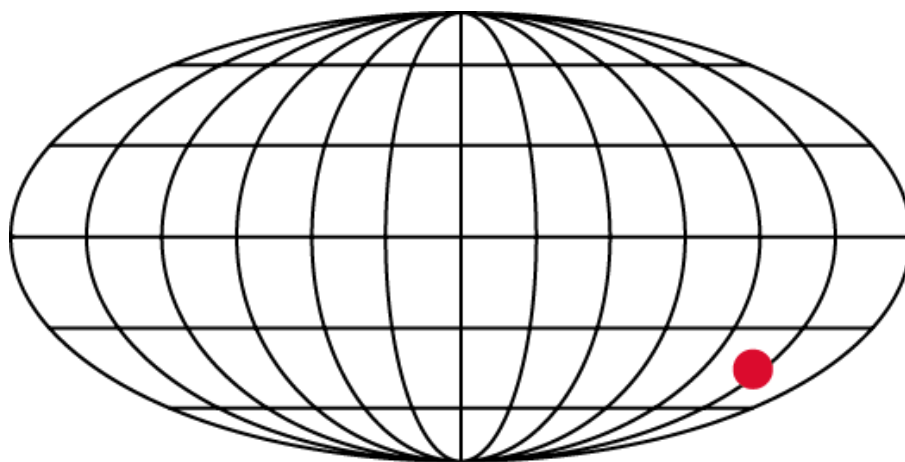


Sometimes nature is the best teacher

Skyscrapers draped in greenery, roof gardens and planted facades provide shade, store moisture and absorb toxins from the air—architects and city planners are tapping the power of luxuriant greenery to boost the quality of life in urban centers.

Jan Oliver Löffken (copy) & Raymond Biesinger (illustration)



Sydney, Australia

Grasses, ferns, herbaceous plants, orchids or violets—around 450 different plant species

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architects and city planners worldwide. That's because adding rampant green growth to a design not only improves the indoor climate and energy footprint of a building. It also filters toxins from the polluted city air and can cool urban canyons efficiently in oppressive summer heat.

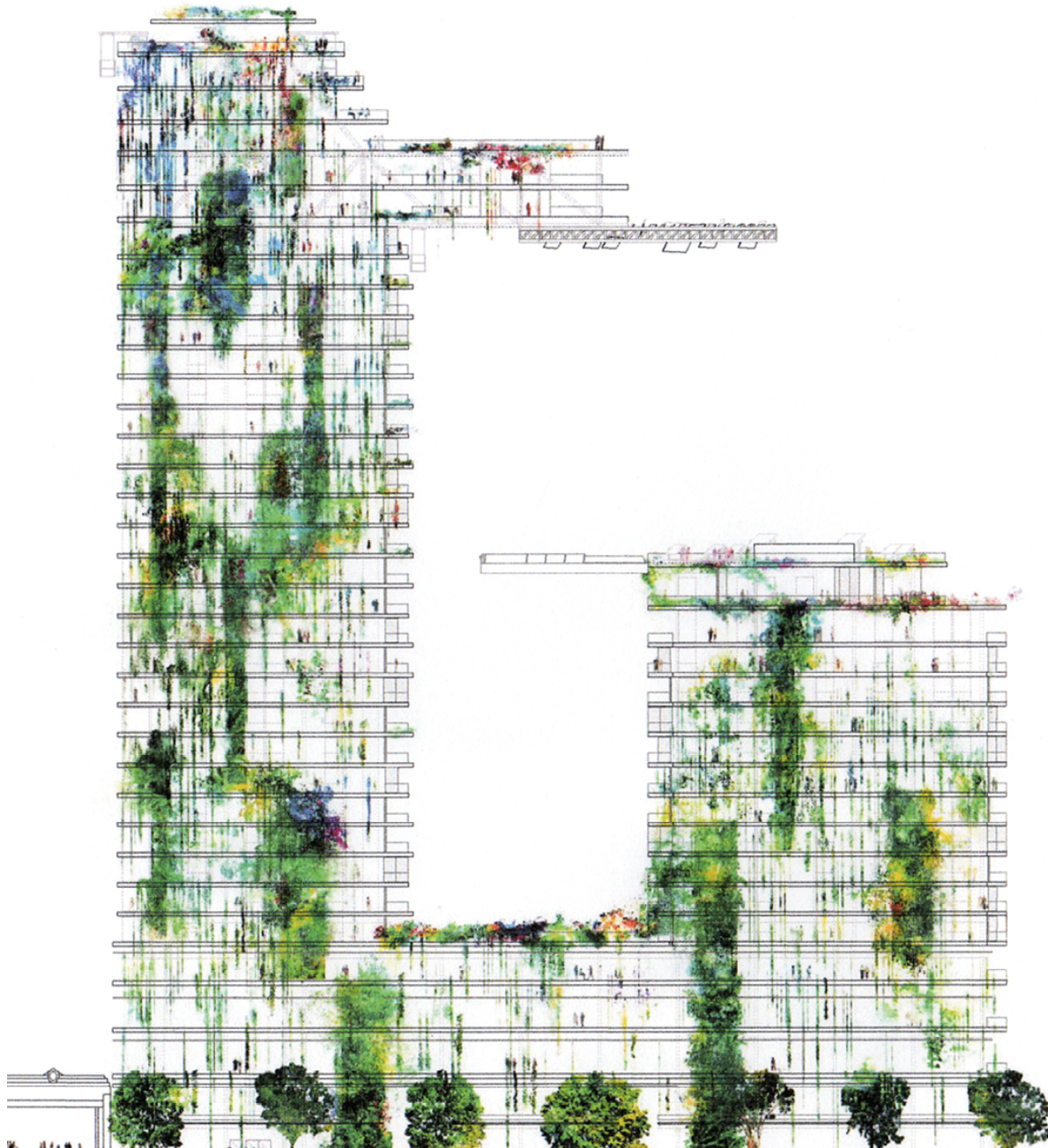
Throughout the year, green and colorful flowering climbers wrap their way around the 117-meter-high facade of the urban oasis that opened in 2014. The project required much more planning and expertise than balcony gardeners can imagine. "Designing a vertical garden is a combination of science and aesthetics," says French botanist Patrick Blanc, who is considered the modern innovator of the vertical garden. Together with Parisian architect Jean Nouvel, Blanc designed One Central Park, and selected hundreds of suitable plant species, roughly half of which are endemic and therefore unique to Australia. "The right plant in the right place," says Blanc, summarizing his botanic concept. Robust grasses and shrubs are more suited to the upper floors exposed to wind and sun. They also provide shade, thereby reducing the strain on power-hungry air conditioning systems. Middle floors afford the plants more protection and serve as a habitat for vines and more sensitive flowering plants. Ferns, rhododendrons and azalea species do best on the lower floors where there is less sunlight. Blanc seeks inspiration for his work on numerous expeditions into the plant kingdom. He chooses plants according to his motto: from nature to the city! To this end, his high-rise habitats often feature species that can survive outdoors on cliffs or trees without a conventional plant base of soil. "Soil merely acts as a mechanical foundation anyway," says Blanc. Plants only need water, minerals, light and carbon dioxide for growth and photosynthesis. Be it in Tokyo or Paris, Riyadh, São Paulo or New York—Blanc largely does without fertile soil in his more than 300 vertical garden projects. An ingenious system of little hoses supplies water and nutrients automatically to each plant, which puts down roots on a substrate made of basalt or mineral fiber. As well as using this low-maintenance hydroponic system, the plants even fertilize themselves from the city air—a welcome side-effect of the process of filtering particulates and nitrogen oxides that pollute the air in cities.

Bringing more greenery into urban areas is also one of the strategies for making cities more livable, as endorsed by the international community in 2016 at the UN Conference "Habitat

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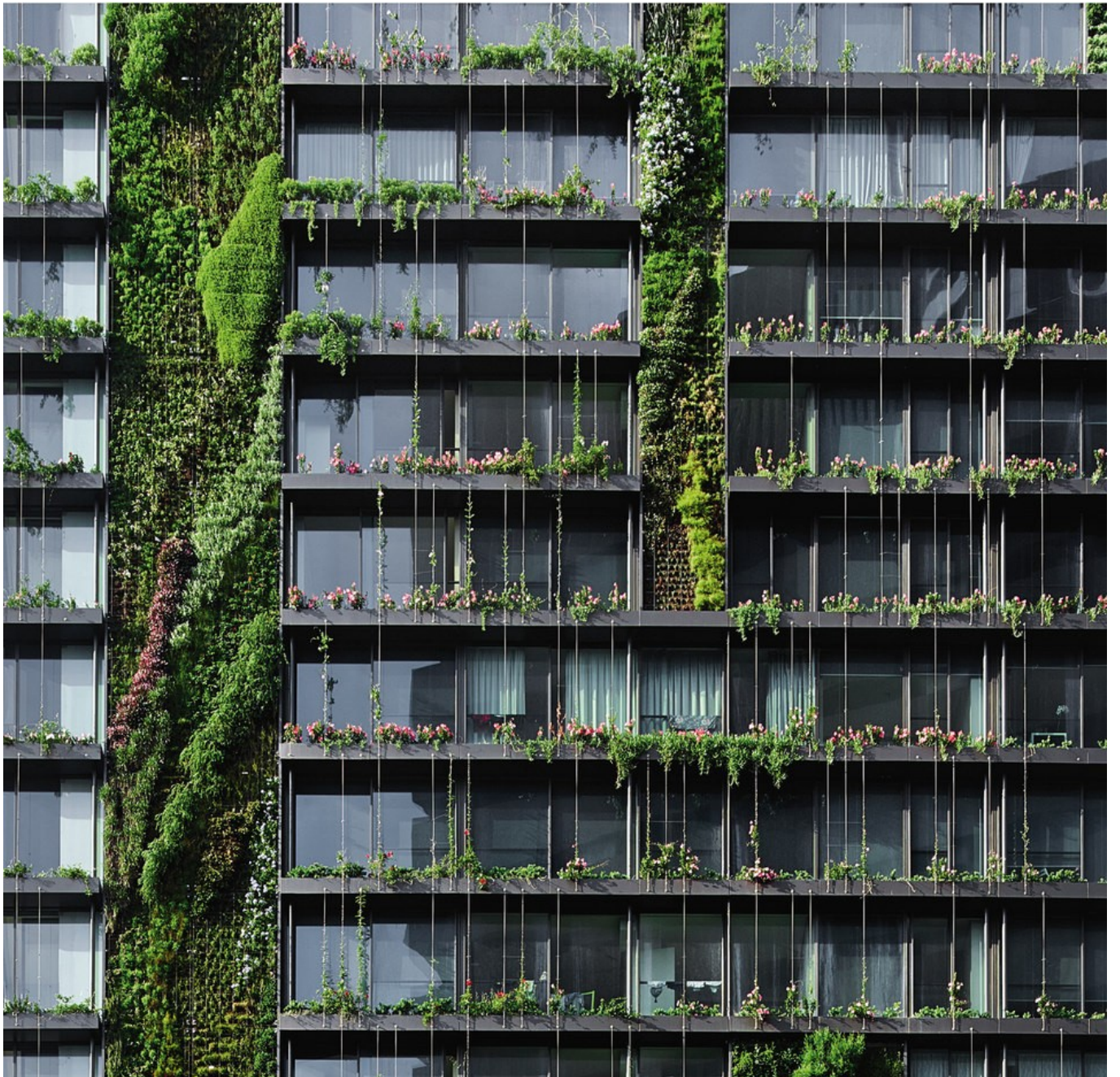
Environmental Sciences at the University of Birmingham. The chemist has already shown in a much-quoted 2012 study that planted facades can reduce the concentration of particulates and toxic nitrogen dioxide by as much as 90 percent.



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Other urban garden designs by Patrick Blanc are (in addition to One Central Park) the vertical garden at the CaixaForum (Madrid), the (indoor) wall in the KulturKaufhaus Dussmann in Berlin as well as Le Nouvel in Kuala Lumpur.



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The One Central Park project in Sydney is a paradigm for green buildings. In total, more than 85,000 plants cover the 23 green cloaks of vegetation that stretch up to 50 meters high on the facade.

So it is hardly surprising that Patrick Blanc is not the only one to extol the numerous benefits of strategically planted structures. The Bosco Verticale, a vertical forest planned by Italian architect Stefano Boeri, was constructed in Milan almost in parallel with the One Central Park Sydney. For this project, he designed two residential buildings—116 and 85 meters high respectively—with expansive balconies on all sides. Covering an accumulated area of 20,000 square meters, they provide space for a total of 700 trees and 5,000 shrubs, securely planted in concrete tubs that are just under one-and-a-half meters deep. Thousands of creepers and flowering shrubs round out the planting of this magnificent green building. In collaboration with botanists from the University of Milan, Boeri sought out twenty different species of deciduous and evergreen trees as well as eighty additional plant species for the plant cover on the facade. The result? The Bosco Verticale changes its appearance with the seasons and never appears bare. “The vertical forest creates its own microclimate and increases the air humidity,” explains Boeri. Each year, his trees and bushes absorb 20 tons of the greenhouse gas carbon dioxide and release almost the same amount of oxygen back into the city’s air. Dust particles and nitrogen oxides from exhaust gases are also efficiently absorbed by the plants. As well as improving the air quality in the immediate vicinity of the building, the project benefits urban biodiversity. From larks to sparrows, more than 20 species of bird nest in the biotope. A microclimate forms around the building, reducing the air temperature by up to two degrees, particularly during the summer months. In this way, the Bosco Verticale effectively counters the heat island effect that drives summer temperatures in densely built-up urban areas several degrees higher than the surrounding countryside. “Essentially, this is

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hundreds of trees and thousands of plants is implemented in a 54-meter-high residential tower in Villiers-sur-Marne, a suburb of Paris, and in Utrecht in Holland. Concentrated in a confined urban space, the planting there is designed to be equivalent to roughly one hectare of conventional forest. Boeri's most recent project in southern China even goes one step further. At a site 300 kilometers northeast of Hong Kong, the architect is designing the master plan for an entire city based on the prototype of his Bosco Verticale. With construction scheduled to commence in 2020, Liuzhou Forest City is to be developed for 30,000 inhabitants on a 175-hectare site. Not just the individual residential buildings, but also the schools, administration offices, hotels and hospitals will be planted using 40,000 trees, at least one million plants in total and more than 100 different species. With this diversity of vegetation, the planner also hopes to create an urban ecosystem for a wide variety of bird and insect species. The forest city aims to prevent the smog that frequently plagues Beijing and other Chinese mega-cities from occurring in the first place.



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Ferns are ideal for planting on lower floors where the incidence of light is low. Just as they do in natural forests, these plants thrive in damp, shaded surroundings.



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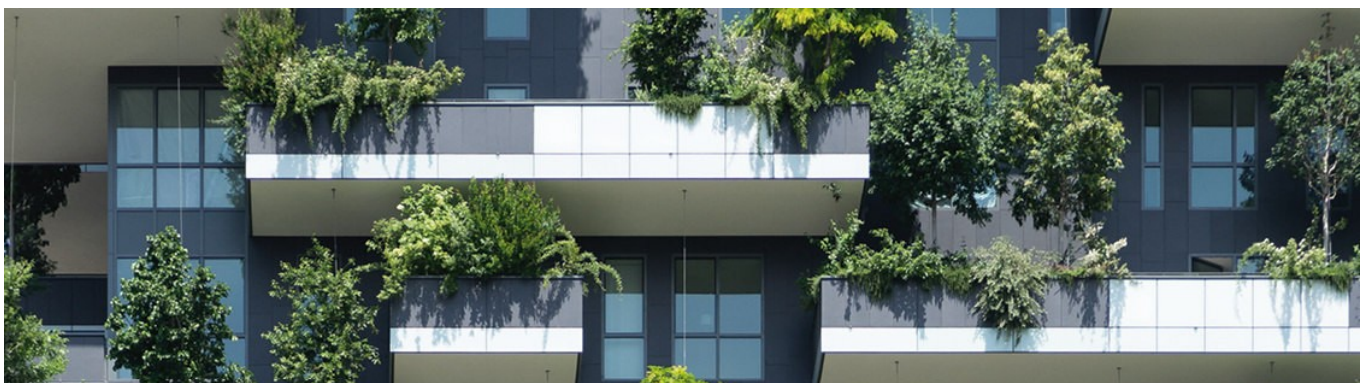
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shrubs and perennials guarantee a humid, temperate microclimate throughout the year. They also counter localized heat island effects that warm up large cities excessively, especially during the summer months.



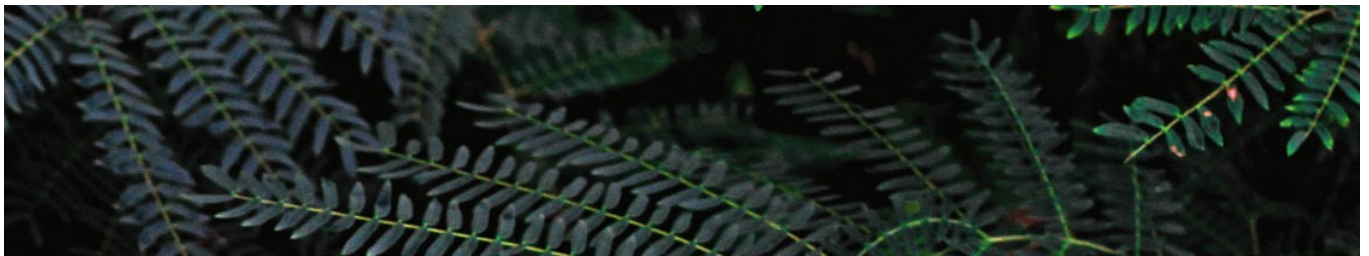
The concept for the Dragonfly Building, which Belgian architect Vincent Callebaut places in the heart of New York City, aims to revolutionize agriculture. Rising to almost 600 vertical meters and with 132 floors, it is designed to provide space for crops.



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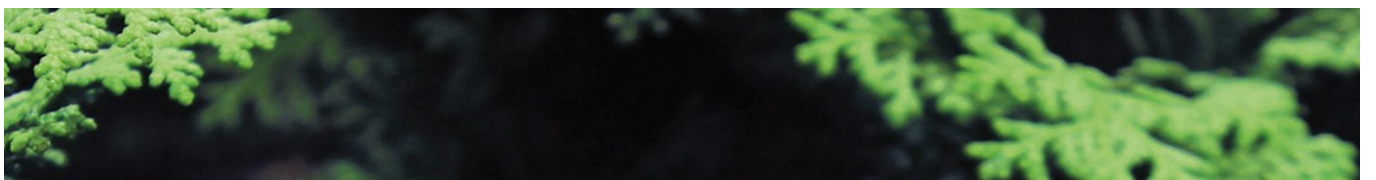
The Bosco Verticale (vertical forest) in Milan consists of twin towers with expansive balconies on all sides that accommodate roughly 700 trees, 5,000 shrubs as well as thousands of creepers and flowering shrubs.



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The honey locust is a tolerant and hardy tree. Like all robust plants, it is predominantly used on higher floors to withstand the wind and sun.



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A tree of life (botanic name: thuja) from the cypress family (cupressaceae) is a durable evergreen plant genus, three species of which are native to eastern Asia.

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With Liuzhou Forest City in China, architect Stefano Boeri is going a significant step further than vertical gardens. Here, an all-green city aims to accommodate a total of 30,000 inhabitants and eliminate 10,000 tons of CO₂ annually.

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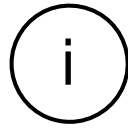


for cooling building facades, fruit and vegetables on balconies and freely accessible bodies of water. With their new building projects ranging from residential towers all the way to the planned city, Stefano Boeri and Patrick Blanc are already getting quite close to these ideals. Yet fully developed cities, too, must not overlook the need to add greenery for a better quality of life. Take, for instance, the “CityTree” by Dresden startup Green City Solutions.

While it absorbs far less carbon dioxide and particulates than vertical gardens or forests, it is much cheaper and offers greater flexibility of use. Strictly speaking, it is not actually a tree but rather a vertical arrangement of planter boxes in which mosses and perennials are integrated in an area measuring twelve square meters. Installed in Stuttgart, Berlin and Hong Kong, the first CityTrees absorb up to half of the particulates and one eighth of the nitrogen oxides from polluted city air. The virtually maintenance-free wall of moss in this design is irrigated with around 10,000 liters of water annually delivered using a pump powered by solar cells. The addition of benches allows CityTrees to integrate seamlessly into the urban landscape. “In the future, there will be planted areas that we have not yet considered,” predicts Christian Ulrichs, who heads up the Division of Urban Plant Ecophysiology at the Humboldt University of Berlin. He recommends adding plants to urban furniture such as bus stops or advertising columns. Were city dwellers also to become actively involved in this planting movement, better air quality and high levels of biodiversity of flora and fauna could be achieved even more quickly than with the help of ingenious new buildings and smart inventions. For instance, the number of roof gardens in cities around the world is increasing with the support of non-profit organizations such as Green Roofs for Healthy Cities in the U.S. Many city administrations and nature conservation associations offer concepts for sustainable and, above all, insect-friendly balcony planting. These concepts can be used to generate a level of biodiversity that rural communities surrounded by vast fields of rapeseed or corn can only dream about.

Urban gardening—the cultivation of vegetables and herbs in private or communal spaces—has also long ceased to be considered an eccentric pastime of a few enthusiasts, and is becoming a hip trend with a growing following, particularly in sprawling cities. Even the allotment garden—previously regarded as the epitome of bourgeois living—is shedding its stuffy image.

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Urban gardening: With beds for blooms and vegetables grown on wasteland, roofs and walls, residents are injecting a bit of nature into life in big cities.



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Twelve square meters of greenery: The flexible-use, vertical CityTree plant box is virtually maintenance-free. Built-in solar modules power the irrigation pump.