

PERFECT factsheet 5 green roofs



Definitions

- **Green Infrastructure:**
A strategically planned network of high-quality natural and semi-natural areas with other environmental features which is designed and managed to deliver a wide range of ecosystem services, in either rural or urban settings.
- **Green roof:** A vegetative roof system that hosts plants in a growing medium installed over a waterproof membrane, often including an irrigation system and drainage layer.
- **Green wall:** A wall (partially) covered with greenery planted in a layer of soil, water and/or growing substrate – also known as a living wall or vertical garden.

Luka Vidic, Paziļpark archive

Planting into a green roof at Jozе Plecnik High School in Ljubljana

Why are green roofs important?

While protecting us from the elements, the roofs over our heads can be an otherwise wasted resource when taking their traditional form, potentially having negative

'Green roofs can provide resilience in urban environments and help to reduce the (costly) impact of flooding'

impacts such as increased stormwater run-off. Planting our roofs offers an opportunity to adapt our buildings to the effects of climate change and extreme weather events, with green roofs serving multiple purposes, including the absorption of rainwater, provision of insulation for our homes, and habitat creation for wildlife, as well as the further greening of our cities and towns.

Green walls share many of the benefits associated with green roofs, including their capacity to reduce stormwater run-off by storing rainwater for irrigation.¹

As a key component of the wider green infrastructure network, particularly in urban areas characterised by a constrained land supply and competing land uses, green roofs can be used to refurbish existing buildings or can be included in new development to contribute to urban flood management and water retention systems.

As there is an increasing likelihood of flooding events in many of our cities, green roofs can provide resilience in urban environments and help to reduce the (costly) impact of flooding.

Types of green roof

The many different forms of green roof can be split in two categories: intensive and extensive.²

Intensive green roofs have a deeper layer of soil (20 centimetres or more) that can support trees and shrubs, as well as grasses and perennials. The extensive green roof, which has received more interest as it does not require additional structural support, includes lightweight layers of free-draining material that can support low-growing and drought-tolerant vegetation.

Using a diverse set of vegetation to replicate specific habitats, planted roofs can support a variety of flora and fauna. Design, installation and maintenance are factors to consider when selecting a type of green roof.³

General characteristics and benefits of types of green roof

	Green roof type		
	Extensive	Semi-intensive	Intensive
Use	Ecological landscape	Garden or ecological landscape	Garden, park, or roof terrace
Type of vegetation	Moss, herbs, and grasses	Moss, herbs, and grasses	Lawn/perennials, shrubs, and trees
Benefit	Water retention, thermal, and biodiversity	Water retention, thermal, biodiversity, and amenity	Water retention, thermal, biodiversity, and amenity
Depth of substrate	60-200 millimetres	120-250 millimetres	150-400 millimetres
Weight	60-150 kilogrammes per square metre	120-200 kilogrammes per square metre	180-500 kilogrammes per square metre
Cost	Low	Periodic	High

Source: 'Types of green roofs'. Webpage. European Federation of Green Roof Associations. <https://efb-greenroof.eu/green-roof-basics/>


Benefits of green roofs

Green roofs offer a wide range of benefits, as outlined below.

Benefits in addressing climate change

- **Flood risk reduction:** Green roofs reduce peak flow rates and rainwater run-off, as they store rainwater in the plants and the substrate, with some research findings⁴ indicating reductions in run-off volume of up to 65.7%. The same research found that a 10% increase in intensive green roof construction would increase annual rainfall retention for Manchester city centre by 2.3%, demonstrating the benefits of scaling-up green roof construction and the possibility of saving costs on drainage infrastructure.⁵ Rainfall retention can even be achieved on sloped green roofs, although different construction methods (at higher costs) are required.⁶
- **Countering the urban heat island effect:** Given their different thermal qualities in comparison with conventional roofs, green roofs reflect more sunlight,

'Green roofs reduce peak flow rates and rainwater run-off, with some research indicating reductions in run-off volume of up to 65.7%'





Green roof on top of the Breevast office in Zuidas, Amsterdam

while water evaporation from plants cools down the roof, reducing roof surface temperatures by 50%.⁷

- **Increased biodiversity:** Green roofs can be designed to replicate various habitats to support a range of species, particularly when used in combination with green walls and other green infrastructure to create green corridors.⁸
- **Improvements in air and water quality:** A planted roof can contribute to the removal of airborne particles and heavy metals from the local atmosphere, in turn improving local water quality by retaining contaminants found in infiltrating water.⁹

Benefits for people

- **Increases in amenity space:** Depending on the level of access to the rooftop, green roofs can provide new green space for building occupants or the general public to enjoy. For example, a strategy for greening the Amsterdam Zuidas business district recognises the user and experience value of green roofs, in addition to their ability to store stormwater.¹⁰
- **Reductions in noise pollution:** The organic material on the rooftop can reduce noise transfer through the roof structure and increase acoustic insulation.¹¹
- **Supporting better health:** By further greening the built environment, green roofs can help to deliver mental health and wellbeing benefits, although future research on the specific health benefits of green roofs is needed.¹²



Green roof of the New Town Hall building in Freiburg, Germany

Benefits for building(s)

- **Increases in roof lifespan:** Green roofs have been found to slow down the rate at which waterproof membranes wear out, and last up to three times longer than conventional roofs.¹³
- **Reductions in energy consumption:** Green roofs provide additional insulation that reduces air cooling requirements in summer and heating requirements during the winter, and have been found to reduce energy consumption by up to 9% in summer.¹⁴

Communities and green roofs

The greening of roofs offers additional benefits when opportunities are created for the local community to participate in their construction and upkeep. The roof terrace garden at Joze Plecnik High School in Ljubljana demonstrates that the greening of roofs does not have to be a resource-intensive exercise, while providing students and staff with additional opportunities for socialising and learning.¹⁵ Students themselves designed and constructed the roof garden and are responsible for the maintenance of the beds, which has become part of their education on ecology and biology.

References

- 1 *Living Roofs and Walls from Policy to Practice: 10 Years of Urban Greening in London and Beyond*. European Federation of Green Roof and Green Wall Associations (EFB) and Livingroofs.org, for the Greater London Authority, 2019. <https://livingroofs.org/wp-content/uploads/2019/04/LONDON-LIVING-ROOFS-WALLS-REPORT-2019.pdf>
- 2 'Green Roofs'. Webpage. Green Roof Centre, University of Sheffield. http://www.thegreenroofcentre.co.uk/green_roofs.html
- 3 For further information on the design, installation and maintenance of green roofs, see *GRO Green Roof Code: Green Roof Code of Best Practice for the UK 2014*. Green Roof Organisation, Sept. 2014. <http://www.greenroofguide.co.uk/media/en/applications/grocode2014.pdf>; see also *Green Roof Guidelines: Guidelines for the Planning, Construction and Maintenance of Green Roofs*. 2018 Edition. Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau (Landscape Research, Development and Construction Society), Germany. Available through <https://shop.flf.de/de/english-publications.html>
- 4 AF Speak, JJ Rothwell, SJ Lindley and CL Smith: 'Rainwater runoff retention on an aged intensive green roof'. *Science of the Total Environment*, 2013, Vols 461-462, 28-38. <https://doi.org/10.1016/j.scitotenv.2013.04.0855>
- 5 See also the *Green Roof Guide*. Green Roof Centre, Sheffield University, 2011. <https://sites.google.com/a/sheffield.ac.uk/green-roof-research/home/green-roof-guide>
- 6 For an example of a pitched green roof developed by the German green roof manufacturing company ZinCo, see ZinCo's 'Pitched green roofs up to 25°' webpage, at https://zinco-greenroof.com/systems/pitched_green_roof
- 7 P Bevilacqua, D Mazzeo, R Bruno and N Arcuri: 'Surface temperature analysis of an extensive green roof for the mitigation of urban heat island in southern Mediterranean climate'. *Energy & Buildings*, 2017, Vol. 50, Sept., 318-27. <https://doi.org/10.1016/j.enbuild.2017.05.081>
- 8 For a discussion on green roof patch size, quality, abundance and isolation in relation to biodiversity, see F Mayrand and P Clergeau: 'Green roofs and green walls for biodiversity conservation: a contribution to urban connectivity?'. *Sustainability*, 2018, Vol. 10(4), 985. <https://doi.org/10.3390/su10040985>
- 9 CMG Carpenter, D Todorov, CT Driscoll and M Montesdeoca: 'Water quantity and quality response of a green roof to storm events: Experimental and monitoring observations'. *Environmental Pollution*, 2016, Vol. 218, Nov., 664-72. <https://doi.org/10.1016/j.envpol.2016.07.056>
- 10 See *Planning for Green and Prosperous Places*. Guide 7. Practical Guides for Creating Successful New Communities. TCPA, Jan. 2018, p.24. <https://www.tcpa.org.uk/Handlers/Download.ashx?IDMF=db632de1-38cc-468a-9401-0599b0bea52b>; and the Amsterdam Rainproof website, at <https://www.rainproof.nl/english>
- 11 T Van Renterghem: 'Green roofs for acoustic insulation and noise reduction'. In G Pérez and K Perini (Eds): *Nature Based Strategies for Urban and Building Sustainability*. Butterworth-Heinemann, 2018, Chap. 3.8 (pp.167-79). <https://doi.org/10.1016/B978-0-12-812150-4.00016-1>
- 12 P Suppakittpaisarn, X Jiang and WC Sullivan: 'Green infrastructure, green stormwater infrastructure, and human health: a review'. *Current Landscape Ecology Reports*, 2017, Vol. 2(4), 96-110. <https://doi.org/10.1007/s40823-017-0028-y>
- 13 L Tolderlund: *Design Guidelines and Maintenance Manual for Green Roofs in the Semi-Arid and Arid West*. University of Colorado Denver, et al., Nov. 2010. <http://www.cityofgolden.net/media/GreenRoofsSemiAridAridWest.pdf>
- 14 AH Refahi and H Talkhabi: 'Investigating the effective factors on the reduction of energy consumption in residential buildings with green roofs'. *Renewable Energy*, 2015, Vol. 80, 595-603. <https://doi.org/10.1016/j.renene.2015.02.030>; and F Ascione, N Bianco, F de' Rossi, G Turnic and GP Vanoli: 'Green roofs in European climates. Are effective solutions for the energy savings in air-conditioning?'. *Applied Energy*, 2013, Vol. 104, 845-59. <https://doi.org/10.1016/j.apenergy.2012.11.068>
- 15 'Small actions with big impact'. News Story. PERFECT project, Apr. 2018 (on the roof terrace garden at Joze Plecnik High School in Ljubljana). <https://www.interregeurope.eu/perfect/news/news-article/3131/small-actions-with-a-big-impact/>

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About PERFECT

PERFECT (Planning for Environment and Resource efficiency in European Cities and Towns) is a five-year project, running from January 2017 to December 2021, funded by Interreg Europe. It aims to demonstrate how the multiple uses of green infrastructure can provide social, economic and environmental benefits. It will raise awareness of this potential, influence the policy-making process, and encourage greater investment in green infrastructure.

To find out more about PERFECT, visit <http://www.interregeurope.eu/perfect/>

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