



## Features - Business

### Calculating the green in green

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The benefits of urban trees can be measured in dollars.

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The ancient bond between humans and trees is expressed in a modern city dweller's intuition that trees add value to an urban landscape.

And so they do, but how much?

Neighborhood and yard trees are not market commodities, so there is no simple, agreed-upon basis for calculating their value, comparing it to that of other urban-planning priorities such as keeping development costs low, or weighing benefits of trees against their costs.



*Street trees can increase a home's sale price, reduce its time on the market and reduce summer electricity use – all excellent selling points for marketing trees.*

#### Dollars and cents

Two recent studies by Geoffrey Donovan, an economist and research forester at the Pacific Northwest (PNW) Research Station, and David Butry, an economist with the National Institute of Standards and Technology, yielded specific dollar values for street and neighborhood trees in Portland, Ore., and for yard trees that provide summer shade in Sacramento, Calif. This research is important to city governments, communities and environmental organizations because it helps them make a case for publicly funded “green infrastructure,” that supports many environmental and social amenities.

For nearly 30 years, Forest Service scientists and their collaborators have been exploring the economic links between urban trees and a suite of environmental and social amenities, including cleaner air, moderated storm runoff, sequestering of atmospheric carbon dioxide, higher property values, reduced energy consumption and improved human health.

This research has produced practical tools for managers and planners, such as STRATUM, a benefit-calculation model developed by researchers at the Pacific Southwest Research Station and the University of California-Davis.

The model estimates the value of amenities like urban trees and green spaces, basing its calculations on findings like those of Donovan and Butry. The New York City Parks

Department used STRATUM to determine that the nearly 600,000 street trees in its five boroughs provide an annual benefit of \$122 million-- more than five times the cost of maintaining them.

Research on valuation of urban trees is useful also to companies looking to document their environmental performance. For several years, the National Football League has been working with host cities to reduce the environmental impact of the Super Bowl by (among other things) planting trees. In 2008, the NFL began using a software tool called i-Tree, developed by the Forest Service and the Davey Tree Expert Co., to assess how much carbon the trees would remove from the air, along with measures of other environmental benefits.

The Donovan-Butry studies address gaps in the literature, updating and refining the body of knowledge that powers models like STRATUM and i-Tree.

Few previous studies have examined the effects of urban trees on the housing market, and none has focused on street trees -- those growing along public rights-of-way, such as parking strips or grassy medians -- or on the effects of tree attributes (crown size or deciduous vs. conifer type, for example) on the housing market.

#### **Portland's urban trees**

Donovan, who lives in the moderately tree-covered Mount Tabor neighborhood of Portland, Ore., was of course aware that "there is a profound difference between neighborhoods with trees and neighborhoods without." In Portland, the bigger trees tend to be in the pricier neighborhoods. "But I thought there must be more to it than that," Donovan said.

In an earlier project, Donovan had used an economists' tool called hedonic price valuation to study the effects of wildfire risk on a housing market.

"My program manager made some passing remark about urban forestry being a topic of the future. I realized I could apply the same methods to urban forestry," he said.

Hedonic price valuation breaks down the value of a market-traded commodity (such as a house) into its nonmarket-traded attributes and calculates the value of each. For example, a three bedroom house usually costs more than a two-bedroom house. What is the value of that third bedroom? The researcher works from actual house sale prices to calculate these component values, which include not only the house's attributes but also environmental qualities.

"The hedonic method is what economists call a revealed-preference model, because it's based on real market transactions. Using it, we were able to show that a tree adds value to a house just as a third bedroom does," Donovan said.

In summer 2007, Donovan and Butry hired two data collectors to take detailed measurements on 3,479 single-family houses on Portland's east side that had sold in the



*A volunteer spreads mulch around a recently planted tree. Photo courtesy of Sacramento Shade*

previous 10 months. They counted and measured the street trees at each site and noted their type (flowering, fruiting, deciduous without flowers or fruits, or coniferous) and condition. They also recorded data about the property's physical environment, such as pavement condition and proximity to an arterial street. They augmented these data with sales records of each property, including attributes of the house (square footage, number of bedrooms, type of heat, presence of a fireplace, etc.) and of the neighborhood (ZIP code, school district, distance from downtown, etc.).

Donovan and Butry found that, on average, street trees added \$8,870 to a house's sale price -- the equivalent of adding 129 finished square feet -- and decreased the house's time on the market by 1.7 days. They also found that a single tree raised the value of multiple houses. A tree with an average canopy of 312 square feet -- a good-sized bigleaf maple, for example -- added an average \$7,130 in value to the house it fronted, plus additional value to neighboring houses.

Such a tree added an average combined value of \$12,828 to the 7.6 houses lying within that radius. Extrapolating to the entire city, the researchers determined that Portland's street trees have a capital value of \$1.1 billion, which translates to \$45 million in benefits annually.

Street trees provide benefits far exceeding their annual maintenance costs, which are estimated at \$4.6 million.

Property owners pay most of these costs, which means they subsidize a benefit that goes to everyone.

"As long as homeowners bear most of the cost," Donovan explains, "they will likely underinvest in street trees."

The city of Portland wants to plant 33,000 yard trees and 50,000 street trees by July 2013 as part of its 5-year, \$50 million Grey to Green initiative. Grey to Green plants trees along streets and in other public spaces, and its Treebate program offers a utility-bill credit to homeowners who plant trees in their yards.

#### **Sacramento's shade**

As with Portland's street trees, Sacramento's shade trees add value to homes in many ways, not least by reducing the need for summer air conditioning.

For 20 years, Sacramento Municipal Utility District (SMUD) has been giving free shade trees to homeowners who agree to plant and care for them. Since 1990, the utility and its customers have planted nearly half a million trees. The program is carried out by the local nonprofit Sacramento Tree Foundation, which delivers the trees and helps homeowners site them strategically to maximize direct shading. SMUD keeps detailed electronic records for each tree planted -- address, distance from the house, orientation to the house, species and other information.

Donovan and Butry analyzed SMUD's tree planting information along with its monthly billing data. They also examined aerial photographs of crowns of trees on the sampled properties. They determined shade trees on the west and south sides of a house reduced summertime electricity use, whereas trees on the east had no effect.

"This makes sense because east-side trees cast morning shadows on the house, before most people feel the need for air conditioning," Donovan said.

They were surprised to find that north-side trees not only didn't reduce energy consumption, they were correlated with increased summertime electricity use. The researchers surmised trees close to a house may reduce the cooling effect of wind, slow the release of heat at night, or cause more lighting to be used in the house.

On average, households with trees on the west and south sides reduced their summertime bills by \$25.16, compared to houses with no trees. (Those with north side trees had an average summertime increase of \$7.48.) Although not a huge savings per household, these savings add up quickly in a city of nearly half a million people. And each kilowatt saved means less fossil fuel burned and less CO2 released into the air.

### **Trees work**

Cities and environmental organizations have put the Donovan-Butry findings to immediate use. "This study is the first to document the energy-saving efficacy of trees directly, not just by modeling," said Jacobe Caditz of the Sacramento Tree Foundation. "One thing we've been asking ourselves for a long time is, 'Are tree-planting programs effective in reducing energy use?' The answer is clearly, 'Yes, they are.'"

In Portland, the findings are helping persuade homeowners to participate in the city's tree-planting programs. "We have teams of canvassers going door to door," said Whitney Dorer of Friends of Trees, a local nonprofit partnering with the city in its Grey to Green initiative. "Having studies like Geof Donovan's helps us put a number on something that's hard to describe. For a lot of people, it's really about the economic benefits, the property values. It sinks in when we can show them the numbers."

The study is also getting the attention of urban planners. In the Portland suburb of Tigard, the urban-forestry component of the city's draft comprehensive plan was challenged by a local homebuilder's association. In the next draft, city planner John Floyd beefed up the rationale for urban forests by citing the Donovan-Butry study along with other economic data. "We're using Dr. Donovan's work to defend our decision to adopt policies specific to trees," Floyd said. Tigard's urban forester, Todd Prager, added, "Geof's research is valuable because it's local and because it's the most current information out there on the economic value [of trees] to real estate."

Finally, the findings help convince taxpayers and property owners that cities have a legitimate public interest in cultivating and protecting their trees.

"A lot of people don't understand why we are looking to regulate trees, beyond aesthetics," Floyd said. "When you're talking about air quality or water quality, or a good healthy urban canopy, you're talking about a somewhat abstract concept. Dr. Donovan's work helps place a dollar value on that healthy urban canopy. Dollars are something anyone can understand."

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*Read Wells' entire analysis of the research in the September issue of Pacific Northwest Research Station's Science Findings; [www.fs.fed.us/pnw/science/scifi126.pdf](http://www.fs.fed.us/pnw/science/scifi126.pdf).*