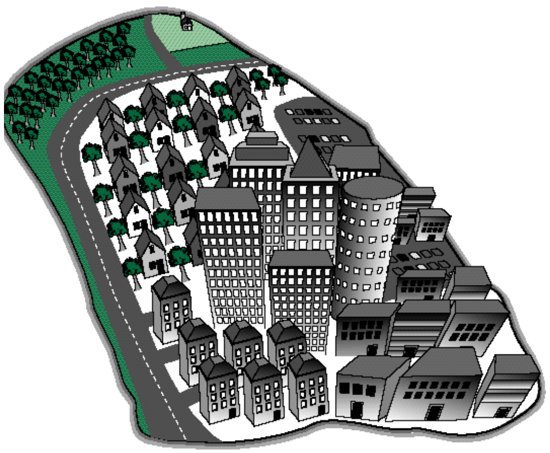
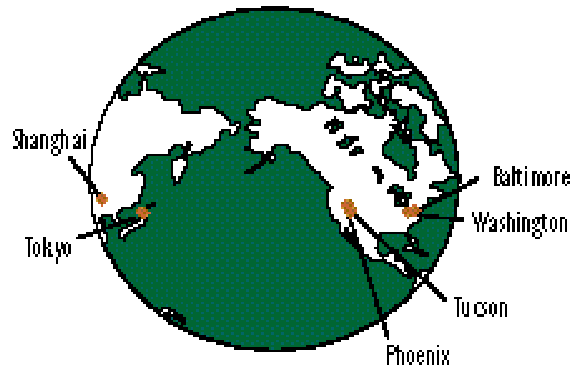
Working to Cool



Urban Heat Islands

The U.S. Department of Energy in cooperation with other agencies and private industry

On warm summer days, the air in a city can be 6–8˚F hotter than the surrounding countryside. Scientists call these cities “Urban Heat Islands.”



In these cities, the temperature on the hottest summer day is rising by up to 1˚F each decade.

Urban Heat Islands have been created over time here in the United States and around the world. In Baltimore, Phoenix, Tucson, Washington, Shanghai, and Tokyo, for example, scientific data show that July's maximum temperatures during the last 30 to 80 years have been steadily increasing at a rate of one-half to one degree Fahrenheit every ten years.

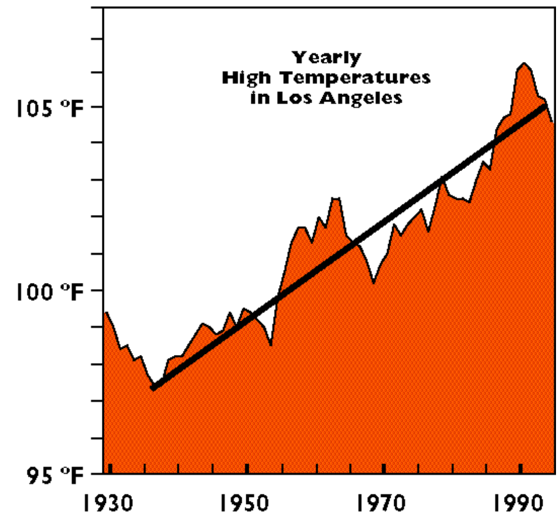
How Do Cities Become Heat Islands?

Temperatures are higher in cities because

- There are few trees, shrubs, and other plants to shade buildings, intercept solar radiation, and cool the air by “evapotranspiration.”
- Buildings and pavement made of dark materials absorb the sun’s rays, causing the temperature of the surfaces and the air around them to rise.

The Making of Los Angeles “Island”

Los Angeles is a striking example of how a city was transformed into an Urban Heat Island.



Note: Temperatures are averaged over a ten-year period.

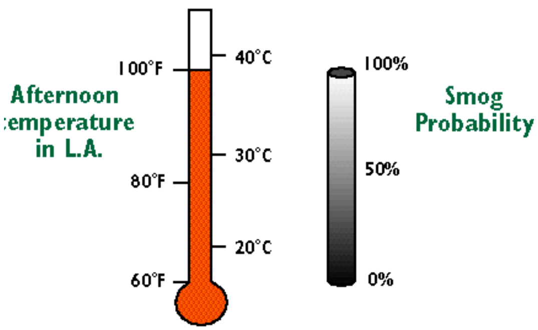
In the 1930s, Los Angeles was an area covered with irrigated orchards. The high temperature in the summer of 1934 was 97˚F. Then, as pavement, commercial buildings, and homes replaced trees, Los Angeles warmed steadily, reaching 105˚ and higher in the 1990s.

THE SMOG CONNECTION

Urban Heat Islands are not only uncomfortably hot, they are smoggier.

Smog is created by photochemical reactions of pollutants in the air, and these reactions are more likely to intensify at higher temperatures.

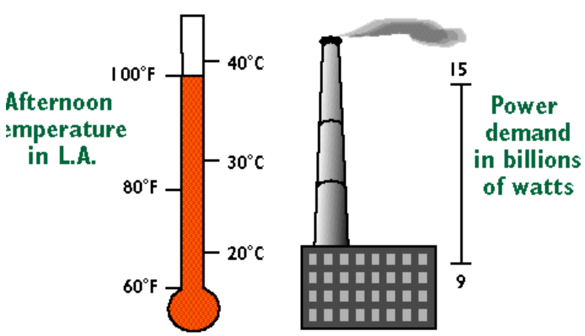
In Los Angeles, for every degree the temperature rises above 70˚F, the incidence of smog increases by 3%.



THE ENERGY LINK

Higher temperatures also mean increased energy use, mostly due to a greater demand for air conditioning. As power plants burn more fossil fuels, they drive up both the pollution level and energy costs.

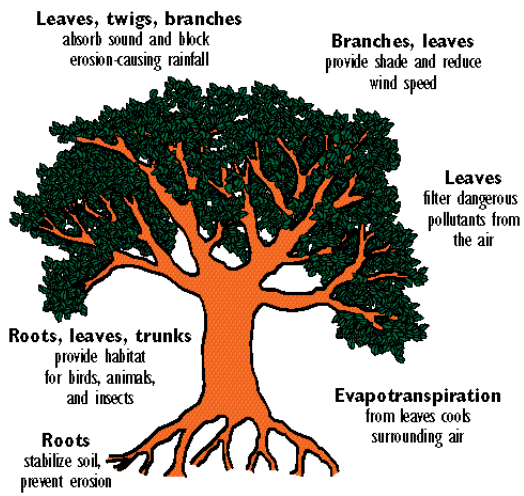
On warm afternoons in Los Angeles, the demand for electric power rises nearly 2% for every degree Fahrenheit the daily maximum temperature rises.



COOLING COMES NATURALLY

Trees have great potential to cool cities by shading and by "evapotranspiration."

Evapotranspiration occurs when plants transpire water through pores in their leaves. The water draws heat as it evaporates, cooling the air. One mature, properly watered shade tree with a crown of 30 feet can "evapotranspire" up to 40 gallons of water in a day, which is like removing all the heat produced in four hours by a small electric space heater.



Planting programs can help reduce urban temperatures. Within ten to fifteen years—the time it takes a tree to grow to a useful size—properly placed trees can reduce heating and cooling costs by an average of 10–20%. Over their lives, trees can be much less expensive than air conditioners and the energy needed to run them.

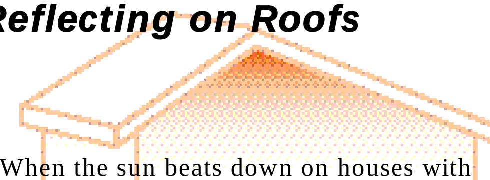
Correct selection and location of trees is important to achieve the best results. Two proven methods bring maximum benefit:

- Deciduous trees shading the south and west sides of a building block the summer sun. For a home monitored in Sacramento, CA, researchers found that this reduced cooling energy use by as much as 30%.
- Trees grouped together create a refreshing oasis in a city and also cool nearby neighborhoods. Grouped trees can protect each other from the sun and wind, making them more likely to grow to maturity and live longer.

DARK VERSUS LIGHT

Dark materials absorb more heat from the sun—as anyone who has worn a black t-shirt on a sunny day knows. Black surfaces in the sun can become up to 70˚F hotter than the most reflective white surfaces.

Reflecting on Roofs



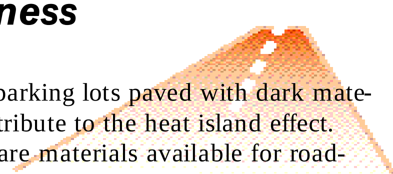
When the sun beats down on houses with dark shingle roofs, some of the heat collected by the roof is transferred inside. Staying comfortable in these homes often means more air conditioning and higher utility bills.

Scientists have found that buildings with light-colored roofs that reflect the sun's rays use up to 40% less energy for cooling than buildings with darker roofs.

A new rating system called the solar reflectance index (SRI) is being developed to measure how hot materials are in the sun. Traditional roofing materials have an SRI of between 5% (brown shingles) and 20% (green shingles). Manufacturers have recently developed clean, "self-washing" white shingles with even higher SRIs—up to 62%.

Reroofing with shingles rated SRI 50% or higher will keep a home cooler and reduce energy bills.

Paving the Way to Coolness



Roads and parking lots paved with dark materials also contribute to the heat island effect.

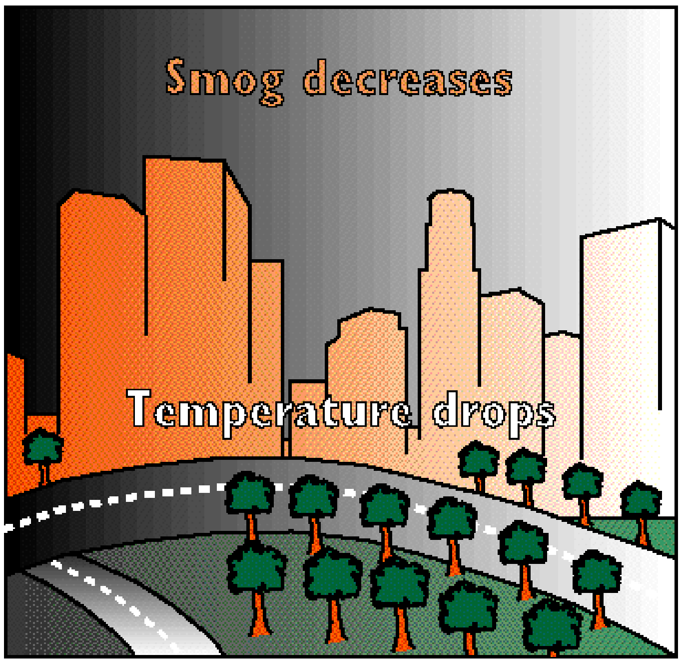
Now there are materials available for roadways that reflect more sunlight and last longer because they are not as stressed by the excessive heat. If cities began using these for paving new roads and resurfacing old ones as the need arose, they would have cooler summers at no extra cost.

IF L.A. WOULD LIGHTEN UP

What would happen in Los Angeles if some roofs and pavements were resurfaced with lighter materials and the right kind of trees were planted in several communities?

Scientists at Berkeley National Laboratory have been painting the town and shading its homes—all by computer simulation—to answer that question.

Dividing the L.A. basin into hundreds of portions, they estimated how much vegetation and reflective surfaces could be added to each location. Then they added trees and lightened surfaces in only about 15% of the possible areas. Summer temperatures at 3:00 p.m. dropped 6˚F.



Because the rate of smog formation depends on temperature, this same model was used to estimate the effect on the region's smog, taking into consideration wind patterns, moisture, and other factors specific to the area. The results showed an overall reduction in smog by about 10%, the equivalent of removing three to five million cars from the roads.

COOL COMMUNITIES FOR A HEALTHIER PLANET

Urban Heat Islands have an impact beyond the city limits. The higher temperatures create more air pollution, and the greater demand for air conditioning means more greenhouse gases are being produced at electric generating plants.

Through the simple approach of planting trees and using light-colored reflective materials on roofs and pavement, city residents can be more comfortable—and take comfort in knowing that the environment is benefiting as well.

In the United States, the Cool Communities Program is part of a national effort to prevent global warming as outlined in the Climate Change Action Plan of 1993.

Much of the scientific research and development of materials for cooling our nation's cities is being done by the Heat Island Project at Berkeley National Laboratory. Funding for the program is provided by the U.S. Department of Energy and the Environmental Protection Agency.

AMERICAN FORESTS, a non-profit citizens' conservation group, is leading the Cool Communities outreach campaign, in cooperation with federal and local government agencies and private organizations. The program includes pilot projects in seven communities across the country.

Communities interested in taking part in the program should contact AMERICAN FORESTS at the address and phone number listed below.

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