Research Highlights
LBNL Heat Island Group
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Heat Island Reduction Strategies Offer Over $10M per Year Energy Savings in Toronto, Canada

A recent simulation study at LBNL has estimated that heat-island reduction strategies offer potential savings in total heating- and cooling-energy expenditure in the Greater Toronto Area, Canada exceeding CAD $10M per year (all figures given in Canadian Dollars: 1.00 CAD = c. 0.63 USD).

Heat-island reduction (HIR) measures include reflective roofs, reflective pavements, and urban vegetation. During the summer, reflective roofs reflect most of incident sunlight and reduce the amount of heat conducted into a building. Similarly, strategically placed trees can shade windows and walls, lowering direct heat gain. Reductions in summer heat gains yielded by cool roofs and shade trees lower building air-conditioning loads, improve thermal comfort, save peak-demand electricity, and reduce energy costs. Cool surfaces (roofs and pavements) and urban vegetation (shade trees, park trees, lawns, etc.) can also potentially cool the city by a few degrees Celsius. Lowered urban air temperatures can further reduce cooling-energy demand. More importantly, cooler ambient conditions can also slow the rate of smog (O_3) formation and significantly improve ambient air quality.

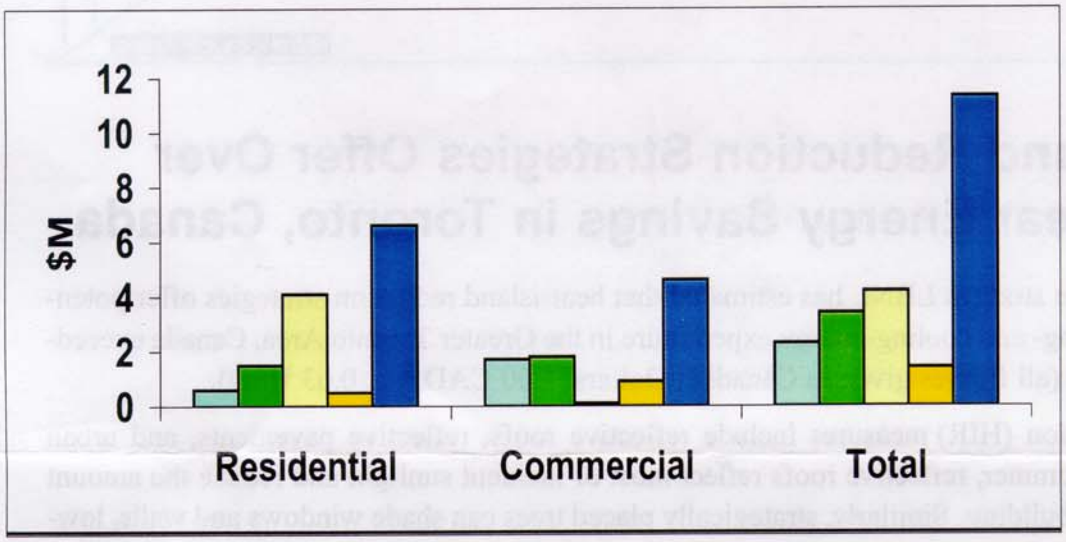
This study focused on the analysis of energy savings in the three major building types that offer most (over 90%) of the total potential savings: residence, office and retail store. Using an hourly building energy simulation model, we quantified the energy saving potentials of (1) using a cool roof [*direct effect*]; (2) placing deciduous shade trees near the south and west walls of a building [*direct effect*]; (3) placing coniferous wind-shielding vegetation near a building [*direct effect*]; (4) ambient cooling by a large-scale program of urban reforestation with reflective building roofs and pavements [*indirect effect*]; and (5) the combined direct and indirect effects.

Results show that potential annual energy savings of over $11M (with uniform average residential and commercial electricity and gas prices of $0.084/kWh and $5.54/GJ) could be realized by ratepayers from the combined direct and indirect effects of HIR strategies. Of that total, about 88% was from direct effects and the remainder (12%) from the indirect effects of the cooler ambient air temperature. The residential sector accounts for over half of the total savings (59%); offices, 13%; and retail stores, 28%. Savings from cool roofs were about 20%; shade trees, 30%; wind-shielding by trees, 38%; and the indirect effect, 12%. These results were highly sensitive to the price of gas. As an example, assuming a residential gas price of $10.84/GJ (as was the case for December 2001), the net annual savings were reduced to about $10M: 78% from wind-shielding, 16% from shading by trees, and 5% from cool roofs.

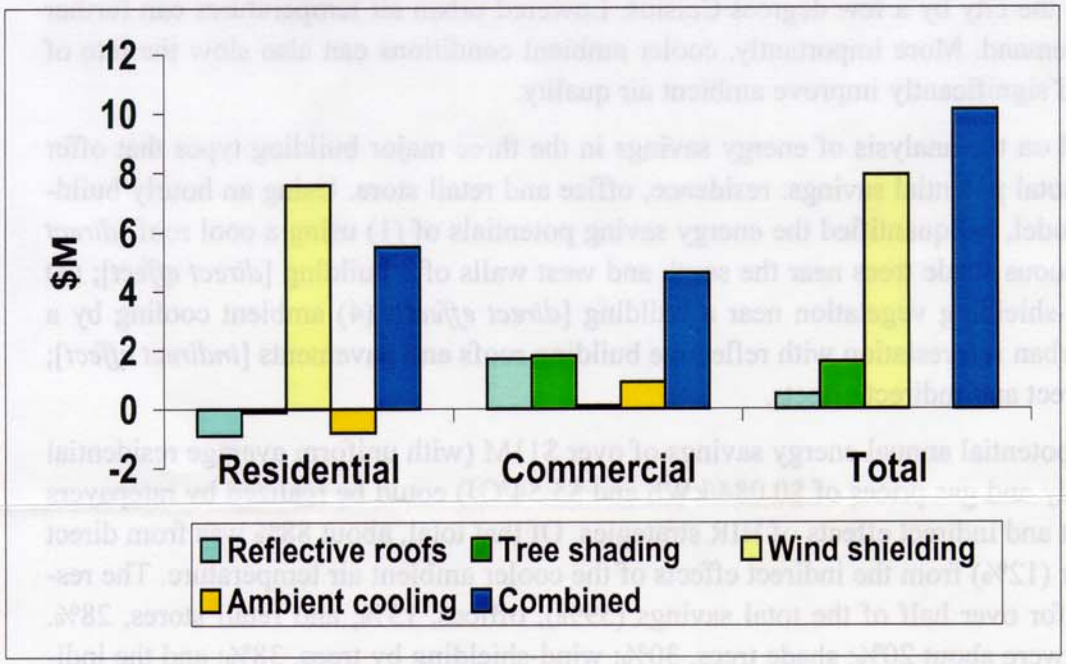
Potential annual electricity savings were estimated at about 150 GWh and potential peak-power avoidance was estimated at 250 MW.

Reference:

Konopacki, S. and H. Akbari. 2001. “Energy Impacts of Heat Island Reduction Strategies in Toronto, Canada,” Lawrence Berkeley National Laboratory Report LBNL-49172, Berkeley, CA.



Savings in annual heating and cooling energy-use expenditure assuming a uniform residential and commercial electricity rate of $0.084/kWh and a gas rate of $5.54/GJ.



Savings in annual heating and cooling energy-use expenditure assuming a uniform residential and commercial electricity rate of $0.084/kWh, a commercial gas rate of $5.54/GJ, and a residential gas rate of $10.84/GJ.

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