

Cool Roofs: A Big Deal

In the ongoing efforts to reduce our nation's carbon output by improving the energy efficiency of our built environment, a new old idea is shaping up to be a key player: cool roofs. Used throughout the Mediterranean and tropical climates worldwide, the solar reflectance value (albedo) of a white or light-colored roof has been long understood—the more sunlight the roof reflects, the less the building absorbs and the easier it is to keep the building cool.



Figure 1: Satellite view of Hamilton, Bermuda



Figure 2: Satellite view of Los Angeles, California

A recent report by Hashem Akbari, Surabi Menon and Art Rosenfeld titled, “Global Cooling: Effect of Urban Albedo on Global Temperature”, quantifies cool roofs’ potential impact on improving energy efficiency and slowing climate change. The report notes that painting 100 feet² of black roof a lighter color offsets the extra heating caused by 1 metric ton of CO₂ in the atmosphere. Scaled up to the national level, converting dark-colored roofs and pavements in urban areas around the world to lighter colors would offset the extra heating caused by 44 billion metric tons of CO₂ in the atmosphere, effectively offsetting over 6 years of the U.S.’s CO₂ equivalent greenhouse gas output and saving the country over \$1 billion per year in energy costs.

Clearly, cool roofs are a big deal. But from a building technology perspective, just painting the roof a lighter color isn't enough, since the lighter color only solves half of the cool roof equation. Calculating the coolness of a roof requires measuring both solar reflectance (the fraction of solar energy reflected by the roof) and thermal emittance (the measure of a roof's ability to radiate absorbed heat as infrared light); the most useful method available for calculating roof coolness is the solar reflective index (SRI). This index utilizes both factors to generate a 1-100 SRI rating, where 100 indicates a roof with perfect solar reflectance and thermal emittance. The higher the SRI, the cooler a roof will be, even in full sunlight on a hot day.

Much like the HERS index for whole house energy efficiency, this rating index is essential to meeting the goal of retrofitting and constructing new buildings with cool roofs. Without a scientifically sound method to rate the cooling properties of various roofing materials, consumers cannot make educated decisions and the maximum cooling benefits cannot be harnessed.

And while many current cool roof materials apply the latest and most advanced technologies, from spray polyurethane foam systems to brightly-colored tiles that reflect infrared energy, our historic understanding of the relationship between color and solar reflectance retains its preeminent importance. Lighter roofing materials keep buildings cooler than darker materials, yielding more energy efficient structures that have a lower carbon footprint and are less expensive to operate.

Resources:

Hashem Akbari, Surabi Menon and Arthur Rosenfeld, "Global Cooling: Effect of Urban Albedo on Global Temperature", 2008. <http://repositories.cdlib.org/lbnl/LBNL-63490/>

Energy Information Administration, "Emissions of Greenhouse Gases Report", December 2008. <http://www.eia.doe.gov/oiaf/1605/ggrpt/>

The Lawrence Berkeley National Laboratory (LBNL) Cool Roofing Materials Database. <http://eetd.lbl.gov/coolroof/>

The Cool Roof Rating Council (CRRC). <http://www.coolroofs.org/>

Celeste Allen Novak and Sarah Van Mantgem, "What's So Cool About Cool Roofs", *GreenSource*, March 2009. <http://continuingeducation.construction.com/article.php?L=68&C=488&P=1>

The DOE Cool Roof Calculator provides an estimate of cooling and heating savings for small to medium size facilities that purchase electricity with a demand charge and an alternative version for larger facilities. <http://www.ornl.gov/sci/roofs%2Bwalls/facts/CoolCalcEnergy.htm>

The EPA Cool Roof Calculator allows the designer to input specific details about a building, including heating and cooling systems as well as location and the cost of energy. <http://www.roofcalc.com/RoofCalcBuildingInput.aspx>