

The Tree Project
Integrated Urban Environmental Improvement Through Tree Selection and Mangement
Trees and Energy

Trees and Energy-Background Information

Trees play a significant role in reducing energy demands. They modify climate and conserve building energy use in three principal ways: 1) Shading - reduces the amount of radiant energy absorbed and stored by built surfaces. 2) Transpiration - converts liquid water to water vapor and thus cools the air and reduces temperatures by using solar energy that would otherwise results in heating of the air. 3) Wind speed reduction (windbreaks) - reduces the infiltration of outside air into interior spaces and conductive heat loss, especially where thermal conductivity is relatively high (e.g. glass windows). (McPherson et. al., 2003a).

Technical Issue	Benefit/Potential Effect	Cost/Potential Issues	Sources	Notes
Trees and Air Conditioning	Shade Trees : Shade Trees planted around buildings can reduce air conditioning use by up to 30%. Deciduous trees, which shed their leaves during the winter, provide shade and block heat during hotter months. By dropping their leaves in the fall they admit sunlight in the colder months, placed on the south and west side of buildings. Trees provide greater energy savings in the Northern Mountain and Prairie region than in milder climate regions because of the cold winters and hot summers.	Costs are related to planting and maintenance. Negative issues related to shade trees and A/C usage are minimal: trees may block summer breezes, causing an increase in A/C use. Other issues include possible reduced revenue for energy providers such as Xcel Energy.	1.) Maryland Dept. of Natural Resources. "Trees Save Energy". (n.d). www.dnr.state.md.us/forests/publications/urban5.html .2.) Northern Mountain and Prairie Community Tree Guide: Benefits, Costs and Strategic Planting. McPherson, et. al., (2003)	Simulation of annual cooling savings for an energy efficient home in Denver indicated that typical household with air conditioning spent \$125 for cooling. Shade and lower air temp's from 2 25 ft. tall trees on west side of house was estimated to reduce cooling costs by about \$30/yr (24%).

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Trees and Heating	<p>Trees as windbreaks: Evergreens placed in planned pattern on north side of home serve as windbreaks in winter, which keeps building temperature warmer, reducing heating usage. (Maryland DNR, n.d.) Simulation indicated that a typical Denver household spent \$400/yr in heating costs. Wind protection by 2 25-ft tall trees on the west side of the house was estimated to save \$15/yr for heating, a 4% reduction. Windbreaks reduce wind speed and therefore reduce the amount of cold outside air which infiltrates into the building by up to 50%, which reduces energy usage. Windbreaks also reduce conductive heat loss from buildings. Cold wind blowing against windows causes increases the temperature gradient between inside and outside temperatures. Using trees as a break, conductive materials such as windows do not get as cold, resulting in less energy usage.</p>	<p>Proper Placement is crucial. (e.g. Deciduous trees that shade south and east-facing walls during winter can increase heating costs (Maryland)</p>		
Trees and Air Temperature	<p>Trees combat urban heat island effect by lowering air temp's through evapotranspiration, similar to swamp cooler. Urban heat island effect refers to process in which typical urban surfaces, mostly concrete and asphalt, get much hotter during the day than do vegetated surfaces. Man-made surfaces store incoming solar energy, converting it to thermal energy, and releasing it again at night, created areas of warm air over the city. Effect is compounded over many hot days. Trees in individual building sites may lower air temp's 5 d F compared to outside greenspace. At larger scale urban areas, climate differences of > 9 d F have been observed. (According to the Boulder report, the temperature measured directly above man-made surfaces can be as much as 25 degrees hotter than the temperature beneath a forested area).</p>	<p>Although trees usually contribute to cooler summer air temperatures, their presence can increase air temperatures in some instances. In areas with scattered tree canopies, radiation can reach and heat ground surfaces; at the same time, the canopy may reduce atmospheric mixing such that cooler air is prevented from reaching the area. In this case, tree shade and transpiration may not compensate for the increased air temperatures due to reduced mixing (of layers of air/chemicals) (Nowak, n.d)</p>	<p>Nowak, D.J. The Effects of Urban Trees and Air Quality. USDA F.S. Accessed via: http://www.fs.fed.us/ne/syracuse/gif/trees.pdf</p>	