

# Skyrise Greenery - Incentive Scheme SGIS

Republic of Singapore



## Singapore's Skyrise Greenery Incentive Scheme for Buildings

Singapore is one of the world's leaders in urban greenery on buildings. In 2009, the National Parks Board of Singapore developed the Skyrise Greenery Incentive Scheme (SGIS) [1, 2], which promotes greenery on high-rise buildings, and thus contributes towards Singapore's vision of a City in a Garden. Additionally Skyrise Greenery under the SGIS offers environmental, economic, social and aesthetic benefits. Because of limited land space in Singapore the SGIS became an important element in sustainable urban development. There are two categories of urban greenery actions funded by the SGIS, the rooftop greenery and vertical greenery on facades and walls of existing and new buildings. The program encourages building developers to provide communal green spaces at the ground and upper levels of high-rise buildings.

### City State Profile

	<b>City State</b>	
	Population (2014)	5.5 million [4]
	Land area (km <sup>2</sup> )	718[3]
	GDP per capita (2014, current international \$, at purchasing power parity)	82,763[4]
	Region	Southeast Asia, coastal (1°17'N 103°50'E)
<b>City's physical geography</b>	Location	<ul style="list-style-type: none"> <li>✓ Consists of 63 low-lying islands at the southern tip of the Malaysian peninsula (flooding risk, severe weather events, water resource impacts)</li> <li>✓ On-going land reclamation projects have increased Singapore's land area</li> <li>✓ Main island of Pulau Ujong is densely populated (urban heat island effects)</li> </ul>
	Climate	<ul style="list-style-type: none"> <li>✓ Tropical rainforest climate (average temperature: 22-35 C°)</li> <li>✓ 2,342 mm/year annual rainfall, northeast and south west monsoon</li> </ul>

### Initiating context

The Skyrise Greenery Incentive Scheme (SGIS) was introduced by the National Parks Board (NParks) of Singapore in 2009 [1] as a contribution to Singapore's vision of a City in a Garden. Singapore has already a long tradition in integral planning of urban green spaces. Examples are the Greenery master plan of 2007 and the Park Connector Network which connects 200 kilometers of linear parks throughout Singapore. In the Sustainable Development Blueprint 2009 [5] Singapore's government defined the following goals concerning the planned enlargement of green spaces: By 2030 8m<sup>2</sup>/person of green area and an increase of greenery on high-rise buildings to 50 ha were envisaged. In 2013 the 50 ha goal of greenery on high-rise buildings was already surpassed with 61 ha per person installed [6] and has been increased in 2015 to 200 ha [2]. This enormous increase in greenery on high-rise buildings is mainly linked to the introduction of the SGIS. Thus the SGIS can be seen as an additional innovative and well-integrated form of urban nature into the built environment. Benefits range from cooling effects and reduced urban temperatures and air-conditioning loads, to better air quality, noise reduction, and higher biodiversity, to improved health and well-being of humans and aesthetic benefits which increase also the buildings value. Meanwhile a variety of public greeneries ranging from extensive green roofs to edible gardens, recreational rooftop gardens and lush verdant green walls have been funded by this incentive scheme. For 2015 an enhanced version of the SGIS has been developed, which encourages more intensive forms of landscaping on build forms.

## Project description

SGIS has become an important component of sustainable urban development in Singapore with the vision of a city in a Garden. In April 2015 the enhanced version of SGIS 2.0 started. It is planned to last for another five years [1]. SGIS 2.0 as well as the original SGIS version have two main categories of application:

1. **Rooftop Greenery** referring to greening efforts (green roofs) and landscaping on rooftop surfaces (roof gardens). New aspects of SGIS 2.0 include also community gardening with rooftop farming and the creation of educational learning gardens.
2. **Vertical Greenery** by incorporating plants within vertical surfaces (green walls). This includes self-clinging roots growing directly on coarse of building surfaces, twiners growing on trellis and pergolas, or plants growing within crevices. Vertical greenery on indoor walls and in air wells is not funded.

Only investment costs are funded. Maintenance costs are not considered under the SGIS. New aspects relevant for both categories under the SGIS 2.0 are the promotion of native plants and the exploration of innovative aesthetic methods of designing and painting Singapore's aerial canvas, transforming green walls and roofs into living works of art.

## Implementation process

SGIS is implemented by NParks. Owners of residential buildings as well as owners of non-residential buildings such as commercial, office, retail, business parks, industrial, institutional, community buildings, hotels and hospitals can apply the SGIS. The applicant has to submit an application form with the proposed rooftop and/or vertical greenery plan and estimated costs. After approval, the applicants have to complete their installations within six months. After completion a reimbursement form has to be submitted. NParks funds up to 50% of Rooftop Greenery project costs, capped at EUR 131<sup>1</sup> per m<sup>2</sup>, and also up to 50% of Vertical Greenery projects costs, capped at EUR 328<sup>1</sup> per m<sup>2</sup>. After a site inspection by NParks to ensure that at least 80% of planned greenery coverage has been achieved, costs are reimbursed.

NParks provides also scientific and general information on its greenery activities, such as publications, conference papers and guidelines and organises international conferences on the topic. Much effort has been put into research and promotion. NParks is in contact with involved stakeholders, such as researchers in the field of urban green infrastructure, landscape companies and architects implementing these greenery projects and building companies. A Skyrise Greenery Award was established to recognise architects taking the lead role in providing green elements into buildings from the initial design stages, working in conjunction with stakeholders to bring a project to fruition. Comprehensive information on the SGIS, and how to apply, description of finalised projects, and many practical information are collected on a specific website available under: [www.skyrisegreenery.com](http://www.skyrisegreenery.com)

## Results

Since 2009 more than 100 buildings including residential buildings, shopping centers, offices, schools, museums, companies and hotels have benefited from the SGIS funding scheme [2]. SGIS has been very well received so that the city goal for 2030 on 50 ha of green areas from green rooftops and walls has already been achieved by 2015, resulting in an increase to 200 ha of green area per person. The advantages of the SGIS include environmental, economic, social and aesthetic benefits. Both green roofs and walls are able to lower the Urban Heat Island (UHI) effect and to act as a heat sink. A study in Singapore [7] has indicated that the installation of rooftop gardens can significantly reduce the peak heat transfer through the roof and consequently also the energy consumption for cooling. The space cooling load is estimated in this study to reduce with savings between 1 and 15% depending on green roof type. For green walls cooling effects and reduced energy consumption have been indicated: depending on the different vertical greenery systems a surface temperature reduction of up to 11.58°C has been measured on clear days [8].

In the course of a perception study, in which architects, landscape architects, developers, governmental agencies, and residents have been surveyed on experiences with vertical greenery systems, in Singapore [9,10] the following benefits have been documented. Vertical greenery systems:

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<sup>1</sup> Rate of exchange (OANDA), June 2015

- help to improve air quality by filtering airborne dust particles,
- reduce noise pollution in the building's vicinity and interior,
- have therapeutic effects with improvement of users health,
- enhance the psychological well being of city dwellers by enabling more frequent contacts between dwellers and green areas,
- add and increase visual interest to the urban environment and beautify the urban environment,
- help to reintroduce biodiversity into the urban environment and to preserve habitats of plants and animals, and
- increase the building's property value.

## Lessons learned

The SGIS funding scheme has been very successful and has been adapted on the basis of experiences, new challenges and ideas. It is one important component among others to regenerate natural systems in a high-density urban system. To cover the need of necessary technical information, information on plants especially suitable for vertical greenery systems and maintenance instructions N Parks of Singapore prepared specific guidelines, also concerning safety aspects. SGIS is a good example for megacities of how to enlarge their green areas within densely populated urban areas.

New research has started to evaluate rooftop gardens and green walls by applying Life Cycle Assessment on energy use and linked CO<sub>2</sub> emissions [11,12]. First results show that green roofs and walls - depending on construction details and system components applied - may lead to an increased carbon footprint. However, the carbon sequestration of plants was not considered because other studies in the USA indicated a negligible increase in CO<sub>2</sub> emissions [13].

## References

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