Green Parking Lots: Can Trees Improve Air Quality?

Abstract

The Green Parking Lot study quantifies the differences in the levels of ozone emissions occurring in shaded and unshaded parking lots. The study is helping to foster new partnerships between air quality agencies, non-profit volunteer groups, landscape professionals, local government, and businesses.

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Ozone is a serious air pollution problem in most large U.S. cities. In the Sacramento County metropolitan area, motor vehicles are a major source of ozone precursors, contributing approximately 59 tons per day (tpd)(68% of total) nitrogen oxides (NO_x) and 59 tpd (49% of total) anthropogenic hydrocarbon (HC) emissions.

While the bulk of HC emissions are from tailpipe exhaust, approximately 9.7 tpd (16%) are from evaporative emissions that occur during daytime heating of fuel delivery systems of parked vehicles. Evaporative emissions, as well as exhaust emissions during the first few minutes of engine operation (primarily NOx), are sensitive to local microclimate.

Many municipalities in the West also have parking lot shade tree ordinances, which require that parking lots be designed to achieve 50% tree canopy cover within 15 years of construction. While originally viewed by ordinances as an aesthetic amenity, parking lot trees may provide important environmental benefits. In the pilot study described here, we posit a relationship between tree cover, parking lot microclimate and vehicle emissions.

Experiment Overview

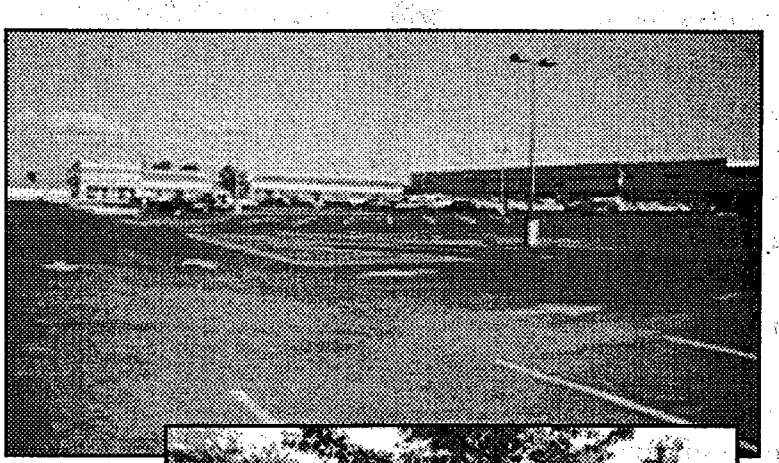
Microclimate measurements were taken to quantify the moderating influence of tree canopy on parking lot microclimate via shading and evaporative cooling from leaves. These estimates were used to calculate potential temperature-dependent **emissions reductions from parked vehicles** using the California Air Resources Board MVEI7G model.

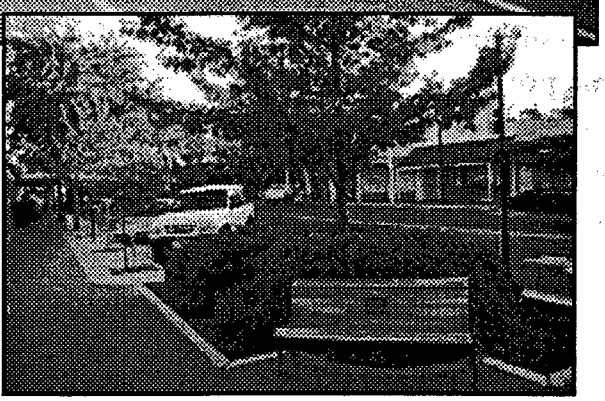
Measurements

Two automated weather stations and instrumented passenger cars were located in unshaded and shaded portions of a parking lot in Davis, CA for a week in August 1997. Air temperature, solar and net radiation, wind speed and direction, and vehicle cabin and fuel tank temperatures were measured.

Peak daytime air temperatures at the shaded parking lot averaged 1 to 2°C cooler than the unshaded site; fuel tank temperatures of the shaded car were 2 to 4°C cooler than fuel tank temperatures of the unshaded car.

Larger temperature differences between fuel tanks of shaded and unshaded cars, compared to air temperature differences between shaded and unshaded lots, indicate that direct shading of the vehicle influenced fuel tank temperature (hence HC evaporation rates) as much as, or more than, the aggregate effect of trees on air temperature.





Emissions Modeling

Observed air temperature regimes at the Davis parking lot were used to design "base case" and "treatment" cases for hypothetical changes in parking lot tree canopy. These temperature regimes were used as input to the MVEI7G model to simulate vehicle emissions in Sacramento County. ROG emissions (reactive organic gases) were reduced by 2% (0.85 tpd) for an increase in canopy cover from 8% to 50%. NO_x emissions from cooler engine starts were reduced by 0.1 tpd (0.2%).

Though modest, projected ROG reductions were equivalent to projected hydrocarbon emission reductions for existing Sacramento Metropolitan Air Quality Management District control measures for graphic arts, ethylene oxide sterilizers, alternative fuel stations and waste burning (totaling 0.89 tpd). Projected NO_x emission reductions (0.1 tpd) were equivalent to reductions projected from the district's light-duty vehicle scrappage program (0.1 tpd).

This study is helping to foster new partnerships between air quality agencies, non-profit volunteer groups, landscape professionals, local government and businesses. As a result, the livability of our communities is improving through better design and stewardship of "green parking lots."

Urban Tree Reclamation Pilot Project

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Abstract

For the past several years, a pilot project for the utilization of urban trees for more valuable private and public purposes has been underway in Cincinnati, Ohio. Portable mills help to encourage individual property owners to think of their trees as sources of lumber for home projects and/or donate their trees for others to use.

At present, most urban trees felled on both public and private properties end up in municipal landfills as debris. Trees not dumped in landfills are either buried at construction sites, cut into firewood, or ground into mulch. Much of what is discarded, buried, burned, or ground could yield furniture-grade lumber and veneer.

For the past several years, a pilot project has been underway in Cincinnati, Ohio to utilize urban trees for more valuable private and public purposes. The project is supported by *Popular Woodworking Magazine*, the Wood-Mizer Company, the Cincinnati Park Board, and the University of Cincinnati. Individual property owners are encouraged to think of their trees as sources of lumber for home projects such as furniture or to donate the trees for others to use. Governmental agencies are encouraged to use the lumber for public furniture, such as park benches and picnic tables, and to donate lumber to schools and vocational training centers and to projects such as Habitat for Humanity.

In small numbers, we are examining the feasibility, costs, and public significance of converting urban trees to lumber. Portable mills, such as those produced by the Wood-

Mizer Company, allow logs to be cut on-site, an option that significantly reduces the amount of heavy lifting and hauling required to transport logs to a sawmill. There is less danger to operators of portable mills from imbedded metal and concrete than to operators of sawmills. The cost of wet and ungraded hardwoods indigenous to southwestern Ohio (mainly oak, cherry, walnut, and maple) are about $1.50/board foot versus the $3.50 to $5.50 per board foot retail price range for kiln-dried and graded hardwoods. Storage depot for logs and storage for air-drying lumber is a continuing problem.

The public response, by our local and national experience, is entirely positive, and widely and deeply felt. There is no shortage of individual property owners who are willing to donate trees and many callers volunteer to help in cutting, hauling, and storing. Urban forestry agencies that launch a local program similar to what we are doing in Cincinnati should expect a strong, positive response from the general public. You may be overwhelmed by the response, as we were at first.