



Shrubs and plants on top of Chicago's City Hall are expected to save the city up to \$5,000 a year in heating and cooling bills. (City of Chicago)

Blacktops Go Green

City Buildings Donning Green Tops to Reduce Warming

By Amanda Onion



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— In Chicago, there are two buildings with almost all the same features yet with one organic twist. Both have granite columns, 12 stories and are connected as architectural identical twins.

But the County Building is covered with blacktop while City Hall is coated in a layer of greenery. In summer months, that has led to a stunning 70-degree temperature difference.

"Last summer surface temperatures on a 95-degree day were 165 degrees on the County Building; on the city side it was 95 or 85 degrees in the shade," said Mark Farina, spokesman for Chicago Department of Environment.

Dressing Cities in Lighter Hues

As Chicago city spokeswoman Jessica Rio says, "Cities are basically dressed in dark clothes."

Chicago's County Building roof is typical of many tall city buildings. Its blacktop surface absorbs heat, increasing local temperatures and contributing to citywide pockets of warmer weather.

The surface of Chicago's City Hall, meanwhile, hosts a collection of 20,000 shrubs, vines and two trees. As early data suggests, the plants keep the roof surface — and building — cool by their process of releasing water vapor and lowering heat absorption. In the winter, the plants help keep heat in. Farina says estimates show the building's plant covering will save the city up to \$5,000 a year in heating and cooling costs.

Green rooftops remain fairly rare in the United States, but some in the business say that's quickly changing.

"The interest is really phenomenal, almost frightening," says Ed Snodgrass, a horticulturalist in Maryland who has been designing green rooftops for three years. "I can barely keep up."

Cities in Europe, particularly in Germany, have been greening rooftops for about 30 years for ecological purposes. David Beattie, a green roof researcher at Pennsylvania State University, estimates about 20 percent of Germany's roof space is covered in green.

But while the main incentive in Germany is to reduce water runoff and flooding (Germany has high precipitation rates), the bigger issue in the United States is keeping urban centers cool.

Urban Islands Make Rain

Satellite data from NASA's Goddard Space Flight Center confirmed in the July issue of the *Journal of Meteorology* that the dark, non-absorbing surfaces of cities emanate heat, which increases regional temperatures by about 10 degrees Fahrenheit. The rising warm air from urban centers, coupled with colliding air currents caused by the rough aerial surfaces (from skyscrapers) of cities contributes to an increase in rainfall downwind from city centers.

"Our satellite data showed a clear trend," said Marshall Shepherd, a meteorologist at Goddard Space Flight Center. "The rain rate downwind of the city was 28 percent higher than rain rates upwind of the city."

One way to minimize this so-called urban island effect is to alter the surfaces of rooftops to increase their reflectivity and lower the amount of heat absorbed by the surface. Chicago, Philadelphia and Portland, Ore., are among the first U.S. cities to either encourage or require more reflective coverings for city buildings.

Chicago adopted an ordinance this past June requiring that all new buildings be topped with either a white or garden roof. Portland, which has a bigger problem with water runoff than heat island effect, has new zoning rules that allow buildings to be taller and wider if they are topped by a garden roof.

In Philadelphia, the nonprofit Energy Coordinating Agency has painted thick white acrylic coatings on more than 200 roofs of older residents in low-income neighborhoods. The agency estimates the new roofs keep dwellers a few vital degrees cooler in the summer.

Green Roof Varieties: Thick or Thin

While painting a white layer on a roof is fairly straightforward, planting a rooftop garden requires a healthy knowledge of plants and regional climates. Snodgrass, the rooftop horticulturalist, explains there are two basic kinds of green roofs — intensive and extensive.

Intensive rooftop gardens, like the one that tops Rockefeller Center in New York City, are high-maintenance gardens based on 3 to 5 feet of soil. They are heavy — up to 50 pounds per square foot — and require hefty infrastructure in the building below. Extensive gardens require only 3 to 4 inches of soil, need little attention and are about 15 pounds per square foot when soaking wet.

"The plants I use for extensive roofs don't need water, they have to be able to take winter cold and summer heat," said Snodgrass. "These are hardy plants."

Snodgrass says that extensive rooftop gardens, like the one topping Chicago's City Hall, are a less expensive, more practical way of beating the heat island effect.

But while early results are promising, city planners are still awaiting solid data that the roofs do actually make a difference.

"Green roofs could have an impact of lowering heat effects, but we don't know for sure," said Robert Goo of the Environmental Protection Agency.

Waiting for Numbers

To put green roofs to the test, Beattie and colleagues have had six small buildings constructed on the Penn State campus. Three have green roofs and three are topped by asphalt. For the next several seasons, Beattie's team will monitor how much energy each building uses to maintain a steady temperature inside.

"It's still too soon to conclude anything for sure, but preliminary information has shown the green roof buildings require less energy," said Beattie.

Shepherd, of the Goddard Space Flight Center, meanwhile, is running computer simulations to understand at which point the urban heat island effect sets in.

"It seems that there may be a particular trigger point when an urban city reaches a given size and heat absorption level before it produces the effect," he said.

He's also plugging in factors like green top coverings to see if they can minimize the citywide effect.

Data aside, Farina says there's plenty of firsthand evidence on top of Chicago's City Hall.

"We've been amazed at the rate of growth on top of the building," he said. "Standing up there, you can immediately feel the difference."

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