.

International Skyrise Greenery Conference
Held in conjunction with Greenurbanscape Asia

9-11 November 2017

Singapore EXPO Convention and Exhibition Centre
Theme: Symbiosis: INTENSE Nature Within Cities

Focuses on topics of resilience, new levels of greening and integrating social needs into urban infrastructure.

Plenary Sessions

1. Vertical Resilience
2. Cities on a New Level (underground parks)
3. Placemaking (spatial identities for the urban user)
4. Therapeutic on the RISE

Parallel Sessions

1. Green Roofs – My New Backyard
2. Biotech and Innovation
3. Verticality and Safety
4. Hidden Challenges

For more information: http://www.greenurbanscapeasia.com/

Skyrise Greenery Projects In Singapore

Different building types

Usage of rooftop spaces/ wall facades

Design for maintenance considerations

COMMERCIAL
DEVELOPMENTS

PROJECT SHOWCASE: COMMERCIAL DEVELOPMENTS

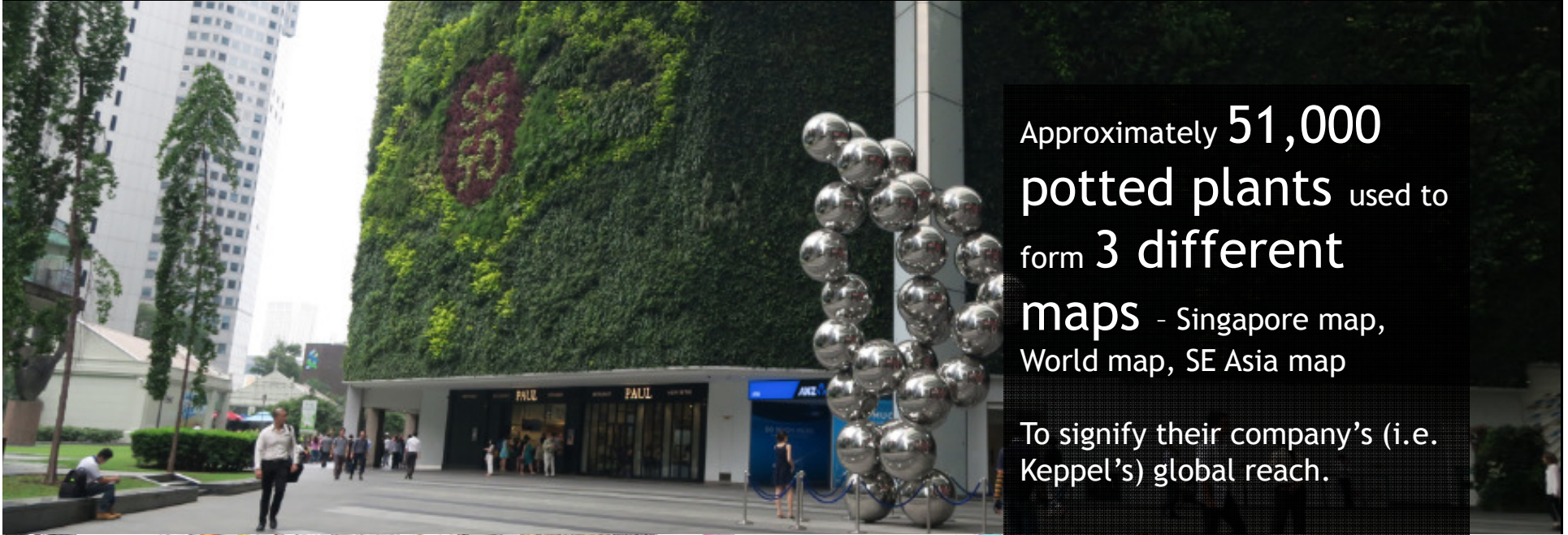Winner of the Skyrise Greenery Awards 2013 –
Excellence Award

Previously certified by the Guinness World Records as the **Largest Vertical Garden in 2013**.

Total green wall area =
2,125.56 sqm

OCEAN FINANCIAL CENTRE

VERTICAL GREENERY

Approximately **51,000 potted plants** used to form **3 different maps** – Singapore map, World map, SE Asia map

To signify their company's (i.e. Keppel's) global reach.

Singapore Map

World Map

Southeast Asia map

OCEAN FINANCIAL CENTRE

VERTICAL GREENERY

OCEAN FINANCIAL CENTRE

VERTICAL GREENERY

Hooks for safety harness are secured on structure.

Pots can be unhooked from behind and maintained.

OCEAN FINANCIAL CENTRE

VERTICAL GREENERY

Test drive circuit integrated with a rooftop garden

Divided into 3 distinct landscapes to test the performance of the Subaru car over different terrains.

SUBARU HUB

ROOFTOP GREENERY

Rainforest area

SUBARU HUB

ROOFTOP GREENERY

Mountainous/ Rockery area

SUBARU HUB

ROOFTOP GREENERY

Desert area

SUBARU HUB
ROOFTOP GREENERY

COMMUNITY
FACILITIES

NUS LEE KONG CHIAN NATURAL HISTORY MUSEUM

ROOFTOP GREENERY

Winner of Skyrise Greenery Awards 2015 Excellence Award

It has 3 thematic educational rooftop gardens and one main vertical façade feature.

NUS LEE KONG CHIAN NATURAL HISTORY MUSEUM

ROOFTOP GREENERY

Maintenance pathways located behind the planting beds.

Cat Ladders to navigate between levels.

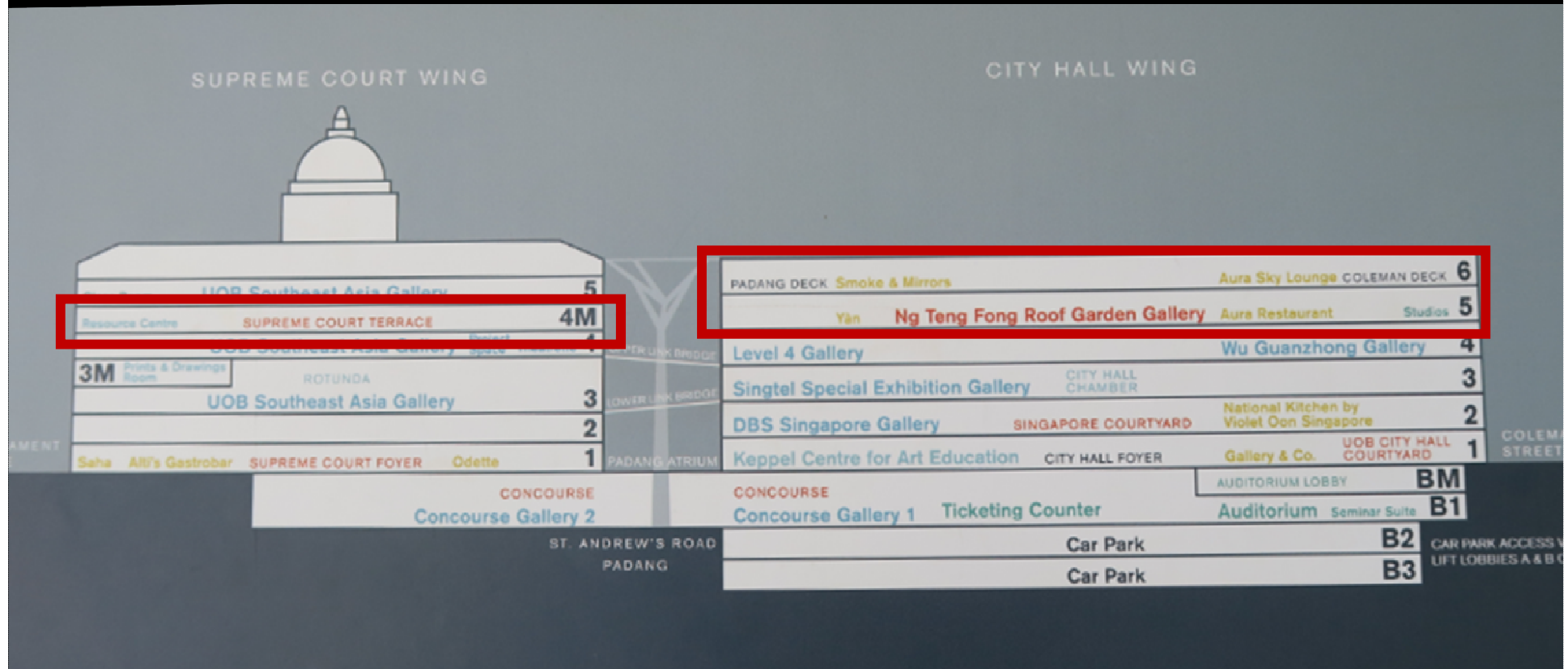**NUS LEE KONG CHIAN NATURAL HISTORY MUSEUM**

ROOFTOP GREENERY

Winner of **skyrise Greenery Awards 2015 Excellence Award**

Addition & Alteration works on existing building

NATIONAL GALLERY SINGAPORE
ROOFTOP & VERTICAL GREENERY

SUPREME COURT WING

CITY HALL WING

UOB Southeast Asia Gallery	5
Resource Centre SUPREME COURT TERRACE	4M
UOB Southeast Asia Gallery Project	4
3M Prints & Drawings Room	
ROTUNDA	
UOB Southeast Asia Gallery	3
	2
Saha Alti's Gastrobar SUPREME COURT FOYER Odette	1

PADANG DECK Smoke & Mirrors — Aura Sky Lounge COLEMAN DECK — 6

Yàn Ng Teng Fong Roof Garden Gallery Aura Restaurant Studios 5

Level 4 Gallery Wu Guanzhong Gallery 4

Singtel Special Exhibition Gallery CITY HALL CHAMBER 3

DBS Singapore Gallery SINGAPORE COURTYARD National Kitchen by Violet Oon Singapore 2

Keppel Centre for Art Education CITY HALL FOYER Gallery & Co. UOB CITY HALL COURTYARD 1

AUDITORIUM LOBBY BM

CONCOURSE
Concourse Gallery 2

CONCOURSE
Concourse Gallery 1 Ticketing Counter Auditorium Seminar Suite B1

ST. ANDREW'S ROAD PADANG Car Park B2 CAR PARK ACCESS
Car Park B3 LIFT LOBBIES A & B

PADANG ATRIUM
UPPER LINK BRIDGE
LOWER LINK BRIDGE
COLEMAN STREET

NATIONAL GALLERY SINGAPORE

ROOFTOP & VERTICAL GREENERY

Supreme Court wing

NATIONAL GALLERY SINGAPORE

ROOFTOP & VERTICAL GREENERY

Supreme Court wing

NATIONAL GALLERY SINGAPORE
ROOFTOP & VERTICAL GREENERY

City Hall wing

NATIONAL GALLERY SINGAPORE
ROOFTOP & VERTICAL GREENERY

City Hall wing

NATIONAL GALLERY SINGAPORE
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City Hall wing

NATIONAL GALLERY SINGAPORE
ROOFTOP & VERTICAL GREENERY

City Hall wing

NATIONAL GALLERY SINGAPORE
ROOFTOP & VERTICAL GREENERY

EDUCATIONAL
INSTITUTIONS

Winner of Skyrise Greenery Awards 2013
Excellence Award,
Special Awards – DIY project,
Special Awards – Innovation

HOUGANG PRIMARY SCHOOL
VERTICAL GREENERY

DIY project –
built by students
and staff

Rotatable green wall installation.

Green wall as a solution to their heat and glare, rainfall issue.

CHIJ TOA PAYOH SECONDARY SCHOOL

VERTICAL GREENERY

Panels are rotatable 359 degrees to ensure that plants on both sides can be maintained.

CHIJ TOA PAYOH SECONDARY SCHOOL

VERTICAL GREENERY

NUS VENTUS
VERTICAL GREENERY

NUS VENTUS
VERTICAL GREENERY

NUS VENTUS

VERTICAL GREENERY

NUS VENTUS

VERTICAL GREENERY

PRIVATE
RESIDENTIAL

CORNWALL GARDENS
ROOFTOP GREENERY

Winner of the **Skyrise Greenery Awards Excellence Award 2015**

Designed with the concept that family and nature share the same breathing space.

CORNWALL GARDENS
ROOFTOP GREENERY

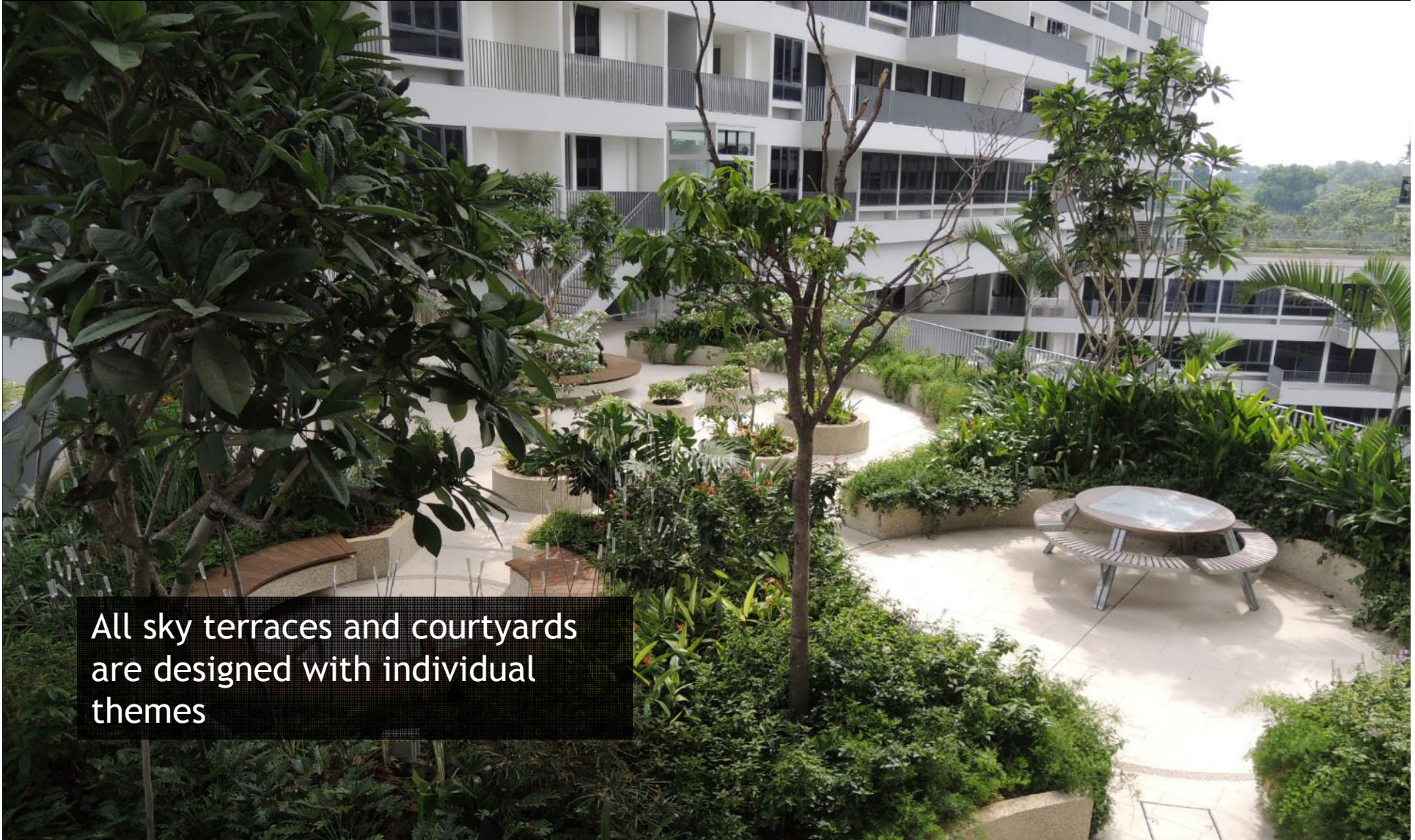Winner of the **Skyrise Greenery Awards Excellence Award 2015**

THE INTERLACE

ROOFTOP GREENERY

This extensive landscaping and sky gardens has increased the greenery footprint at The Interlace to

112% of its original land area

THE INTERLACE

ROOFTOP GREENERY

All sky terraces and courtyards are designed with individual themes

THE INTERLACE

ROOFTOP GREENERY

THE INTERLACE

ROOFTOP GREENERY

PUBLIC
INFRASTRUCTURES

SENTOSA MONORAIL
VERTICAL GREENERY

SENTOSA MONORAIL
VERTICAL GREENERY

Maintenance walkway build behind the green wall.

Cat ladders for workers to access between levels.

SENTOSA MONORAIL

VERTICAL GREENERY

JURONG LAKE DISTRICT BUS STOP INITIATIVE

ROOFTOP & VERTICAL GREENERY

CONCLUSION

- Singapore has both regulations and incentives in place to go beyond just increasing its skyrise greenery coverage but also to ensure its sustainability and usability in the long run for all groups of people.

- Constant need to keep up to date with recent trends through research

- Create knowledge sharing platforms to build capacity in the local industry

Thank you and see you in Singapore!

Website: www.nparks.gov.sg/skyrisegreenery

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