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Green surfacing: an EU-wide assessment of costs and benefits

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Quaranta, E., Dorati, C. and Pistocchi, A. (2021) Water, energy and climate benefits of urban greening throughout Europe under different climatic scenarios. *Scientific Reports*, 11(1): 1–10. https://doi.org/10.1038/s41598-021-88141-7

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Green surfacing (the transformation of urban surfaces into green areas) has been associated with water, energy, climate and well-being benefits. This study conducted an EU-wide assessment to quantify the costs and benefits of green surfacing for different climatic scenarios. The findings suggest that it represents a multifunctional, cost-effective solution to the emerging risks posed by climate change and urbanisation.

Urban greening is attracting increasing interest as a broad-scoped management measure. In the context of urban greening, one option is to transform urban impervious surfaces (such as rooftops) into so-called 'green surfaces'. This typically involves covering the surface with a vegetated soil layer, enabling water infiltration and vegetation growth. Potential benefits of green surfaces included an increased availability of green water (water used by vegetation and soil), reduced cooling costs for buildings, and sequestration of atmospheric CO_2 and pollutants.

Because of these multiple benefits, green surfaces have the potential to be an important urban management measure, meeting the European Green Deal's aspirations on building renovations. However, if the EU is to incorporate green surfacing as a mainstream solution across the region, there is a need for an in-depth discussion of the potential costs and benefits.

Researchers conducted this EU-wide assessment of the potential costs and benefits of green surfacing as part of an EC-funded research project[1]. They used modelling to quantify the potential water, energy and climatic benefits of greening 35% of urban surfaces across the EU region (equivalent to 26 450 km^2). They also estimated the associated monetary costs and savings and used these to calculate net present values (NPVs – a financial metric used to estimate the profitability of an investment over time), enabling an examination of the measure's cost-effectiveness.

Results show that green surfacing has the potential to deliver significant water, energy and climatic benefits. If 35% of Europe's urban surfaces were greened, over the next 40 years this would:

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- Avoid up to 55.8 million tons of carbon dioxide equivalent per year (Mtons year^{-1} CO_2) of greenhouse gas emissions (about 1.2% of the 4 500 million tons CO_2 produced in the EU each year).
- Reduce energy demand for the cooling of buildings in summer by up to 92 terawatt hours (TWh) per year, with an NPV of more than €364 billion.
- Transpire about 10 cubic kilometers per year (km^3 year^{-1}) of rainwater, turning about 17.5% of urban runoff into green water and helping to reduce pollution and urban flooding.
- Decrease green-surface summer temperatures by 2.5–6°C, with a mitigation of the urban heat island effect – estimated to have an NPV of €221 billion.

Combined, these monetised benefits cover less than half of the estimated costs of greening, which has an NPV of €1 323 billion. However, the researchers note that their assessment only examined potential benefits in terms of increased availability of green water, reduction of cooling costs and CO_2 sequestration from the atmosphere. There are other potential benefits to green surfacing (such as benefits to biodiversity, property values, health and wellbeing) that were not quantified in this study, that would help to further offset these costs.

While there may also be trade-offs that were not considered in the assessment, based on the identified benefits the study suggests that green surfacing represents a promising multifunctional, cost-effective solution to sustainable urban development. In order to encourage investment in green surfacing by private property owners, there would be a need for appropriate fiscal and funding policies to incentivise implementation[2].

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1. Water Energy Food Ecosystem Nexus (WEFE) at the EC's Joint Research Centre. For further information see: https://www.water-energy-food.org/fr/resources/wefe-nexus-publication-european-commission-position-paper-on-the-wefe-nexus-and-the-sdgs

2. This study, in particular the runoff reduction, supports the Urban Wastewater Treatment Directive. By reducing runoff, the wastewater (a mix of runoff and sanitary water) reaching the combined sewer system is reduced, as well as the number of spill events and the volume of combined sewer overflows that spill into the environment. In a further study currently in progress, the researchers estimate that, at the EU scale, combined sewer-overflow volumes and related polluting substances could be potentially reduced by 40% by greening 35% of impervious surfaces (a maximum limit to identify a maximum reasonable benefit).