DRISI
Caltrans Division of Research,
Innovation and System Information

Research Results

Life-Cycle Analysis of Cool Pavement

What is the long-term environmental cost of changing to more reflective pavement to mitigate urban heat islands?

Pavement

JANUARY 2016

Project Title:
Use of Environmental Life Cycle Analysis to Develop Tools and Recommend Practices to Reduce Environmental Impact (Sustainable Pavements)

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WHAT IS THE NEED?

The built environment in urban areas can cause the temperature to be warmer than the surrounding undeveloped areas, a phenomenon described as an urban heat island. Urban heat island effects occur across the year and particularly in the summer. Urban heat islands affect air quality, energy consumption to cool buildings, public health, and human comfort. The prevalence of surfaces that absorb and retain energy from the sun and a lack of vegetation are contributing factors. To address the causes and effects of urban heat islands, the Heat Island Group at Lawrence Berkeley National Laboratory (LBNL) promotes the science and implementation of cool community strategies, such as using more reflective materials for roofs, pavements, and cars. The LBNL's Cool Pavement project focuses on reducing pavement temperatures by increasing the albedo—or reflectivity—of the pavements used for roads, parking lots, and other surfaces. The albedo of pavement surfaces differs greatly based on the materials used in construction. The hypothesis is that if large areas of pavement are changed to be more reflective, sending more sunlight back into the atmosphere, less air conditioning would be used, reducing energy consumption, and thereby reducing global warming. However, to achieve a more complete picture of the consequences of changing pavements in metropolitan areas requires also considering the environmental effects and energy consumption involved in constructing and maintaining new cooler pavements.

WHAT WAS OUR GOAL?

The goal was to provide a full life-cycle analysis of changing the pavement albedo in urban areas to address global warming, energy use, and selected air pollutants.

WHAT DID WE DO?

Caltrans, in partnership with the University of California Pavement Research Center and thinkstep, a sustainability consulting company, provided input on the life-cycle effects of cool pavements, such as the energy consumption and emissions required to produce, transport, construct, and maintain different types of pavement. The researchers also provided information on albedo measurements, local government pavement treatment practices, and other factors that contribute to the life-cycle analysis.

WHAT WAS THE OUTCOME?

LBNL developed a software tool that incorporates the full life-cycle analysis to better understand how changing pavement surfaces in urban areas affects global warming. The software uses building energy modeling completed by LBNL, climate modeling completed by the University of Southern California, and the work of the UCPRC and thinkstep.

WHAT IS THE BENEFIT?

Cooler pavements can help mitigate the effects of urban heat islands. When making pavement choices to increase reflectivity and thereby reduce temperatures, it is important to understand the entire life cycle to gain a complete understanding of the long-term environmental effects and consequences.

IMAGES

Figure 1: Thermal infrared (left) and visible (right) images of a road with light and dark segments. The infrared image shows that the light segment (bottom) is about 17°C (30°F) cooler than the dark segment (top). (Image courtesy of Larry Scofield, APCA)

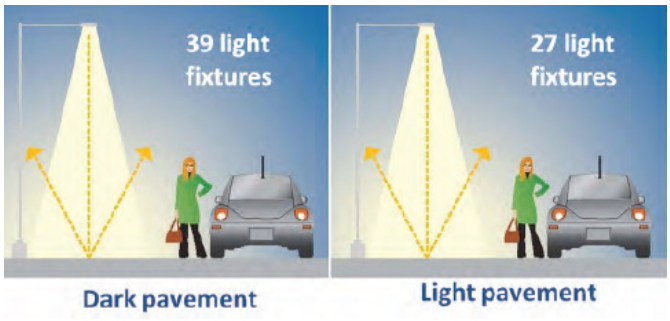

Figure 2: Reflective pavements can reduce the need for street lighting at night. (Image courtesy of Stark 1986)