

# International Green Roof City Network

## Case Study Singapore



### 1) City Data

#### Location

Singapore is located at the southern tip of the Malaysian peninsula within the Southeast Asia region.

#### Area

Land area of 710 km<sup>2</sup>

#### Population

Population is over 5.1 million.

#### Other Information

Singapore is a bustling cosmopolitan city populated with high-rise buildings and landscape gardens. Brimming with a harmonious blend of culture, cuisine, arts and architecture, Singapore is a dynamic city that's rich in contrast and colour. Coming together as a society and living in harmony, there are four major races – namely the Chinese (majority), Malay, Indian and Eurasian. Each community offers a different perspective of life in Singapore in terms of culture, religion, food and language.

Climate: A tropical rainforest climate with no distinct seasons. Fairly uniform temperature all year round, high humidity with abundant rainfall.

## 2) Description of the local Green Roof Policy Initiative

### 2.1 Start

The National Parks Board (NParks) introduced a pilot programme in 2009 to encourage the installation of green roofs on existing buildings in selected high-visibility city areas. It was eventually extended to all existing buildings island-wide to encourage the adoption of more green roofs in totality. In March 2011, NParks revamped the programme and it was subsumed under the new Skyrise Greenery Incentive Scheme (SGIS).

### 2.2 Expected environmental benefits

- Stormwater management
- Biodiversity
- Urban Heat Island Effect
- Air Quality
- Climate Change
- Energy Savings
- Beautification of the City

### 2.3 Environmental benefit that is the carrier of the green roof initiative

Greenery and landscaping were seen as enhancements to the environment, as 'carriers' of biodiversity, and crucial to the whole sustainable energy/resource cycle. It was in recent years that green architectural features such as sky gardens, roof gardens and vertical green walls begin to be integrated into the building as a sustainable form of architecture.

Skyrise greenery is a strategy to extend greenery upwards, through plantings on walls of buildings, balconies, mid-levels of buildings, and on the top of roofs, to create a larger sum total of greenery. The development of skyrise greenery began as an aesthetic feature but evolved into an approach to enhance sustainability in architecture. It is thus in this regard that skyrise

greenery (a term that was coined in Singapore) reflects our collective approach towards holistic greening in an urban, high-density environment.

Skyrise greenery helps mitigate the urban heat island effect. In a study comparing well-planted areas and urban concrete zones a maximum of 4.01 °C temperature difference was observed. A layer of plants on the roof skin can cool the immediate surrounding environment by 1.5 °C and the surface temperature by up to 18 °C. This improves the urban environment and reduces energy costs spent on air-conditioning. For example, up to a 14.5 % saving on air conditioning costs may be experienced by installing a green roof on a five-story office building in Singapore. Similarly, vertical greenery can shield buildings from the sun's heat, with denser plant covers being more effective. Surface and ambient temperatures can be lowered by up to 11.58 °C and 3.33 °C respectively. Rooftop vegetation improves the air quality directly by filtering airborne particles in their leaves and branches. It also provides better acoustic insulation, being able to reduce noise levels by up to 10dB, which is clearly noticeable.

## 2.4 Support instruments that are used by the municipality to promote green roofs

- Building, landscape, energy, or other code or policy (e.g. land-use plan, green roof bylaw, zoning code, green factor, design regulations, etc.)
- Reduced stormwater fee
- Financial Incentives
- Tax Credits
- Favourable Credit Terms
- Density Bonus
- Demonstration Projects
- Ecological Labels
- Press, Internet
- Education and Information (e.g. seminars, conferences, green roof tours, etc.)
- Research
- Local Green Roof Guidelines
- Consultancy offer for constructors, investors, building owner
- Other instruments: Skyrise Greenery Awards

### Description of support instruments

#### **Building, landscape, energy, or other code or policy**

To encourage the integration of skyrise greenery in developments, the Landscaping for Urban Spaces and High-rise (LUSH) by the Urban Redevelopment Authority (URA) was introduced in April 2009. Besides the provision of greenery within green buffer and peripheral planting strip for developments at 1st storey, it also include the following:

Landscape Replacement Policy – all new developments in selected areas are required to provide landscape areas to make up for the greenery and landscape lost on the ground. The landscape areas provided should be at least equivalent in size to the development site area, in the form of landscaping at the ground level, sky terraces at mid levels, or rooftop gardens.

Revised Gross Floor Area (GFA) Exemption for Sky Terraces – encourages the provision of larger and loftier sky terraces, and hence more communal spaces. The landscape should not only exhibit a variety of plants but also be available for the building users to enjoy and be visible from surrounding buildings. The inclusion of communal facilities is also encouraged.

Outdoor Refreshment Areas (ORAs) on Landscaped Roof Tops – existing buildings within key activity areas will be granted additional GRA, which is beyond the Master Plan permissible Gross Plot Ratio (GPR) and could be used for ORAs on the rooftop level. This is provided the owners provide rooftop landscaping for their developments and make the rooftop available for communal activities.

Landscape Deck Guidelines for Residential Flat and Condominium Development – all earth berms of a landscaped deck would need to be properly landscaped with trees and shrubs. This will enhance the greenery along the road and immediate surroundings.

Green Building: The Building and Construction Authority (BCA) launched the Green Mark Scheme in January 2005. It aims to inculcate a culture of environmental awareness among developers, designers and builders from the point of project conceptualization to building construction, to achieve sustainability and integrated greenery in the built environment. Benefits of the Green Mark include facilitating the reduction of water and energy bills, reducing potential environmental impact, improving indoor environmental quality for a healthy and productive workplace, and providing clear direction for continual improvement. Adoption of extensive greenery is an assessment criterion for Green Mark certification. This greenery may be in the form of skyrise greenery on the rooftops, sky terraces, balconies or vertical greenery.

**Financial Incentives:** The Skyrise Greenery Incentive Scheme by the National Parks Board (NParks) provides funding support to building owners for the greening of not just rooftops but also for building façades. It takes the form of a cash reimbursement for 50 % of the actual installation costs. Since its introduction in 2009, SGIS has assisted in greening more than 100

existing buildings in Singapore which support a variety of uses ranging from extensive green roof to edible gardens and recreational rooftop gardens with lush verdant green walls.

**Education & Information:** The first “Skyrise Gardens: Plants for Apartments” exhibition was held in 1992 to encourage the cultivation and display of plants within apartment flats. The book “A Guide to Skyrise Gardening” was also published to provide suggestions on the types of plants that could be grown in high-rise apartments and how to care for them. Subsequent similar events, such as the “Skyrise Gardens” Exhibition organised in 1998, were held at community centres to reach out to the community. More information to promote skyrise greenery has also been released in recent years, including publications such as “A Selection of Plants for Green Roofs in Singapore”, “Introduction to Vertical Greenery” and “Vertical Greenery for the Tropics”. The inaugural International Skyrise Greenery Conference 2010 from 1<sup>st</sup> to 3<sup>rd</sup> November 2010 included a trade exhibition and technical tours. A total 479 delegates from 28 countries attended the conference which featured 30 speakers and 16 exhibition booths. Local awareness of the emerging skyrise greenery market was created and participants were generally pleased with the exchanges of knowledge and know-how made possible by the conference, as well as the networking opportunities.

**Research:** As the research arm of NParks, the Centre for Urban Greenery and Ecology (CUGE) aims to enhance the urban living environment by advancing knowledge and sharing expertise in urban greenery and ecology. CUGE collaborated with the School of Design and Environment of the National University of Singapore in quantifying the benefits of green roofs and walls. The research outcomes were published in scientific papers that addressed the cooling effects plants have on buildings, as well as the energy savings that can be attributed to green roofs and vertical greenery. New systems have also been developed. “Verti-Green” is a vertical modular carrier jointly developed by CUGE and the Housing and Development Board’s Building Research Institute (BRI). Planting variety is achieved here by allowing up to 16 different types of plants to be planted in a single module. “Ovalis” plantercell system is another vertical greenery system development that encourages indoor planting. This system’s patent has already been licensed to a commercial partner.

**Local Green Roof Guidelines:** CUGE is also producing a series of standards, focusing on skyrise greenery guidelines. Some of the topics covered are design for safety, design loads, substrate layer, as well as filter, drainage and root penetration barrier layers for rooftop greenery.

CS E01:2010	Guidelines on Design Loads for Rooftop Greenery
CS E02:2010	Guidelines on Design for Safety on Rooftop Greenery
CS E03:2010	Guidelines on Substrate Layer for Rooftop Greenery
CS E04:2010	Guidelines on Filter, Drainage and Root Penetration Barrier Layers for Rooftop Greenery

**Other instruments:** To recognise and encourage excellence in skyrise greenery development, the National Parks Board (NParks) and the Singapore Institute of Architects (SIA) had jointly organised the Skyrise Greenery Awards. Since its inception, entries received have been increasing and submissions have been received from overseas participants.

### 3) Number and area of green roofs

	Buildings	Total area
Green Roofs/Rooftop Gardens	378	468,000 m <sup>2</sup>

### 4) Challenges and future prospects

In promoting and maintaining skyrise greenery in Singapore, ownership is important. Accordingly, engaging government agencies, industry partners and the community would enable skyrise greenery to grow, mature, improve and be sustained. Technology transfer is equally important in developing the capabilities of the local skyrise greenery industry. In addition, the market demand and consumer interest needs to be present to provide the driving force for the further development and sustainability of skyrise greenery in Singapore.

### 5) Contact persons

Skyrise Greenery  
National Parks Board HQ  
1 Cluny Road  
Singapore 259569  
Tel: ++65 6471 7808  
Email: [skyrisegreenery@nparks.gov.sg](mailto:skyrisegreenery@nparks.gov.sg)

### 6) Internet resources

<https://www.skyrisegreenery.com/>