

Building a Cool World, With New Roofs

Your roof is an island of heat. Cooling it could reduce billions of tons of carbon dioxide emissions. But how do you make these roofs attractive?

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Using reflective materials for paving roofs and streets in the world's urban areas could offset 44 billion metric tons of carbon dioxide emissions.

That would be akin to taking 600 million cars off the road for 18 years, according to a recently published paper in the journal *Climatic Change* by researchers at the Lawrence Berkeley National Laboratory (see [summary](#)).

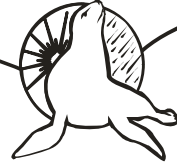
The paper, authored by Hashem Akbari, Surabi Menon and Art Rosenfeld, looked at the impact of using materials especially designed to reflect sunlight and emit heat to reduce building cooling costs and minimize what's called the "heat island effect."

The heat island effect occurs when buildings, roads and sidewalks absorb a lot of heat, which is released at night and keeps the air temperature warm. It can raise a city's temperature by 2 degrees to 8 degrees Fahrenheit and lead to smog, which can cause all sorts of health problems, according to the U.S. Environmental Protection Agency.

Akbari, a senior scientist and head of the Urban Heat Islands Group at Berkeley Lab's Environmental Energy Technology Division, said in an interview that he would like to work with international organizations such as the United Nations or the Clinton Foundation to promote the idea of replacing the world's urban rooftops and streets with solar reflective materials.

"My view is it's a program that save energy and improves urban comfort," Akbari said. "The world can be united under this platform, and we can use this framework to address more complicated [climate change] issues."

The idea of using so-called "cool roofing materials" to reduce energy use isn't new. But it's a low-tech approach with commercial products readily available. And it has yet to take hold in most of the commercial and residential roofs in the United States. California already has [cool roofing regulations](#) in place.



Researchers at Berkeley Lab's Environmental Energy Technologies Division (EETD) have been studying the effect of the heat island effect since the 1980s. The roofing industry began developing cool roofing materials, such as in paints and coatings, in the 1990s.

Painting the roofs and buildings white can do the trick. But that color isn't so popular for the roofs of American homes. Akbari, head of the Urban Heat Islands Group at the EETD, and fellow researchers have worked with the industry on developing solar-reflective materials in asphalt shingle, metal and tiles that also come in different colors. Some of those materials can reflect light in the near-infrared part of the spectrum that isn't visible to the naked eye.

Industry group such as the [Cool Roofing Rating Council](#) also have sprung to set product testing and rating standards. The U.S. Green Building Council, which certifies how energy efficient a building is, gives credits for cool roofs.

The voluntary [Energy Star](#) program run by the EPA and the U.S. Department of Energy has certified energy-efficient roofing products, which have to meet [certain criteria](#). These cool roofing materials represented 25 percent of the commercial roofing products and 10 percent of the residential products shipped in 2006, the most recent data available from the EPA.

The Energy Star program have received poor review by federal auditors, however. A report by the EPA's Inspector General, released last month, found that many energy saving claims by manufacturers seeking the Energy Star certification [couldn't be independently verified](#). The report said the program also used shoddy methods to calculate carbon dioxide emission reductions.

Costs will vary for using cool roofing materials, of course. In general, coatings for a low-sloped roof could cost \$0.75 to \$1.50 per square foot, said the EPA on its [cool roofs Website](#). Single-ply cool roof membranes can go for \$1.50 to \$3 per square foot. Those costs can run between 5 percent to 20 percent more than conventional roofing materials, but the idea is that they would provide much more in energy costs in the long run.

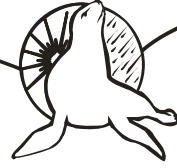
Using cool roofing materials can reduce on average 20 percent to 30 percent of air conditioning energy use, according Berkeley Lab researchers. The Cool Roof Rating Council said doing so can cut cooling costs on average 7 percent to 15 percent.

The downside is that homeowners might have to pay more to heat their houses in the winter.

In the new research paper, Akbari, Menon and Rosenfeld ran a series of calculations to figure out the benefits of using cool roofing materials, in terms of the carbon dioxide emission offsets. [Rosenfeld](#), by the way, is a former Berkeley Lab physicist and energy conservation champion who serves on the

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California Energy Commission. The Department of Energy has said his work has cut power consumption by more than over \$100 billion over the last 30 plus years.

By using roofing materials that can reflect at least 60 percent of the sunlight, a 1,000-square-foot roof can offset a one-time, 10 metric tons of the emissions, according to the authors. Conventional roofs can reflect between 10 percent and 20 percent of the sunlight.

A one-time, 44 billion metric tons of emissions offsets can be achieved by using the reflective materials for roofs *and* pavements in the world, the researchers wrote in the paper. Using the European's emissions trading market to make their point, the researchers estimated that the 44 billion metric tons of offsets would worth \$1.1 trillion (at \$25 per metric ton).

Targeting paved surfaces is a good way to fight climate change because the human population in urban centers shows no signs of decreasing, the researchers wrote. About 50 percent of the population in the world lives in urban areas, and that figure would increase to 70 percent by 2040, according to the researchers.

The U.S. Department of Energy has a ["cool roof calculator"](#) online that helps people figure out how much energy savings can be achieved. The EPA has [a similar tool](#).