Trees benefit energy use and stormwater

Urban trees help cities become more resilient to climate change

Trees can help communities adapt to climate change by absorbing carbon, soaking up rainfall, and reducing energy use. This is why cities are increasingly using trees and other green infrastructure to help manage today's challenges in an increasingly urbanized world.

Our research helps city planners, utility companies, landscape designers, and homeowners understand how to maximize the benefits of urban trees in mitigating the effects of extreme heat and increasing urban sustainability.

Carbon benefits

Like trees in a forest, city trees directly sequester carbon. But unlike wild trees, urban trees can also indirectly reduce a home's carbon footprint by reducing emissions from electricity generation.

Our research helps illustrate these carbon benefits. For example, over 100 years, a London plane tree next to a home reduces net carbon dioxide emissions from summertime electricity use by 31 percent, provided it is on the west side of the house.

Trees and energy use

To gain understanding of the impact of shade trees on summertime electricity use, we looked at the utility bills for 460 homes in Sacramento, California. Ours was the first study to use utility billing data to show that trees reduce energy consumption.

We found that location matters. The magnitude of the effect of shade trees on summertime electricity use depends on a tree's location. Trees on the west and south sides of a house reduce electricity use in the summer. Tree cover on the east has no effect. This makes sense, because east-side trees cast shadows on the house during the cool morning hours, before most people feel the need for air conditioning.

In addition, we found that the average combined amount of south- and west-side tree cover reduced summertime electricity use by 5.2 percent. Because of how their shadows fall at different times of day, a tree within 40 feet of the south side of a house, or within 60 feet of the west side of the house, would generate approximately the same benefits for a homeowner.

Trees can provide significant energy savings to homeowners.

Trees and stormwater

it is important to understand the relationship between trees and stormwater runoff at the same scale as potential policy remedies. We addressed this by quantifying the effect of vegetation on stormwater runoff in a combined-sewer system in Portland, Oregon.

For summer storms in Portland, we found that shrubs and grass reduce peak flow. The results for trees were more ambiguous. In winter, when most of the annual rainfall occurs, neither total flow nor peak flow were affected by trees or groundcover.

These results provide support for the use of bioswales and other ground-covering vegetation to augment traditional gray infrastructure. However, increasing groundcover was associated with relatively modest reductions in peak flow.

A bioswale in Portland, Oregon.

The bottom line: Placing bioswales strategically, or combing them with other mitigation techniques, may have a significant effect on fixed infrastructure costs, but they shouldn't be considered a panacea.

Donovan, G.H., D.T. Butry and M.Y. Mao. 2016. Statistical Analysis of Vegetation and Stormwater Runoff in an Urban Watershed During Summer and Winter Storms in Portland, Oregon, U.S. *Journal of Arboriculture and Urban Forestry* 42: 318-328.

Donovan, G.H., David Butry. 2009. The value of shade: Estimating the effect of urban trees on summertime electricity use. *Energy and Buildings*. 41(6):662-668

There's more . . .

A healthy urban forest is an asset for the entire community. In addition to positively affecting urban sustainability, trees can increase social cohesion and reduce crime, increase property value (thereby raising city revenue), and perhaps most importantly, improve individual health outcomes from cradle to grave.

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