White Paper

The Five E's of High-Performance Roofing

A truly sustainable roofing system is a protective, performance-enhancing umbrella that protects buildings from the elements, enables uninterrupted facility operations, and contributes to the health and productivity of the building occupants.

THE WORLD'S DURO-LAST® Roofing, Inc. BEST ROOF®

Introduction

In the commercial roofing industry, reflectivity and cool roofing has been the dominant discussion point for several years. Now, terms like sustainability, cool roofs, and cool roofing are receiving a great deal of attention. But what does sustainability and cool roofing really mean for building owners, facility managers, contractors, architects, and other specifiers? It means that the design, construction, maintenance, life-cycle impact, adaptive re-use, destruction, and recycling of roofing components must help meet the long-term environmental standards demanded by today's high-performance buildings.

What Is a Cool Roof?

A cool roof is both highly reflective and highly emissive, transferring less heat into the building compared to a dark colored "non-cool roof."

Cool roofs provide benefits in all climates throughout the United States:

- Cool roofs, with highly reflectivity and emittance, can be 70 degrees cooler or more during hot summer days when compared with traditional roofing materials.
- Cool roof systems save money and energy during peak cooling demand periods - typically mid-days, when electricity demand and costs are highest.
- A cool roof surface can reduce the cost of operating rooftop HVAC units because the units will use cooler air than if mounted on a dark roof surface.
- Cool roof systems help reduce the urban heat-island effect by reflecting solar heat rather than absorbing and transferring it to buildings.
- By keeping moisture out while reflecting ultraviolet (UV) and infrared (IR) radiation, a cool roof can help to protect underlying insulation and the roofing substrate from deterioration.

To be considered "sustainable," a roofing system must provide trouble-free service, competitive life-cycle costs, and environmental advantages. We've defined five interrelated attributes that are important in the selection of a high-performance roofing system. Let's call them the Five E's: Energy, Environment, Endurance, Economics, and Engineering.

1) **Energy –** With energy costs continuing to rise, it's more important than ever to select a roof that can reduce energy use and improve a building's efficiency in any climate.

2) **Environment –** High-performance roofing minimizes the impact on the Earth's environment throughout the roof's life, while also helping to maintain a healthy, productive environment inside the building.

3) **Endurance –** A high-performance roof meets or exceeds performance requirements for long life: all-weather reliability; chemical, fire, and puncture resistance; and ease of maintenance and repair.

4) **Economics –** A high-performance roof has to make economic sense, not just at the time of purchase, but also in the long run. A true economic comparison analyzes the cost of a roof throughout its life cycle.

5) **Engineering –** Utilizing the right materials, design, and manufacturing process is the key enabler of the other four E's, resulting in a complete, integrated roofing system that can be installed easily and performs reliably over the long run.

When you consider these Five E's, alone and together, high-performance roofing takes on a new meaning, and one very cool solution emerges. Following is a more in-depth description of those elements and more information on what characteristics make them essential to "sustainable" roofing.

1) ENERGY

Energy-Efficient Roof: Delivered by Reflective Roofing

A high-performance roof can be a powerful asset in reducing energy consumption by becoming an energy efficient roof… a cool roof. When used with appropriate insulation on low-sloped or flat roofs, a high-emissivity reflective roofing system can:

- Reduce building energy consumption by up to 40 percent
- Improve insulation performance to reduce winter heat loss and summer heat gain
- Preserve the efficiency of rooftop air conditioning
- Potentially reduce HVAC capacity requirements
- Decrease the effects of Urban Heat Islands and related urban air pollution.

Make your roof an Energy Efficient Roof by meeting or exceeding the "cool roof" standards established by these organizations:

- The EPA's ENERGY STAR® Roof Products Program has established a minimum standard that requires low-slope reflective roof products to have an initial reflectance of at least 65 percent, and a reflectance of at least 50 percent after three years of weathering. If there is any doubt about whether a roofing system is "cool roof" or energy efficient roof, check to see if it is listed in the ENERGY STAR Roof Products listings – www.energystar.gov.
- The Cool Roof Rating Council (CRRC) is a non-profit association that implements and promotes fair, accurate performance ratings for solar reflectance and emittance from roof surfaces. All tests for measuring reflective roofing properties are performed by accredited, independent laboratories following established ASTM International protocols. Performance data for products from numerous manufacturers can be found on the CRRC's web site, www.coolroofs.org.
- Title 24 of California's Energy Efficiency Standards for Residential and Nonresidential Buildings is a wide-ranging "green" construction bill that became effective in October, 2005. Title 24 specifies that new and replacement commercial roofs – virtually any low-slope roofing project that requires a construction permit – must have a minimum thermal emittance of 75 percent, and a minimum 3-year aged solar reflectance of 70 percent, or a minimum aged SRI of 64, as rated by the Cool Roof Rating Council. (See http://www.energy.ca.gov/title24/).

Other Energy Considerations:

- The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) established Standard 90.1 as a minimum requirement for energy-efficient building design.
- Lawrence Berkeley National Laboratory recently determined that increasing the R-value of a roofing system in Los Angeles from R-9 to R-15 would reduce annual energy costs by $2,500 and lower carbon dioxide emissions by thousands of pounds.
- In cooperation with state and local governments, many utility companies offer rebates for using reflective roofing systems. These rebate programs are offered nationwide, not just in southern climates. For instance, Excel Power, the fourth largest utility company in the United States, has awarded rebates as far north as Minnesota.
- Energy efficiency also reduces pollution by mitigating the urban heat island effect (see http://eandE.LBL.gov/heatisland).

2) ENVIRONMENT

Better for the Environment - Inside and Out

A popular definition for sustainable roofing was developed during a workshop held at the Oak Ridge National Laboratory (ORNL) in 1996: A roof system that is designed, constructed, maintained, rehabilitated and demolished with an emphasis throughout its life cycle on using natural resources efficiently and preserving the global environment.

A cool roofing system can minimize environmental impact in several ways:

- The U.S. Green Building Council's (www.usgbc.org) Leadership in Energy and Environmental Design (LEED) voluntary rating system is an increasingly popular means for helping building owners determine environmental performance of building components. A cool roofing system can help in obtaining credits toward LEED-NC and LEED-EB certification.
- Find a manufacturer whose process recycles production scrap, benefiting waste reduction.
- Use a roofing system that is lightweight, so less fuel is needed to transport it to the job site than other systems.
- Use a cool roofing system that can often be installed over an existing roof, to reduce waste, landfill space and disposal costs. Oak Ridge National Laboratories (ORNL - http://www.ornl.gov) recently estimated that 9-10 million tons of non-recyclable roofing waste is sent to U.S. landfills every year.
- A roofing recycling program can reduce disposal costs of existing PVC roof membrane tear-offs when a tear-off is required.
- Find a roofing system that, at the end of its life as a roof, can be recycled into other useful products such as specialty flooring and other products.

3) ENDURANCE

Endurance That Passes the Test of Time

In terms of high-performance roofing, *endurance* is the ultimate reflection of the performance of every roofing component in terms of reliability, water absorption, wind and fire resistance, maintenance, and repair. No matter how "cool" or "green" a roof is, it still has to protect the building – for years – in all types of weather – a reality that is sometimes neglected in sustainability discussions.

Billions of square feet of membrane roofing have been installed throughout the U.S. since the late 1970s – and many of these roofs are still in service. What qualities make a roofing system so durable?

- Resistance to water, fire, chemicals, grease, and punctures
- Ability to stand up to all types of weather – including high winds and extremes of hot and cold
- Virtually maintenance free, unlike other roof materials that may require regular patching and repairs
- Reinforced with materials such as high-density weft-insertion scrim for exceptional strength and durability
- Use a product and manufacturer that is confidently backed by the industry's best warranties with either a 15-year full warranty or a 20-year prorated warranty that is transferable and provides maximum protection. (Look for warranties that include coverage for consequential damages that result from defects in material and/or installation.)

Not only should a cool roof perform well over the years, but it should also help extend the useful life of other building components. By keeping moisture out while reflecting ultraviolet (UV) and infrared (IR) radiation, it can help to protect underlying insulation and the roofing substrate from deterioration.

To help promote Endurance for the long-term, building owners should ensure that a new roof:

- Is properly designed for the location, climate, roof deck and type of building
- Is installed professionally. Defective workmanship accounts for roughly 30 percent of roofing failures
- Has physical properties that will stand the test of time: solar reflectance and emittance, tensile strength, water absorption, fire resistance, wind uplift, elongation and thermal expansion, dynamic puncture resistance and resistance to rooftop contaminants such as acid rain and air pollution
- Is inspected and maintained regularly. This includes limiting the access and traffic on the roof.

4) ECONOMICS

Better Economics Over the Long Haul

While some types of roofing may have lower initial costs, the true costs of a roofing system are measured over its total life cycle. These include maintenance and repair costs, energy savings, and tear-off and disposal costs. Clearly, economics is a very important criterion for building owners, and high-performance roofing systems must be economical if they are to become viable, real-world options.

A cool roofing system should deliver excellent life-cycle economics. Key benefits must include:

- Reduced installation costs through custom factory prefabrication
- Low maintenance and repair costs
- Protection from interior damage costs through leak-proof performance
- Elimination of extended warranty costs
- Savings incurred through reduced energy consumption, and related rebates or incentives.

In 2004 – before the most recent energy price increases – a 20-year comparison was prepared with the help of independent Midwest roofing contractors. The objective was to compare the life-cycle costs of a high-performance roofing system – in this case, a prefabricated white PVC single-ply – with popular black EPDM and BUR systems for a fully-warranted, 50,000 square-foot re-roof in the Midwest. This hypothetical comparison clearly demonstrates the impact that an energy-efficient, high-performance roof can have over time.

20-Year Life Cycle Cost Considerations	**Roof A (Black EPDM/BUR)**	**Roof B (HPR White PVC Single Ply)**
Roof Size	50,000 Square Feet	50,000 Square Feet
Roof Product Cost	$70,000	$88,000
Installation (labor + overhead)	$60,000	$45,000
Tear-Off, Disposal Costs	$12,500	$0
Est. Maintenance Costs, 20 Years	$5,000	$1,500
Est. Repair Costs, 20 years	$7,750	$0
Est. Energy Savings, 20 years	$0	($84,000)
Est. Life Cycle Costs	**$155,250**	**$50,500**

5) ENGINEERING

Expert Engineering Enables Long-Lasting, Money-Saving Performance

Smart, coordinated engineering and design is not only the essential enabler for the other "E's" of high-performance roofing, it is the key to what the Department of Energy calls "whole-building design," which integrates all the subsystems and parts of the building to work more effectively together from "cradle to cradle."

Stringent measures help ensure that the highest level of quality control is implemented throughout the roof manufacturing process. From raw material selection to job site delivery, roofing manufacturer personnel need to inspect, evaluate, and qualify the materials and processes that are used to produce a cool roofing (or any roofing) system.

Ideally, a cool roof system would be engineered as a completely integrated system and prefabricated to the exact measurements of each building. That way, up to 85 percent of membrane seaming can be completed in a factory-controlled environment. Under these circumstances, roof stacks, flashings, and edge details can also be completed at the factory and shipped to the building site as part of the complete roofing system. The few remaining seams can then be hot-air welded on-site by an approved contractor and inspected by the manufacturer's or supplier's technical representative before a warranty would be issued.

By utilizing precision fabrication of a cool roofing system, installation would be much faster and less disruptive than for a typical "roll-goods" roof. The installation process would also be quiet, with no noxious fumes or flames, so building occupants can continue with their regular routines.

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For more information on high-performance roofing or to learn how **Duro-Last Roofing, Inc.** can help you with your roofing system, please call **1-800-248-0280**, email us at information@duro-last.com, or visit our website at www.duro-last.com.