Solar Reflectance Index and Cool Roofs

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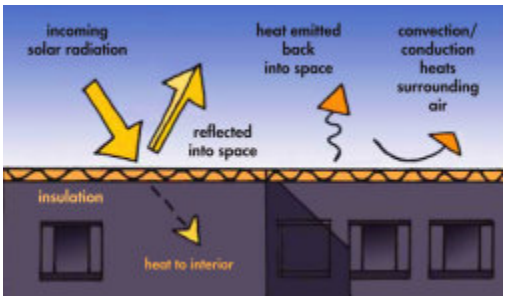
By: Staff



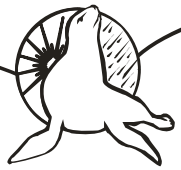
It's no surprise that light-colored, reflective surfaces heat up less in the sun. That translates into less solar-generated cooling loads for buildings with white, reflective roofs. It can also mean lower ambient temperatures outside those buildings, because dark roofs and pavement heat the outdoor air, contributing to the "urban heat island" effect.

Late summer afternoon temperatures in cities are 2°F to 10°F (1.5°C–6°C) higher than in surrounding areas. Only about 1% of that increase is from heat generated directly by vehicles and equipment, according to Lawrence Berkeley National Laboratory (LBNL) research. The rest is from solar-heated surfaces. Those higher temperatures decrease comfort, increase air-conditioning costs, and exacerbate health problems, because ozone (a component of smog) is created when pollutants, such as nitrogen oxides and volatile organic compounds, heat up. A temperature drop of 3°F–4°F (2°C) can reduce smog by 10%–20%, according to LBNL.

For a surface to stay cool, it needs two key attributes: reflectivity and emissivity. Reflectivity measures how well a material bounces back radiation. But since all surfaces absorb some heat, we also need to consider emissivity, or how good a surface is at radiating heat back out into space. The Energy Star label for roofing requires initial reflectivity of at least 0.65 (on a 0-to-1 scale). The "solar reflectance index" (SRI), defined by ASTM E 1980, incorporates both reflectivity and emissivity. The combination of reflectivity and emissivity means that light-colored polymeric roof membranes and coatings, which are good emitters of heat, tend to perform better than metallic surfaces, which can be more reflective but which heats up more because of its low emissivity.

The Cool Roof Rating Council (CRRC), an independent nonprofit, publishes reflectivity and emissivity values for roofing products. The LEED Rating System credit for mitigating urban heat islands limits the SRI of low-slope roofs to 78, and steep roofs to 29 (most materials fall between 0 and 100—low reflectance to high—on the SRI scale). Because CRRC doesn't publish SRI values, the LEED submission template for the relevant credits has a built-in calculator that converts reflectivity and emissivity into SRI.

Both the reflectance and the emissivity of cool roofs decline over time, as the surfaces get dirty, so CRRC includes both initial values and three-year aged values, although for many newer products the three-year values are still pending. Energy Star as well as energy codes, that encourage the use of cool roof products, anticipate some performance deterioration in picking their initial values.



Reflective surfaces on steep-sloped roofs can cause glare and look unattractive. In response to those concerns, manufacturers have developed pigments that look like standard colors but are highly reflective to infrared light, which isn't visible but carries a lot of heat. Roofing products are now available that meet LEED's target SRI of 29 in nearly any standard color. These and other cool roof products help lower heat gain indoors—how much depends on how well the roof or ceiling is insulated—and reduce the urban heat island effect by lowering outdoor temperatures.