Cool Roofing

What is a Cool Roof & Why Does it Make Economic & Sustainable Sense?

by Michael Magallanes, vice president of sales, Coat'N'Cool

While there are many different products and procedures available in the ever-expanding green marketplace, there are some steps that can be taken which are basic yet effective. At the top of the list is the "cool roof," which can be implemented rather easily and at a very reasonable cost. Black and dark-colored roofing materials can dramatically increase a building's cooling load, while cool roofs reflect the sun's radiant energy before it penetrates into the interior of the building, reducing the load.

Energy-efficient, cool roofing systems can significantly reduce roof temperature during the summer, and thereby reduce the building's energy requirements for air conditioning. This helps to cut energy costs by keeping attics and ducts cooler, improving occupant comfort, cutting maintenance costs, increasing the lifecycle of the roof, and reducing urban heat-island effect along with associated smog. In fact, reflective materials can help keep a building's surrounding neighborhood cooler.

What is a "Cool Roof?"

Cool roofs are roofs consisting of materials that very effectively reflect the sun's energy from the roof surface. Cool materials for low-slope roofs are mainly bright white in color, although non-white colors are starting to become available for roof applications. Cool roofs must also have high "emissivity," allowing them to emit infrared energy. Bare metals and some metallic coatings tend to have low reflectivity and are not considered cool materials.

Solar reflectance and thermal emittance are the two measures used to determine the "coolness" of a roof. Solar Reflectance Index (SRI) of a

roofing product is a method for determining the radiative properties of roofing materials. SRI is defined by ASTM Standard E1980-01; the EPA summarizes SRI as "the relative steady-state surface temperature with respect to the standard white (SRI=100) and standard black (SRI=0) under the standard solar and ambient conditions."

White reflective coatings contain transparent polymeric materials, such as acrylic, and a white pigment, such as titantium dioxide (rutile), to make them opaque and reflective. These coatings typically reflect 70% to 80% of the sun's energy. Despite the white appearance, these pigments absorb the 5% or so of the sun's energy that falls in the ultraviolet spectrum. Thus, the pigments help protect the polymer material and the substrate underneath from UV damage. As long as the coating is white or light-colored, the roof will have high reflectance and emittance levels.

If you as a building owner or manager decide to go in the cool roof direction, here are some factors to consider:

- Look for these important properties when selecting a roof material: high solar reflectance, endurance of high reflectance over time, and high emittance. High emittance lowers the roof temperature by increasing the release of heat by thermal radiation. For a high-reflective roof, avoid untreated metal roofs and aluminum coatings. If installing a metal roof, make sure it is coated with a light color (not a clear coating) and is rated by the Cool Roof Rating Council.
- Evaluate your climate. Do heating or cooling loads dominate your energy usage? If cooling dominates, you may be a good candidate for a new energy-efficient roof.
- Determine what makes more sense economically. Transforming your existing roof into a cool roof by coating it with a cool roof product, or replacing your roof entirely with a manufactured cool roof. While it may make more sense to replace an older roof near the end of its lifecycle, a

newer roof still in good shape can be economically transformed into a cool roof that will rival the effectiveness of a new, manufactured cool roof.

Four Categories of Cool Roofs

There are four broad categories of roofing materials that can be used to upgrade a roof's reflectivity to "Energy Star" levels: metal, tile, roofing membranes, and reflective coating. Of the four, a reflective coating may be the most economically achievable for existing buildings because it doesn't require any significant retrofitting of the structure, which can be costly and time-consuming.

Exact energy and money savings for each type of cool roof will depend on a number of factors, such as the type and efficiency of insulation in the ceilings and exterior walls; the windows; the efficiency of the cooling system; and, most importantly, the climate of the building's location. A reflective coating can lower interior temperature of a commercial or industrial building by 8°-12° during the hottest four hours of a summer day, noon to 4:00 pm. Not only does the lower interior temperature help reduce energy costs, it also improves worker productivity, especially in a non-air conditioned space, by creating a working environment that is more comfortable.

Some specific benefits of cool roofs are:

- Saving on annual electricity bills by reducing summer air-conditioning costs.
- Saving peak electricity demand costs if you have time-of-use metering.
- Reducing roof maintenance and replacement expenses by extending roof life.
- Increasing indoor comfort in summer by reduction of infrared conversion from visible light.

- Reducing the "heat island effect" in cities and suburbs.
- Reducing air pollution and smog formation.
- Reducing roofing waste added to landfills.

A Benefit to Surrounding Neighborhoods

A cool roof not only benefits the building or buildings on which it is installed, but also the surrounding neighborhood. In the summer, major urban areas become heat islands where temperatures can soar 4° to 8°F above the temperature in the surrounding area. This rise in temperature corresponds to a rise in harmful ozone, and therefore smog levels in the urban air. For every degree above 70°F, the incidence of smog increases 3%.

However, a city populated with buildings with reflective roofs will not experience this effect as strongly. A recent study by the Lawrence Berkeley National Laboratory (LBNL)'s Heat Island Group found that if the buildings in Los Angeles were upgraded with reflective roofs, the city could save $35 million per year in energy costs.

Tax Incentives Available

The federal government is offering through its Tax Incentive Assistance Project a tax deduction of up to $1.80 per square foot to owners or tenants (or designers, in the case of government-owned buildings) of new or existing commercial buildings that are constructed or reconstructed to save at least 50% of the heating, cooling, ventilation, water heating, and interior lighting energy cost of a building that meets ASHRAE Standard 90.1-2001.

Only buildings covered by the scope of ASHRAE Standard 90.1-2001 are eligible. Partial deductions of $.60 per square foot can be taken for improvements to one of three building systems that reduce total heating,

cooling, ventilation, water heating, and interior lighting energy use by a certain percentage - the building envelope (10%), lighting (20%), or heating and cooling system (20%). These deductions are available for buildings or systems placed in service from January 1, 2006, through December 31, 2013.

Cool Roofs and Sustainable Programs and Codes

A key set of codes for cool roofs has been established by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers in its ASHRAE Standard 90.1-2001. Other codes and rating systems are offered by the following organizations:

Cool Roof Rating Council: The CRRC administers a rating program in which companies can label roof surface products with radiative property values. The CRRC does not set a minimum definition for "cool," the CRRC simply lists the measured radiative property values on its directory. However, a cool roof product that provides 70% reflectivity and 75% emissivity is effective. Any roofing product can be tested as long as it is in compliance with the Product Rating Program Manual (CRRC-1). All radiative property testing is conducted by accredited testing laboratories. Solar reflectance can be measured in accordance with ASTM test methods C1549, E1918, E903, and CRRC-1 Method #1: Test Method for Certain Variegated Products. Thermal emittance is measured in accordance with ASTM C1371. A product's placement on the directory does not mean that the product is "cool" as defined by any particular code body or program.

LEED: Leadership in Energy and Environmental Design is the U.S. Green Building Council's Green Building Rating System, a voluntary certification program for sustainable buildings. LEED has several different systems, including one for new construction and existing buildings. LEED for new construction and major renovations (LEED-NC) - Version 2.2 - gives

credit for a cool roof under "Sustainable Site Credit 7.2: Heat Island Effect: Roof." LEED-NC credits roofs with a Solar Reflectance Index value greater than or equal to 78 for low-slope roofs, and 29 for steep-slope roofs. LEED for Existing Buildings (LEED-EB) Version 2 gives credit for a cool roof under "Sustainable Site Credit 6.2: Heat Island Reduction: Roof." LEED-EB gives credit for a roof that is an Energy Star-compliant roofing material that has a minimum thermal emittance of 0.90. LEED-NC references the Cool Roof Rating Council (CRRC) as a source of product ratings, though it does not require the product to be CRRC-rated. It permits other sources as well, such as the US-EPA Energy Star Reflective Roof program.

Energy Star: Energy Star qualified roof products reflect more of the sun's rays. This can lower roof surface temperature, decreasing the amount of heat transferred into a building. Roof products qualify for the Energy Star label based on their solar reflectance, without compromising product quality and performance. Energy Star labeled roofs are more common on commercial buildings, but can also be used on residential homes. You'll get the most benefit if you live in hot sunny climates where you are using your air conditioning a lot. If your house is already shaded and the roof is not exposed to much sun, then a reflective roof may not provide a significant benefit. The benefits will also be lessened if the attic space is well insulated.

•••