

Science for Environment Policy

Green infrastructure in street canyons could reduce air pollution

Planting vegetation in city streets could significantly reduce air pollution in urban street canyons, according to new research. Traffic pollutants are deposited on vegetation at a higher rate than on hard, built surfaces and could reduce the concentration of nitrogen dioxide (NO₂) and PM₁₀ in the air by as much as 40% and 60%, respectively, under certain conditions.

Outdoor air pollution is a major cause of premature deaths, but concentrations of air pollutants still exceed public health standards in many urban areas, particularly poorly-ventilated street canyons, created by tall buildings either side of the road, that carry heavy traffic. One method of reducing air pollution is to enhance the deposition of pollutants to surfaces by planting additional vegetation. Compared to hard surfaces, pollutant uptake by plants is much higher.

The study focused on street canyons, which are very common in dense urban areas, where pollutants tend to become trapped by air recirculating between the buildings. It focused on two of the dominant pollutants – NO₂ and PM₁₀ – and modelled the effects of vegetation on their deposition and concentrations in street canyons, taking London, UK, as a case study. The study assumed that the vegetation in canyons would respond similarly to green walls, which can refer to any type of greening, from ivy to a canopy of grass and broadleaved species.

The model estimated that greening of individual street canyons could reduce the annual average concentrations of NO₂ and PM₁₀ within the canyons by 7-20% and 11-31% respectively, if the canyon walls were fully covered with 100% vegetation. Even if the sources of pollution (mainly traffic) are removed, the vegetation continues to offer benefits in reducing background pollution, by creating 'filtered avenues'. This is particularly important for pollutants that may travel long distances from their sources, such as PM₁₀.

The effectiveness of vegetation at improving air quality in street canyons varies greatly and it depends not only on surface properties of vegetation, but also wind speed and the shape of the canyon. The 'cleaning effects' of vegetation are better in deeper canyons with lower wind speeds because the air tends to reside longer, thus enhancing the likelihood of deposition of pollutants on the vegetation. Deeper canyons with low wind speeds are also the most likely to suffer high levels of air pollution so it appears vegetation would be most effective here. At low wind speeds, the effect of vegetation on pollution was enhanced with reductions in air pollutant concentrations of as much as 40% and 60% for NO₂ and PM₁₀, respectively.

The study also examined the possible effect of planting trees at ground level in combination with wall vegetation. Street trees can increase deposition of pollutants, but they also reduce the mixing between the air in the canyon and the air at the level of the city buildings. With light traffic and a low level of emissions in the canyon, street trees have a beneficial effect, but at higher levels of emissions, the reduced mixing caused by street trees may reduce the ability of vegetation within the street canyons to remove pollutants from the air.

The modelling in the research supports the strategy of greening street canyons to reduce air pollution in some contexts. In addition greening may also offer benefits of reduced surface temperature, noise pollution and increased biodiversity. However, greening initiatives aiming to improve air quality in the real world must consider the interactive effect with road-level trees and the influence of the canyon's layout on the vegetation's ability to enhance pollutant deposition, as well as any maintenance and ongoing costs of looking after the vegetation.



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