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Urban green areas and roofs regulate temperature and reduce energy

A new study highlights the positive effects of plants and trees in cities. Urban green areas provide shade and reduce temperature fluctuations, bringing average temperatures down, while covering roofs with plants, rather than black roofs, reduces the energy required to heat and cool buildings.

The 'urban heat island' (UHI) effect is well-known. Many factors contribute to the formation of the UHI, including thermal properties of building materials and the reduction in surface reflectivity, mean that heat is less easily dissipated from urban environments. Since half of the world's population now lives in cities, this effect has an important influence on many people's daily lives. Land use planning and building strategies to regulate temperature within cities will influence wellbeing as well as the environmental impact of heating and cooling buildings.

The current study focuses on urban heat islands in New York City and the effect of green spaces and green roofs in mitigating their impact. Green roofs may incorporate soil and any kind of vegetation.

Between October 2008 and May 2009, US and Italian researchers monitored temperatures in four different areas of New York City. On average, those areas with less vegetation were hotter than those with more vegetation, with the difference between the hottest and the coolest areas around 2°C. More detailed studies at the monitoring stations with the highest and lowest temperatures revealed that temperature differences between the two sites were greater during summer than during winter, and greater during the night than during the day. The 'canyon effect' – which traps heat between the walls of tall buildings – has more influence in areas with less vegetation and means heat is lost slowly overnight.

The researchers also compared temperature fluctuations on the black, white and green roofs. Their results reveal that white and green roofs keep the temperature more constant compared to black roofs, meaning that less energy has to be used to control the temperature of buildings. In the case of white roofs, most of the benefit comes from the reflection of sunlight from the surface, whereas with green roofs, reduction in energy use is more of a combination of different factors – including the surface albedo, the thermal resistance of the soil and plants, as well as the process of evapo-transpiration.

By the life cycle impact assessment conducted about the three roofing systems and focused on the impact on climate, it results that substituting one square metre of black roof with a white one would avoid 140kg of CO_2eq over a 50-year period, thanks to the white roof's high reflectivity. The increase in surface reflectivity by substituting of one square metre of black roof with one square metre of green one would be responsible for around 38 kg of avoided CO_2eq for the same period. Furthermore, among the three roofs the green roof requires less energy and materials substitution during its lifespan and it also could provide better storm-water management, improvements in air quality and increases in urban biodiversity.

The study suggests that swapping black roofs for white or green roofs will have a positive impact on the urban environment and on the impact of heat regulation in urban buildings. The researchers also explain that the energy impacts of specific buildings will depend on individual factors, such as local climate conditions, the type of roofing materials used and their lifespan.

Source: Susca, T., Gaffin, S.R. and Dell'Osso, G.R. (2011). Positive effects of vegetation: Urban heat island and green roofs. *Environmental Pollution*. 159: 2119-2126.

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