



# VERTICAL GREENERY

ADDRESSED  
HAZARDSPROTECTED CRITICAL  
INFRASTRUCTURE

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The living walls treating greywater, designed by Iridra in collaboration with American University of Beirut (AUB) and implemented during the Nawamed project in Spring 2023 in Beirut. Image Credit: [IRIDRA], [2024], Used with permission

## Primary functions and key services

- **Urban cooling & heat mitigation:** reduces surface and ambient temperatures, lowering energy demand for cooling.
- **Air quality improvement:** absorbs pollutants such as NO<sub>2</sub> and particulate matter (PM).
- **Stormwater management:** minimises runoff to a certain extent and enhances water retention (green walls).
- **Building energy efficiency:** provides insulation, reducing heating and cooling energy use **in buildings**.
- **Noise reduction:** acts as a sound barrier, lowering urban noise pollution.

## Hazards mitigated by this NbS

### Climatological hazards:

- Limited mitigation of desertification

### Meteorological hazards:

- Moderate mitigation of heatwaves
- Moderate erosion of **buildings facades**

### Hydrological hazards:

- Moderate mitigation of surface runoff

## Site suitability, scale and coverage

Vertical greenery systems are suitable for densely built urban areas, including residential, commercial, and industrial buildings. Effective in locations with high levels of air pollution, urban heat stress, and limited space for horizontal greening. Applicable at various scales, from small facade installations to large-scale building-integrated green walls.

## What is it?

**Vertical greenery systems (VGSs)** integrate vegetation into urban environments by incorporating plants on vertical surfaces of buildings and infrastructure. These systems include green facades and living walls, which provide multiple environmental and aesthetic benefits. VGSs contribute to urban resilience by mitigating the urban heat island effect, reducing air pollution, and enhancing biodiversity. They help regulate microclimates, improving thermal comfort and reducing building energy consumption. By integrating water retention and irrigation solutions, VGSs also support sustainable stormwater management, reducing runoff and improving water infiltration in cities.



Green Facade, 48 er, Vienna.

Image Credit:[Florineth, BOKU], [2012], Used with permission

## Challenges this NbS addresses

- **Heatwaves** – mitigation (provides shade, lowers surface and air temperatures)
- **Air pollution** – reduction (captures particulate matter and pollutants)
- **Stormwater overflow** – prevention (enhances rainwater retention and infiltration)
- **Biodiversity loss** – recovery (creates habitats for urban wildlife)

## Ecosystem services

- ▶ **Climate resilience:** reduced urban heat island effect.
- ▶ **Air purification:** improved air quality and filtering pollutants.
- ▶ **Water management:** enhanced rainwater retention and infiltration.
- ▶ **Energy saving:** reduced building energy demand for cooling and heating.
- ▶ **Biodiversity enhancement:** supports urban wildlife
- ▶ **Carbon Sequestration:** vertical greenery systems capture CO<sub>2</sub> and store it in their biomass.



## ▼ Cost-benefit profile

Vertical Greenery Systems (VGSs), also known as green walls, offer multiple benefits, including energy savings, improved air quality, and urban heat reduction. However, their cost profile varies based on design complexity, plant selection, and maintenance requirements. Initial installation costs can be substantial, influenced by factors such as system type (modular panels, felt systems, or trellis-based systems) and structural considerations. Ongoing maintenance is crucial for longevity and effectiveness, encompassing tasks like irrigation, fertilisation, and pruning. Despite these costs, VGSs can yield long-term economic advantages, including energy savings through natural insulation (reducing building temperatures in summer by 20°C), increased property values (16%) due to aesthetic enhancements, and health benefits from improved air quality, potentially reducing healthcare expenses. (Newman et al., 2017; Rajak et al., 2022)

## Environmental impacts (EU taxonomy)

- Climate change mitigation
- Climate change adaptation
- Sustainable use and protection of water and marine resources
- Transition to a circular economy
- Pollution prevention and control
- Protection and restoration of biodiversity and ecosystems.

## Example of installation

### ▶ Bosco Verticale

▶ **Location:** Milan, Italy

▶ **Implemented by:** Stefano Boeri Architetti

▶ **Description and results:** Bosco Verticale consists of two residential towers (80m and 112m high) densely covered with vegetation, integrating 900 trees, 5,000 shrubs, and 20,000 plants across 8,900 square meters of terraces. Construction began in 2009 and was completed in 2014. This pioneering vertical forest serves as a model for sustainable urban development, mitigating air pollution by absorbing CO<sub>2</sub> and fine dust particles while producing oxygen. It significantly reduces the urban heat island effect, lowering surrounding temperatures and improving energy efficiency through natural insulation. The project has also enhanced biodiversity, attracting birds and insects, thereby reintroducing natural ecosystems into the urban fabric. Studies indicate that the vegetation helps reduce noise pollution and improve residents' well-being, contributing to a healthier and more sustainable cityscape.

### Bosco Verticale projected by Boeri Studio:



Image Credit: [Dimitar Harizanov, Courtesy of Stefano Boeri Architetti], [2018]. Used with permission;



Image Credit: [The Blink Fish, Courtesy of Stefano Boeri Architetti], [2018]. Used with permission

## ▼ Main components

**Green facades:** climbing plants attached to walls or trellises.

**Living walls:** modular panels or hydroponic systems supporting plant growth.

**Water retention systems:** integrated irrigation and stormwater management.

**Structural supports:** frameworks enabling plant establishment on vertical surfaces.

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