COOL METAL
ROOFING FORUM

Advanced Technology for Energy Efficient Roof Systems – 2015 Edition

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Scott Kriner & Cool Reflections

Scott Kriner is a principle with RSK Avanti Partners, LLC and is President of Green Metal Consulting Inc. He consults for the Metal Construction Association as technical director and also consults for metal roofing manufacturers and suppliers in the metal construction industry. Prior to establishing his consulting firm, Kriner was technical-marketing manager, building products for Akzo-Nobel Coatings Inc. He started his career with Bethlehem Steel in the coated steel research and development department. Kriner was the founding chairman of the Cool Metal Roofing Coalition.

He has more than 33 years of experience in the domestic and international metal and coatings industry and has held numerous positions of responsibility including board of directors of NCCA and MCA, chairman of NCCA Residential Metal Roofing Committee, chairman of CRRC Technical Committee and chairman of the Zinc and Aluminum Coaters Association. He assisted in the development of language on cool metal roofing that was included in the Energy Policy Act of 2005. He also assisted in amending the EPA ENERGY STAR® Roof Products program to permit the use of weathering farms for collecting aged data. Kriner has B.S. and Masters degrees in Metallurgy and Materials Engineering from Lehigh University in Bethlehem, PA. He holds a patent of improvement on 55% Al-Zn alloy coated steel.

I am glad to have the opportunity to contribute to the new and improved Cool Metal Roofing Forum. I was involved in the original Forum project eight years ago. Much has changed since then, and now we have the ability to update and modify many issues that were first brought to life in the original Forum. This issue will present information on cool metal roofing that is pertinent to the metal construction industry. The Forum will cover a wide range of topics related to green building design, sustainability, regulations and the impact that these subjects have on cool metal roofing. If you are a building owner, a contractor, a supplier, an architect or a designer, you will learn about the features and benefits of cool metal roofing and where it should be considered for building construction projects.

This updated and modified Forum, as the name implies, should serve as a tool for maintaining dialogue with the metal construction industry. Dialogue is necessary to sort through the complicated world of cool roofing. Cool roofing is but one method to lower the energy usage of buildings. Given the discussion about energy at the national level, any method to lower energy use within the building construction market will rise in importance.

Since the first Forum was published, new technology and techniques have been developed to expand the use of cool roofing in more climate zones. Many of the volunteer programs that included cool roofing have changed, and the number and type of codes that include cool roofing provisions has grown. Another change since the first Forum was published is the growth of sustainable building design, construction, and operation. Of course energy management is one part of a sustainable design, and therefore cool roofing is once again being considered in more energy efficient buildings. The mitigation of urban heat islands is also another benefit with cool roofing. Almost a dozen new standards related to sustainable building design have been introduced just since 2007. Energy codes are getting more stringent which is raising the bar for the required performance of building materials and systems. And if regulations and voluntary programs are not confusing enough, we also have federal, state and local governments raising the bar on energy standards for public building construction. I hope you find the new and improved Forum to be helpful and informative. CMRF

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Robert Scichili & Cool Reflections

Robert Scichili is president of Robert Scichili Associates Inc., a consulting firm prominently involved in the education, marketing and training on coatings and cool roofing issues to coatings manufacturers and building product companies. He has over 40 years of experience in the coatings and metals industries.

Among Scichili's many career accomplishments have been pioneering the use of Kynar 500® coatings in the U.S. and pioneering heat-reflective pigmented coatings in long-life finishes for cool roofing. He was also responsible for the inclusion of tax credits for metal roofing and heat-reflective coated metal in the 2005 Energy Act. Memberships include the Metal Construction Association, Cool Roof Rating Council, Cool Metal Roofing Coalition and California Pier PAC Committee.

With the price of oil expected to rise and the recent institution of a national U.S. energy policy, energy-efficient design and construction is a must. This forum initiative is designed to tell the best story on factual energy savings

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to those on the front lines, to those who have to meet cool roofing codes and regulations. The information presented in this Forum is a fresh and different look at how the subject matter affects you and your market share.

The national energy laboratories-Oak Ridge National Laboratory (ORNL) and Lawrence Berkeley National Laboratory (LBNL)-have tested all types of roofing systems now for several years. Cool metal is the one system that has proven best for sustainability in durability, lower life-cycle cost and energy saving capabilities.

Reflective pigmented coatings on metal are an achievement of many companies, to marry the sustainability of metal with the sustainability of long-life coatings, in order to attain significant energy savings.

These coatings have been documented to maintain their reflectivity and emissivity throughout the life of the coating-30 years or more. This advanced technology clearly validates the energy savings cool metal delivers, and is sustainable to the owner of the building or home.

While metals with solar reflective pigmented coating have the broadest offering for energy savings, the steel granular-coated roof systems have achieved ENERGY STAR® program status in some cases as well. Unpainted metal roofing has also proven to be energy efficient in certain climates.

The facts covered in this first issue of the Cool Metal Roofing Forum are a compilation of work done by dedicated professionals. They add up to the best story on energy savings and energy code compliance available.

No other cool roofing medium can deliver these wonderfull advantages of energy savings, while preserving the vital color space that specifiers want and need. We are confident of the value this technology brings and the sustainable benefits gained through an investment in cool metal roofing.

It is time for the metals community to educate our own people, the specifiers and regulatory community on the best energy story, and that is cool metal roofing and its benefits. **CMRF**

Photo courtesy of: Green American Home

Glossary Of Cool Metal Roofing Terms

Stay up to speed with the terminology you will hear and read with regard to cool metal roofing and green building practice.

Solar Reflectance

The fraction of the total solar energy that is reflected away from a surface. It is expressed as a percentage from 0 to 100% or as a decimal from 0 to 1.00. A material with a low solar reflectance value absorbs much of the solar energy rather than reflecting it.

This term is sometimes referred to as "solar reflectivity".

Thermal Emittance

The ability of a material to radiate the heat energy that builds up in the material from absorbed or non-reflected solar energy. The emitted energy is in the far infrared part of the spectrum. The amount of re-emitted energy is in direct proportion to a roof surface's thermal emittance value. It is expressed as a percentage from 0 to 100% or as a decimal from 0 to 1.00. A material with a very high thermal emittance would re-emit much of its thermal energy to the night sky and help to reduce the surface temperature of the roof. This term is sometimes referred to as "thermal emissivity".

Conduction

The passing of heat through a roof material into the layer in contact directly beneath the roof surface.

Convection

The heating of air that passes over a warm roof surface.

Cooling/Heating Energy Cost

The total estimated annual cost for purchased cooling and heating energy for a building. This includes any demand charges, fuel adjustment factors and delivery charges applicable to the building.

Solar Spectrum

The range of wavelengths radiation originating from the sun, including ultraviolet, visible and infrared radiation.

Urban Heat Island

A built-environment where the large proportion of dark, absorbing surfaces such as asphalt paving and dark roofs, trap solar energy and radiate the heat energy back into the atmosphere. Such areas typically have less vegetation than the surroundings. Urban heat islands can have an air temperature that is 6-12 ° F higher than the rural areas.

Ventilation

The process of supplying or removing air by natural or mechanical means to or from any space.

Above Sheathing Ventilation

A phenomenon seen on roof products installed with an air space between the underside of a roof and the topside of the deck sheathing where solar irradiance absorbed by the roof heats the air within the space and induces a natural convection airflow. This natural ventilation can dissipate heat in summer and reduce heat transfer in winter to optimize energy efficiency of roof systems installed with a gap between the roof product and the deck.

Heat Gain

The quantity of heat that needs to be removed to maintain indoor comfort, on a specific warm day for any region. A building gains heat from the actual outdoor temperature and humidity levels. It gains heat from the people occupying the building, and from lights, computers, copiers and other appliances. Much of the heat gain is from the exposure to solar radiation. Solar energy striking the roof and wall surfaces of a structure contribute greatly to the warming of the interior.

Peak Energy Demand

The cooling energy requirement that occurs during the hottest period of summer afternoons when air conditioning demand is at its highest. The utility industry's planned power generation capacity is based on meeting this level of demand, rather than meeting average energy usage over time. Cool metal roofing helps to reduce the peak energy demand during summer months.

Greenhouse Gases

Gases in the atmosphere that absorb infrared radiation. They include water, carbon dioxide, methane and nitrous oxide. A portion of the re-emitted infrared radiation is reflected back to earth which warms the planet.

Tax Credit

A reduction in taxes resulting from subtracting an amount directly from the total tax liability.

A tax credit can be three or more times more advantageous to a taxpayer than a tax deduction.

For example, a tax credit of $1,000 for someone in the 28% tax bracket is equivalent to a tax deduction of $3,571.

Tax Deduction

A reduction in taxes resulting from subtracting an amount from income before the total tax liability is computed.

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What is Cool Roofing?

The solar reflectance of metal roofing is a function of the surface of the product. Metal roofing can be offered with prepainted surfaces, natural or mill finishes, and even granular-coated surfaces. A mill finish such as unpainted Galvalume® sheet has a solar reflectance of 0.68-0.78 depending on the surface treatment used. Other natural metals such as zinc, copper and aluminum have somewhat lower solar reflectance values. When a paint system is applied to metal roofing, the solar reflectance depends on the color and type of pigments in the paint film. Reflectance values can range from 0.10 up to greater than 0.75. Granular-coated metal roofing can have solar reflectance values of 0.05 to 0.30 depending on pigment and glazing used on granules.

Solar Reflectance

• Metal (unpainted)	**0.50 – 0.80**
• Metal (painted)	**0.10 – 0.75**+
• Comp Asphalt Shingles	**0.05 – 0.28**
• Black EPDM	**0.05 – 0.10**
• Single Ply Membrane	**0.70 – 0.80**
• Smooth Modified Bitumen	**0.05 – 0.25**
• White Granular Bitumen	**0.20 – 0.30**
• Concrete/Clay Tile	**0.20 – 0.75**+

+ **Depends on color and pigment**
Source: ORNL AND LBNL database.

In comparison to these values, asphalt shingle has a relatively low solar reflectance of 0.05-0.28 even with cool granules. Single-ply membranes in light colors have high initial solar reflectance values but some are prone to dirt pick-up which can reduce the aged reflectance values. Darker roofing products such as BUR have low solar reflectance values due to their color. The following table, which is a compilation of data from ORNL and LBNL summarizes the differences.

More information can be found at the Cool Metal Roofing Coalition's website at **www.coolmetalroofing.org.** CMRF

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Photo courtesy of: Green American Home

The Utility Industry's Interest in Cool Roofing

Soaring peak demand for electricity during summer "heat storms" creates problems for utilities, grid operators and, consequently, for utility customers. Air conditioning load is a major cause of these demand spikes. A cool roof movement continues to emerge nationally as a cost-efficient, practical and effective peak mitigation strategy.

Under "heat storm" conditions, several general trends emerge -all of which are detrimental to utilities and the customers and communities they serve:

- Utilities are forced to run their least efficient plants—which are often the least environmentally friendly—to meet peak loads.
- Prices soar for spot-market electricity (electricity generated by merchant providers).
- Physical infrastructure is stressed, occasionally to the breaking point.

Air conditioning-driven peaks can actually create more problems in northern tier states than in the South; not counting the desert Southwest. Absolute peak temperatures in northern states are as high, if not higher than in southern states. For example, the highest "official" temperatures in both Chicago (104° F) and Minneapolis {105°F) exceed the highest official reading ever recorded in Miami {100°F). Of course, utility customers in warmer climates use more energy for cooling overall than those in cooler climates: the peak temperature issue simply illustrates that an efficient building shell and cooling system is important everywhere.

Utility- and state-sponsored programs that help customers reduce usage appear to be on the upswing in the U.S. Increasingly, these programs are focused on reducing air conditioning loads. Cool roofing is becoming part of the solution set, together with more efficient windows, more insulation, high-efficiency air conditioning units and tight ducts. In a relative sense, it's becoming clear that cool roofs are among the least costly, least disruptive and easiest to install among the available options.

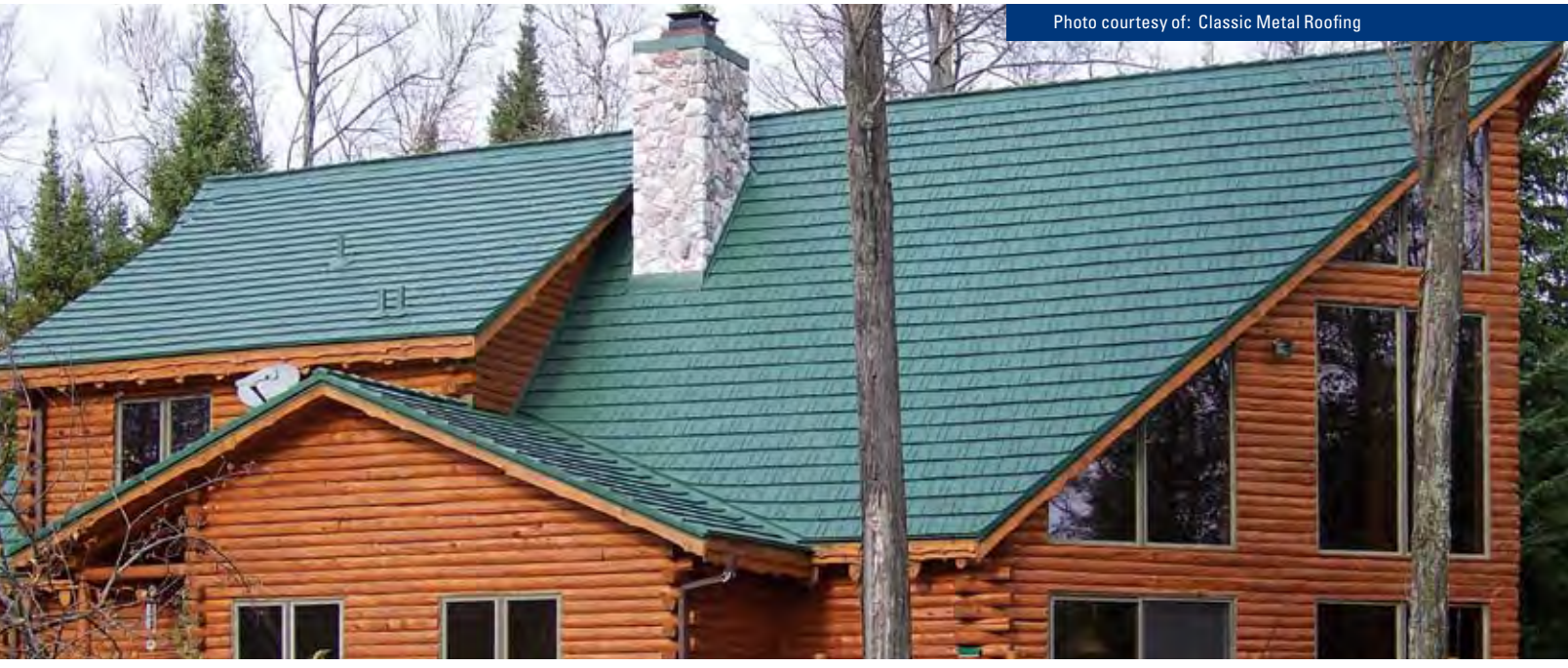
Programs such as ENERGY STAR®, which promote high-performing products including cool roof products, have an important role to play helping consumers choose high-performing products. Organizations such as the Cool Roof Rating Council {CRRC) have established a rigorous rating system suitable for building code applications: the CRRC system reports solar reflectance and thermal emittance data on hundreds of CRRC-rated products.

In California, comprehensive energy efficiency programs administered by utilities are integral to state policy on energy planning. In lay terms, it's a policy that says, "the cheapest, most reliable source of new energy is saved energy."

Efficiency-oriented building codes, strongly supported by California utilities, are key policy components, too. California's 2005 Title 24 building code update includes provisions which encourage cool roofs for low-slope non-residential buildings. Future code updates are likely to see provisions encouraging cool roofs for other building types.

Moving forward, cool roofing shows great promise to become an increasingly important option for helping customers and utilities manage air conditioning costs and loads.

The views expressed in this article are those of the author, Peter W. Turnbull, Senior Program Manager, Pacific Gas and Electric Co. and not necessarily those of Pacific Gas and Electric Co. CMRF



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The Energy Star Program

The Environmental Protection Agency (EPA) ENERGY STAR® program is familiar to many homeowners who see the popular label on appliances and electronic equipment. The EPA has also created an ENERGY STAR program for Roof products that feature cool roofing materials. The current ENERGY STAR Roof Products Program, version 2.3, went into effect on July 1, 2012. A roof that meets ENERGY STAR performance requirements is considered one that is cool and helps to reduce urban heat island effects, pollution and greenhouse gas emissions.

Roof products labeled with the ENERGY STAR logo are referenced in some utility rebates and incentives. The ENERGY STAR program itself is referenced throughout federal legislation as the benchmark labeling program for energy efficient products.

How To Get A Product Labeled

To have a cool metal roof product labeled and listed on the ENERGY STAR Roof Products directory, a manufacturer must first become an ENERGY STAR Roof Products Partner by completing a partnership agreement. By signing that agreement, a partner agrees to the rules and regulations of the ENERGY STAR program, including the licensed use of the label and logo. A partner can then complete a Qualified Product Information form for roof products which contains the manufacturer's information, roof product information, and the testing information for initial and aged solar reflectance and initial thermal emittance. In the current version 2.3, the partner must use a Certification body recognized by EPA. In addition, the Partner must use an approved laboratory to perform roof product testing. A list of EPA-recognized laboratories and Certification bodies can be found at **www.energystar.gov/testingandverification**.

In the past versions there were no costs involved to participate in the ENERGY STAR program and much of the data were self certified. In the current version 2.3, the certification bodies and the laboratories may charge Partners for their required third-party services. The necessary forms for getting an ENERGY STAR label are available on the ENERGY STAR website at **www.energystar.gov**.

ENERGY STAR Buildings

The EPA expanded the ENERGY STAR program in 1995 to allow building owners to improve energy performance of their buildings. More than 3,000 office buildings,

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schools, hotels, hospitals and other buildings have earned the ENERGY STAR label for their energy performance. EPA estimates that these types of buildings use 40% less energy than a typical building of their type. There are also environmental benefits of ENERGY STAR buildings related to their reduced energy usage. According to the EPA, the lower energy use accounts for a reduction of 1.8 billion lbs. of greenhouse gas emissions, which is equivalent to the emissions from 540,000 vehicles.

Once a building has been constructed and is occupied, the owner can measure and track the building's energy use with "Portfolio Manager", which is another online tool offered in the ENERGY STAR program. Again, the building earns the ENERGY STAR label if it scores in the top 25% of buildings in the nation after one year of occupancy. More information can be found at **www.energystar.gov**.

ENERGY STAR Homes

The EPA also promotes its ENERGY STAR Homes program. That program is based on a minimum level of energy efficiency as determined by a Home Energy Rating Service score (HERS Index) that must achieve the same HERS Index of the ENERGY STAR Reference Design Home in that region. This is according to ENERGY STAR Homes version 3. According to the EPA, more than 1.5 million homes have achieved ENERGY STAR certification since the EPA began labeling homes in 1995. Over 91,000 ENERGY STAR homes were built in 2013 alone.

Buildings earn the ENERGY STAR label by scoring in the top 25% according to EPA's energy performance rating system. Scores are based on actual energy use.

Current version 2.3

The current ENERGY STAR Roof Products version 2.3 also differs from previous programs in that the initial emittance measurements must be made and reported, but there is no minimum requirement. Emittance shall be measured using ASTM C1371-04a -"Standard Test Method for Determination of Emittance of Materials Near Room Temperature using Portable Emissometer." Another change is that Color Families can be used instead of individual panels.

The Color Family concept was developed by the Cool Roof Rating Council (CRRC). ENERGY STAR accepts the solar reflectance and emittance values using the color family technique. In essence the Color Family uses a CRRC pre-defined range of Hunter "L", "a", and "b" color values that establishes the color space for a defined set of colors. A product within a given color family that has initial and aged solar reflectance values can represent the entire family of products that fall within the L,a,b range that defines that particular color space. With this program, qualifying products do not need measured aged solar reflectance values. Instead, the initial value is measured and the product takes on the aged solar reflectance value of the representative color family element. This reduces the cost to a partner that has large numbers of colored products.

Upcoming Version 3.0

Starting on July 1, 2017 the ENERGY STAR Roof Products program will change again. The minimum solar reflectance values will remain the same, the reporting of the initial thermal emittance will be required, and the use of Color Families will be accepted. However, a significant change will be that aged solar reflectance will no longer rely on panels exposed at just one location, as in previous versions. Instead, products will be tested in three climate zones and the average across those locations will be used for

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the labeled solar reflectance value. Those climate zones will be Hot/Humid, Hot/Dry and Cold/Temperate. The exact locations are described in the Version 3.0 Product Specification. Effective immediately, partners can elect to have their certification body certify their eligible products to the Version 3.0 requirements.

Beginning January 1, 2017, certification bodies will be asked to stop certifying new product submittals to existing ENERGY STAR version 2.3 specification requirements. Then, as of July 1, 2017 any product manufactured and labeled as ENERGY STAR must meet the version 3.0 requirements.

All products still need to be third party certified to remain ENERGY STAR qualified. Any product that is on the qualified product list that has not been third party certified will not be recognized. Those products will have to be re-tested according to the version 3.0 requirements. There is one exception however. If a product has been weathered in three locations according to the requirements of version 3.0, but not third-party certified, that product may remain on the qualified product list provided the original testing data are submitted an EPA-recognized Certification Body.

EPA remains interested in the development of an accelerated aging test, that is currently moving through the ASTM process. They will also continue to study the impact of thermal emittance of roof products before it would become part of the ENERGY STAR Roof Product program.

Mortgage Money Available

An ENERGY STAR home is 15%-30% more energy efficient than a home built to meet the IECC code. ENERGY STAR homes qualify for Energy Efficient mortgages. An Energy Efficient Mortgage (EEM) is a mortgage that credits a home's energy efficiency in the mortgage itself. EEMs give borrowers the opportunity to finance cost-effective, energy-saving measures as part of a single mortgage. They also allow borrowers to qualify for a larger loan amount and a better, more energy-efficient home.

A borrower normally has to have a home energy rating or audit conducted at the home before financing would be approved. The term "EEM" is commonly used to refer to all types of energy mortgages including Energy Improvement Mortgages (EIMs), which are used to purchase existing homes that will have energy efficiency improvements made to them. EIMs allow borrowers to include the cost of energy-efficiency improvements to an existing home in the mortgage without increasing the down payment. EEMs and EIMs are sponsored by federally insured mortgage programs (FHA and VA) and the conventional secondary mortgage market.

Energy Efficient Mortgages

A study published in the Appraisal Journal stated that the market value of a home increases $20 for every $1 decrease in the annual energy costs.

Energy Efficient Mortgages benefit a homeowner in three ways.

1. The estimated energy savings are added to the borrower's income in the financing process, which allows the home buyer to qualify for a larger mortgage amount.
2. The costs of energy improvements can be included in the total mortgage amount. All of the energy improvements can qualify and normally up to 15% of the value of the home can be financed over the life of the mortgage, which makes more money available to the home buyer for move-in costs.
3. The value of the home is adjusted by the value of the energy improvements.

For an Energy Efficient Mortgage lender to provide financing, the energy savings must be greater than the cost of the improvements over their useful life. Again, since metal roofing's useful life is much longer than most residential roof products, the energy cost savings are beneficial for metal roofing.

More information on Energy Efficient Mortgages can be found at **www.energystar.gov/index.cfm?c=mortgages.energy_efficient_mortgages.** CMRF

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Photo courtesy of: Classic Metal Roofing

Photo courtesy of: Kassel & Irons

The Residential Energy Services Network

In April 1995, the National Association of State Energy Officials and Energy Rated Homes of America founded the Residential Energy Services Network (RESNET) to develop a national market for home energy rating systems and energy efficient mortgages. RESNET's mission is to help homeowners and contractors determine the energy efficiency of buildings, set the standards for verification of building performance and increase the opportunity for ownership of high-performance buildings.

RESNET is a non-profit 501.3.c organization that provides a service to the National Mortgage Association and to the National Association of State Energy Officials.

The group's main product is the Home Energy Rating Service (HERS).

This system includes three components:

- Whole home energy assessment
- Certified home raters
- Accredited software

Over 1 million American homes have received a HERS score. 2,500 certified HERS raters, from all states in the nation, are listed in the RESNET directory. RESNET oversees the HERS raters and the accreditation program.

To find certified raters in your state, select the state from the directory on the RESNET website. Certified Raters who are RESNET members in your state, and the Rating Provider Organizations in your state will appear on the list. You can then contact the raters.

RESNET issues a Rater Seal of Quality to its rater members who subscribe to its standards. These raters have committed to RESNET that they will meet the highest standards of ethics and quality. Raters are required to have Professional Liability insurance and sign an IRS declaration to RESNET in order to certify homes for the federal tax credit for energy efficient homes. The IRS has determined that the rater is responsible for signing the required declaration to the IRS on the home's qualification for a tax credit. In addition, the rater or rater's company must have professional liability insurance coverage. The rater will have to provide a signed statement to RESNET declaring this coverage. To view the new requirement visit **www.resnet.us/taxcredits/requirements.pdf**.

A home energy rating is a standard measurement of the home's energy efficiency. The rating allows a home buyer to compare the energy costs associated with the homes being considered. Home energy ratings involve an on-site inspection by a home energy rater. These professionals are trained and certified by the RESNET accredited home energy rating system. The rater inspects the home or building and measures its energy characteristics, insulation level, window efficiency, wall-to-windows ratio, heating and cooling system, type of roof and solar orientation of the building. Using RESNET accredited software programs*, the home or building receives a point score between 1 and 100 depending on its relative efficiency. An estimate of the total energy costs is also provided. The owner of the home or building can also use the rating software to determine how best to upgrade the energy efficiency with the most cost-effective improvements. The rating is also required to qualify the home for an energy efficient mortgage and to allow the home or building to be labeled ENERGY STAR.

The RESNET home energy rating standards have been adopted by the National Association Of State Energy Officials. They certify the raters, accredit the institutions that train the raters and also certify the estimating software. The fee to have a home rated in the program varies from state to state, but is generally $450. The total cost also varies depending on the number of homes.

The Home Energy Rating system is based on a reference house. This serves as the theoretical benchmark for comparison against new homes or renovations. It is modeled after the reference home defined in the 2004 IECC supplement (**www.iccsafe.org**). In simple terms, if a cool metal roof is used and it is rated as being more energy efficient than the reference roof, a credit is earned. CMRF

Photo courtesy of: Classic Metal Roofing Systems

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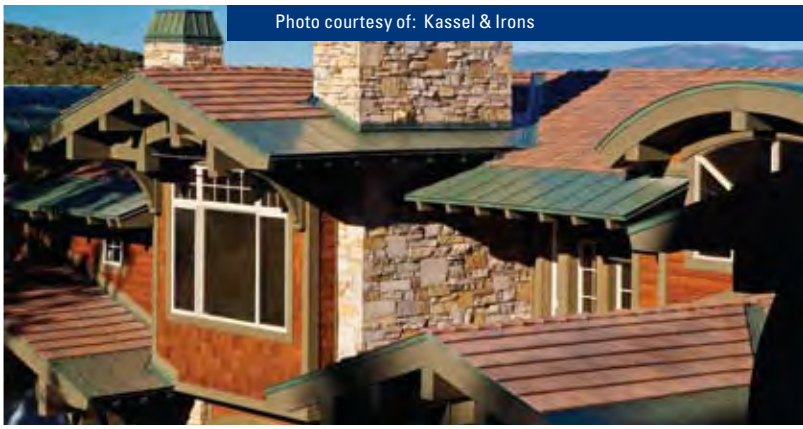

*RESNET has accredited several energy rating software programs to-date including Builder Energy Solutions Calculator, Energy Pro v4, Energy Gauge USA version 2.5 and 2.6, MicroPas 7 v7.1 and v7.3, and REM/Rate. A key service that RESNET provides to its rater members is to give them new business development opportunities. Currently the primary source of economic demand for rating services is verification of homes for the Environmental Protection Agency's (EPA) ENERGY STAR Homes Program.

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Cool Roof Legislation – Past And Present

On August 8, 2005 President George W. Bush signed into law the Energy Policy Act of 2005 (EPAct05).

That legislation had an impact on the use of cool metal roofing because of tax incentives in the law pertaining to energy efficient building improvements.

The bill provided up to $2000 in tax credits to contractors involved in new home construction. For renovations to homes, a $500 tax credit was available to homeowners if they used a cool metal roof as a "qualified energy efficient improvement" to the home. The law defined qualified energy efficient improvements as "any energy efficient building envelope component which meets the prescriptive criteria for such components established by the 2000 International Energy Conservation Code (or in the case of a metal roof with appropriate pigmented coatings which meet the ENERGY STAR® certification program requirement.)

The definition of a "building envelope component" included this excerpt from the law: "any metal roof installed on a dwelling unit, but only if such roof has appropriate pigmented coatings which are specifically and primarily designed to reduce the heat gain of such dwelling unit."

In the commercial and residential markets, tax deduction incentives up to $1.80/sf were available for buildings that achieved a 50% reduction in annual energy costs to the user, compared to a base building defined by ASHRAE 90.1 – 2001 standard... Building envelope components were eligible for one-third of the incentive if it met its share of the whole-building savings.

The incentives of the EPAct05 legislation pertained to property placed in service after December 31, 2005 and up to December 31, 2007. However, the Energy Improvement and Extension Act of 2008 (H.R. 1424: Div. B, Sec. 302) of 2008 reinstated the credits for 2009 purchases and made other minor adjustments.

The American Recovery and Reinvestment Act of 2009 further extended the credits to include improvements made in 2010 and replaced the $500 aggregate cap with a $1,500 aggregate cap for improvements made in 2009 and 2010. That credit was again renewed in 2010 for improvements made in 2011, but the credit was reduced to its original form and original cap of $500.

With no legislation to extend the incentives, this credit was unavailable for purchases made in 2012. More recently, the American Taxpayer Relief Act of 2012 retroactively renewed this tax credit but it was only effective January 1, 2012 through December 31, 2013.

Cool metal roofing that is painted with special cool pigmented coatings that meet ENERGY STAR certification requirements have been subject to these incentives since the Energy Policy Act of 2005 original language in the legislation. As of the printing of this Forum, a federal tax credit is available to a homeowner for 10% of the cost up to $500, for energy improvements made to an existing home, including cool metal roofing, provided the purchase and installation took place prior to December 31, 2013. IRS Form 5695 is used to claim the credit.

Surprisingly, in December 2014 Congress passed an omnibus budget agreement that extended the 10% tax credit to homeowners who made energy efficient improvements through December 31,2014, which included cool metal roofing installations.

However, there have been some new opportunities introduced in the US Congress for energy efficiency incentives. The Energy Savings and Industrial Competitiveness Act (S.1392) was introduced by Sens. Jeanne Shaheen (D-NH) and Rob Portman (R-OH). The Shaheen – Portman bill is designed to spur the use of energy efficiency technologies in the residential, commercial, and industrial sectors of our economy. This energy bill has bipartisan support, but is currently bogged down in Congress. Cool metal roofing would be one of many strategies that could see incentives for its ability to lower energy usage in a building.

Another bill recently introduced to Congress is the Energy Efficient Cool Roof Act (S.2388). The supporters of the bill are Sen. Ben Cardin (D-MD), Sen. Mike Crapo (R-ID) and Dean Heller (R. NV). The bill is also supported by the National Roofing Contractors Association. The bill would shorten the depreciation schedule from 39 years to 20 years for the installation of certain "cool roofs" that meet insulation and other energy efficiency standards on existing buildings. The bill specifies cool roof surfaces with specific solar reflectance and thermal emittance values, which cool metal roofing can achieve. CMRF

Photo courtesy of: PPG Industries Inc.

Photo courtesy of: PPG Industries Inc.

Photo courtesy of: PPG Industries Inc.

Above Sheathing Ventilation For Metal Roofs

Providing an air space above the sheathing of a roof deck offers thermal benefits for stone-coated or standing seam metal roofs that yield energy savings in the summer and winter while also helping to remove unwanted moisture.

By William (Bill) Miller, Ph.D, Andre DeSjarlais Oak Ridge National Laboratory

Stone-coated shake roofs are often offset mounted from the roof deck using a batten and counter-batten system. Here counter-battens (1" x 4") are nailed to the roof deck from soffit to ridge, and battens (2" x 2") are placed above the counter-battens and nailed to the deck (Fig. 1). The batten and counter-batten construction provides a unique inclined air channel running from soffit to ridge. The bottom surface of the channel is formed by the sheathing. The top surface is created by the underside of the stone-coated metal and is broken at regular intervals by the 2" x 2" batten wood furring strip (into which the shakes are fastened). The batten and counter-batten and similar systems provide an air space wherein the solar irradiance absorbed by the metal roof heats the air within the space and induces a natural convection airflow, which we define as above- sheathing ventilation.

To examine the effects of above-sheathing ventilation, a steep-slope roof assembly was constructed for field testing and documenting the energy savings of several stone-coated and standing seam metal roofs (Miller 2006). A commercially available asphalt shingle with a solar reflectance of 0.093 and a thermal emittance of 0.89 (SR093E89) was selected as the control for comparing the thermal performance of the metal roof systems. A conventional shake, a dark-gray stone-coated metal (SR08E90), was also field tested. This shake has a solar reflectance and a thermal emittance very similar to that of the control asphalt shingle. The asphalt shingle, however, was directly nailed to the roof deck, with no air space along its underside, while the dark-gray shake was attached to the batten and counter-batten arrangement. Both assemblies were equipped with attic ventilation through soffit and ridge vents. Thus, a comparison of the two test roofs can provide insight into the effects of above-sheathing ventilation. The light-gray stone-coated shake (SR26E90) had the same batten and counter-batten construction as the dark-gray shake. However, the light gray shake has a solar reflectance of 0.26 and thermal emittance of 0.90; its unpainted underside has a thermal emittance of 0.35. A comparison of the two stone- coated roofs reveals the benefits of high solar reflectance in combination with above-sheathing ventilation.

Summer Field Exposure

A clear, cloudless summer day was selected to display the separate and combined effects of high solar reflectance and above-sheathing ventilation as compared to the asphalt shingle roof. Venting the underside of the dark-gray stone-coated metal shake caused significant reductions in the heat flow crossing the deck during solar noon, as seen in (Fig. 2). The dark-gray stone-coated metal shake and the asphalt shingle have almost identical reflectance and emittance characteristics, yet the heat flow crossing the roof deck of the dark-gray shake is just 70% of the heat flow crossing the roof deck of the asphalt control shingle. The 30% reduction in heat flow is due to above-sheathing ventilation. Note that the air space was closed at the soffit to eliminate wind effects.

The light-gray shake (SR26E90) and the dark-gray shake (SR08E90) have identical batten and counter-batten constructions and low underside emittance values (E=0:35). Both have soffit and ridge vents supporting attic ventilation. The 0.17 increase in the solar reflectance caused the heat flow crossing the roof deck of the light-gray shake to be less than the heat flow crossing the roof deck of the dark-

Fig 1: Batten and Counter-batten system used to mount stone-coated metal roofs

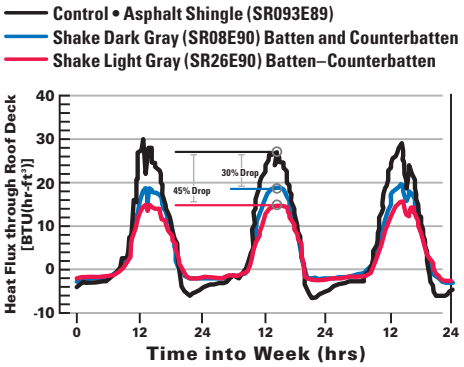


Fig 2: The effect of solar reflectance and above -sheathing ventilation for dark gray (SR08E90 indicates a solar reflectance of 0.08 and an emissivity of 0.90) and light gray (SR26E90) stone-coated metal shake roofs as compared to a direct nailed shingle roof 9solar reflectance 0.093).

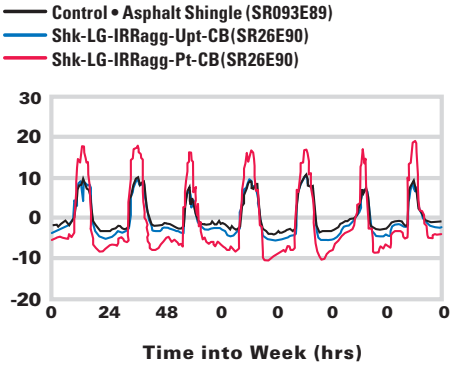


Fig 3: Heatflow measured through the roof deck for stone-coated metal shake and asphalt shingle roof during a week in January 2005. The one light-gray stone-coated metal roof [Shk-LG-IRRagg-Pt-CB (SR26E90)] has a painted underside to show the effect of thermal emittance within the air gap.

gray stone-coated shake. The reduction is about 15% of the heat crossing the deck of the control shingle roof (Fig. 2). The 30% reduction due to above-sheathing ventilation of the dark stone-coated shake can be added to the 15% reduction due to increased solar reflectance to yield a total 45% reductionin heat flow due to both above-sheathing ventilation and increased solar reflectance. The combined results (Fig. 2) shows that ventilating the deck is just as important as is increasing solar reflectance and may be the stronger player in reducing heat gain into the attic. It should also be noted that the heat flow due to above-sheathing ventilation of the hotter dark-gray shake is more than double the amount of heat flow swept away from the deck of the light-gray shake. The hotter dark-gray shake causes greater buoyancy-induced airflows, and therefore above-sheathing ventilation is somewhat self-regulating and offsets the effect of the darker, less reflective color.

Winter Field Exposure

Cool roofs have received much positive trade press where comfort cooling is the dominant building energy load. In mixed climates with both significant heating and cooling loads, the wintertime effect reduces the energy benefit because the desirable roof heat gain in winter is diminished somewhat by the higher solar reflectance of the roof. The Achilles heel of all cool roof systems continues to be the heating penalty that offsets the energy and cost savings associated with the cooling benefit of the reflective roof system. The colder the climate the greater the penalty, and the trade-off between climate and reflective roofs limits their penetration into predominantly heating load climates. However, field data for the stone-coated metal roofs tested in east Tennessee's moderate climate are showing that the metal's above- sheathing ventilation negates the heating penalty associated with cool roofs having high solar reflectance.

Data for a January week with clear skies, shown in (Fig. 3), illustrate the wintertime thermal performance of stone-coated metal roofs compared with that of a dark, heat-absorbing asphalt shingle roof. The ridge vents for these test sections were open, and both attic and above-sheathing ventilation were observed for thls week of January, which had an average daytime ambient air temperature of 36°F. At solar noon for each of the seven days, the attic assembly with asphalt shingles (SR093E89) absorbed moresolar radiation than either of the two more reflective stone-coated metal roofs (18 vs. 10 Btu/hr-ft"; see Fig. 3). However, the nighttime losses for the direct-nailed asphalt shingle roof were significantly larger than losses for the attics with above- sheathing ventilation of the shake roofs (the abscissa in (Fig. 3) shows midnight as multiples of 24). The heat loss from the shingle roof at night was roughly twice that escaping from the two light-gray roofs or from the dark-gray shake roof, all with batten and counter-batten construction. The underside of a second light-gray stone-coated metal was painted to show the effect of thermal emittance, which increased from 0.34 (unpainted) to 0.85 (when painted). The higher underside emittance resulted in larger nighttime heat losses from the roof deck.

Therefore, the air gap appears to be serving as an insulating layer that reduces radiative and convective heat transfer from the roof deck to the metal roofs underside, as compared with the direct conduction path through relatively highly conductive solids in the case of the asphalt shingle roof. From about 8:00 p.m. through about 6:00 a.m. all the stone-coated metal roofs lose less heat to the night sky than does the asphalt shingle roof. The temperature of the stone-coated metal is colder at night than that of the shingle, yet the deck temperature for the stone-coated metal roof (with above-sheathing ventilation) is warmer than the deck temperature for the direct-nailed shingle roof.

Results integrated over the week of January data shown in (Fig. 3) indicate that the above-sheathing ventilation of the stone-coated metal roofs counterbalances the heating penalty associated with cool roofing for the moderate climate of Tennessee (Table 1). The asphalt shingle roof gains through its deck about 476 Btu/ft^2 of attic floor during the daylight hours for the week of January data. The light-gray stone-coated metal roofs gain only half as much heat because of their higher solar reflectance (0.25 vs. 0.09). During the evening hours, however, the heat lost through radiative cooling of the roof decks for the stone- coated metal roofs is 50% less than that lost from the asphalt shingle roof. In fact, during the evening hours the insulation air layer reduced the heat loss from the stone-coated metal roofs to the point that the heat loss from the attic floor was less than the loss from that of the control shingle (-562 Btu/ft^2 of attic floor for the shingle roof vs. -453 and -429 Btu/ft^2 for the stone-coated metal roofs). These data represent a very important finding because they show that stone-coated metal roofs negate the heating penalty associated with a cool roof in Tennessee's moderate climate (3662 HDD65 and 1366 CDD65).

Summary

The improved summer performance coupled with the reduced heat losses during the winter show that high solar reflectance metal roofs negate the heating penalty associated with a cool roof. Offset mounting a stone- coated metal roof provides a seasonal synergistic effect (improved cooling performance and reduced winter heat losses) that the metal roof industry

should exploit for marketing its products in predominately cold climates.

Future articles will address: (1) how above-sheathing ventilation affects moisture removal; (2) does increased spacing of the air gap improve thermal performance; (3) does above-sheathing ventilation help retard ice damming; and, (4) what are the seasonal benefits of above-sheathing ventilation.

Acknowledgements

Funding for this project was provided by the U.S. Department of Energy under the supervision of Marc LaFrance of the Building Technologies Program. The ORNL project team members are Andre Desjarlais, William Miller, Tom Petrie, Jan Kosny and Achilles Karagiozis, all of ORNL's Buildings Envelope Program. The Metal Construction Association and its affiliate members provided the stone-coated shake and S-mission roofs used in testing. Metro Roof Products constructed the attic assemblies and provided valuable assistance in installing the roofs on the steep-slope assemblies. The financial support of the Metal Construction Association, the Cool Metal Roofing Coalition and the guidance of Metro Roof Products are greatly appreciated. CMRF

Photo courtesy of: Kassel & Irons

Another Benefit From Above-Sheathing Ventilation

Moisture Removal Benefits with Above-Sheathing Ventilation on Steep Slope Metal Roofs

William (Bill) Miller, PhD.
Achilles Karagiozis,
Andre Dejarlais

Providing an air space above the sheathing of a roof deck offers thermal benefits for stone-coated or standing seam metal roofs that yield energy savings in the summer and winter, while also helping to remove unwanted moisture. The natural ventilation above the sheathing improves the durability of the underlying structure of the roof. Metal roofs are sometimes offset mounted from the roof deck using a double-batten (counter-batten) construction. The design provides an air space between the exterior face of the roof sheathing and the underside of the roof cover so that a clear, albeit complex, air pathway exists beneath the roof cover. Solar irradiance absorbed at the roof's surface is conducted through the metal roof and heats the air space. The warmer and therefore more buoyant air moves up the inclined air passage. The ventilation scheme helps remove unwanted heat but it also removes unwanted moisture from the roof deck, thereby improving the roof's thermal performance as well as its durability. The thermally induced airflow occurring in this air space is termed above-sheathing ventilation (ASV).

Field studies were conducted on several attic assemblies having stone-coated metal shake roofs with and without cool color (infrared reflective) pigments and with and without above- sheathing ventilation. Stone-coated metal roofs are often offset mounted from the roof deck using a batten and counter-batten system. Here counter-battens made of nominal dimension wood strips (1 by 4's) are nailed to the roof deck from soffit to ridge, and battens (2 x 2's) are placed above the counter-battens and nailed to the deck (Fig 1). MOISTURE REMOVAL BENEFIT
A moisture engineering analysis was performed on the roof system depicted in Figure 1 using the MOISTURE-EXPERT model (Karagiozis 2001) that has shown good agreement in ventilated wall systems. The intent was to show the potential for reducing moisture-related problems in the roofing systems using ASV.

The following modes of heat and moisture transport were included:

- Vapor diffusion through all porous roof construction materials
- Liquid transport through all porous roof construction materials
- Air convection transport for both thermal and moisture components
- Moisture storage in all roof construction materials
- Radiative transport with nighttime sky conditions
- Radiative transport within the air gap provided by the stone coated metal roof
- Condensation and evaporation processes and freeze and thawing processes with the associated latent heat exchanges

[ASV accelerated the removal of unwanted moisture and reduced the moisture content of the OSB sheathing well below that of the OSB in a closed cavity]

In the simulation analysis, the exterior and interior environmental loads were assumed for the climatic conditions of Knoxville, Tennessee. The proposed ASHRAE SPC 160P, "Design Criteria for Moisture Control," was employed for both the exterior and interior hygrothermalloading conditions. All simulations were initiated using double the equilibrium moisture content (EMC) at 80% relative humidity. Both the ventilated and non ventilated cases were simulated for a period of 2 years.

A snapshot of the moisture content in the sheathing board (oriented strand board (OSB)) is given in (Fig. 2). The simulation period started October 1,2005, one of the more difficult periods of the year for the sheathing to dry out. ASV accelerated the removal of unwanted moisture and reduced the moisture content of the OSB sheathing

Photo courtesy of: Classic Metal Roofing

well below that of the OSB in a closed cavity (Fig. 2). Ventilating the roof deck dried the OSB within 200 days to safe moisture limits in which fungal growth would not typically occur. In comparison, the closed roof deck required an additional 100 days to reach safe moisture content.

The number of air exchanges occurring within the ventilated cavity (Fig. 3) tells the story. The occurrence of air exchange rates are displayed for the assumed air changes per hour (ACH), which are dependent on both temperature and wind pressure flows acting along the roof ventilation cavity. Roughly 20-100 ACH are prevalent about 80% of the time during the 2-year simulation runs. The 60 ACH was the maximum incident air exchange rate observed occurring about 25% of the time. Therefore, the potential moisture removal benefits afforded by ASV are evident from the vented compared to the non vented simulations.

As a check, Miller (2006) made field measurements of the airflow underneath stone-coated metal shake roofs (Fig. 1) by monitoring the decay rate of the tracer gas $C0_2$ with time and deducing the flow rate from a continuity balance for the concentration of $C0_2$. The $C0_2$ gas was injected into the vent gap of the soffit to saturate the cavity. After a substantial buildup of concentration registered on a monitor, the gas injection was stopped, and the concentration was recorded at timed intervals. All measurements were made around solar noon, when the roofs were at their highest temperatures. Computed airflows were about 18 cfm, which for the volume of the air space yields about 80 air changes per hour. Therefore, the measured data is well within reason of the results from the hygrothermal simulations.

Summary

Moisture is a prevalent issue in all aspects of building design. Metal roofs employing above-sheathing ventilation show superior hygrothermal performance when compared with a non-vented roof system. Above-sheathing ventilation therefore adds yet another feature to this ecologically sound building material. Providing the ventilation above the sheathing improves the durability of the underlying structure of the roof. As a result, the expected performance of metal roofing in high winds and hail storms is further enhanced because of the improved hygrothermal performance afforded by a metal roof system using above- sheathing ventilation. Future articles will address: (1) does above sheathing ventilation reduce attic air temperatures and in turn reduce heat losses from ducts installed in attics; (2) does increased spacing of the air gap improve thermal performance; (3) what are the seasonal benefits of above sheathing ventilation; and, (4) does above sheathing ventilation help retard ice damming.

Acknowledgments

Funding for this project was provided by the U.S. Department of Energy under the supervision of Marc LaFrance of the Building Technologies Program. The ORNL project team members are Andre Desjarlais, William Miller, Tom Petrie, [an Kosny and Achilles Karagiozis, all of ORNL's Buildings Envelope Program. The Metal Construction Association and its affiliate members provided the stone-coated shake and S-mission roofs used in testing. Metro Roof Products constructed the attic assemblies and provided valuable assistance in installing the roofs on the steep-slope assemblies. The financial support of the Metal Construction Association, the Cool Metal Roofing Coalition and the guidance of Metro Roof Products are greatly appreciated.

Karagiozis, A. N. 2001. "Advanced Hygrothermal Modeling of Building Materials Using MOISTURE-EXPERT 1.0." Pp. 39--.47 in Proceedings of the International Particleboard! Composite Materials Symposium. Miler, W A. 2006. The Effects of Infrared-Blocking Pigments and Deck Venting on Stone-Coated Metal Residential Roofs. ORNLITM-2006!9. Oak Ridge, TN: Oak Ridge National Laboratory CMRF

Fig 1: Batten and Counter-batten system used to mount stone-coated metal roofs

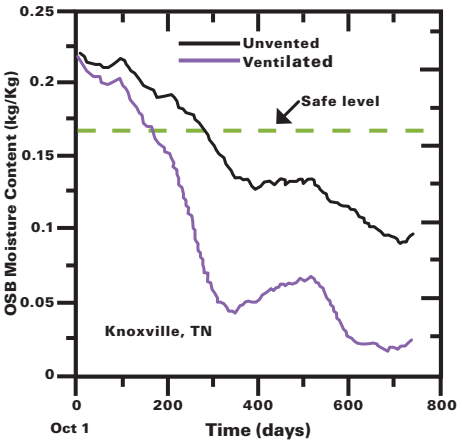


Fig 2: Comparison of moisture content of OSB layer as a function of ventilation strategy (ventilated vs. non-vented) for a 2-year period.

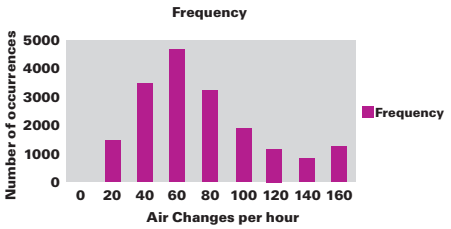


Fig 3: Period of time during 2-year simulation for cavity air changes per hour (wind- and temperature-dependent).

Life Cycle Assessments

Cool roofing legislation, codes and architectural guidelines have become familiar to nearly everyone in the metal roofing industry. Cool metal roofing has many advantages over other roofing materials with strong science to back it up. A better educated and motivated market, with a clear message and unified front among our industry stakeholders, will more quickly achieve optimal impact in the marketplace and on the environment.

The reality is that for most building owners and home owners, the energy savings alone resulting from installing a cool metal roof are not enough to cause a mass shift to this material. We need to establish other compelling selling points to complement the savings that will be realized from using cool metal roofing technology.

The concept of Sustainable Building Design has become mainstream for architects, specifiers and building owners around the country. Sustainable buildings are built to the highest environmental performance standards. They seek to minimize the use of energy, water and other natural resources. All this is accomplished without jeopardizing the needs of future generations.

Improved products, effective communication and new marketing tools can be used to demonstrate the benefits of cool metal roofing. One such tool is the Life Cycle Assessment (LCA) of the product. The LCA compares the environmental impact of the process to manufacture prepainted (70% Kynar 500®) rollformed cool metal roofing panels, from a cradle-to-gate assessment. The Metal Construction Association, with assistance from PE International (a LCA Practitioner) conducted an industry-average LCA in 2012 and later developed an Environmental Product Declaration for the product. In both cases the environmental impact categories that were used included ozone depletion potential, greenhouse gas emissions, global warming potential, and other impacts listed in the EPA's TRACI program.

The primary use of a LCA is to assess the overall environmental impact of the product or process being evaluated, but also to determine which component of the process and/or product is responsible for the most environmental impact. With that information determined, the LCA then acts as a quality improvement tool to allow the manufacturers to make the necessary changes to lower the environmental impact. The industry wide LCA also establishes a benchmark against which other producers can compare their process or products' environmental impact. With the full LCA report now available to the public from the Metal Construction Association website **(www.metalconstruction.org)** these goals were accomplished. The LCA showed that the overall environmental impacts of prepainted cool metal roofing panels were largely dominated by upstream steel production. The impacts from the

Photo courtesy of: ATAS International, Inc.

Photo courtesy of: ATAS International, Inc.

Life Cycle Assessments continued

coil coating process and the rollforming process were insignificant compared to the impacts of steelmaking.

Another tool that is similar to the LCA is the Eco Efficiency Analysis (EEA) developed by BASF. This marketing tool can be used to demonstrate the benefits of cool metal roofing. In the EEA analysis a holistic approach to construction materials is used. In addition to considering the built environment, other aspects are analyzed such as:

- **The source of the raw materials to manufacture the building component**
- **The environmental impact of their manufacture**
- **The environmental impact of their disposal at the end of their useful life.**

The EEA compares the life-cycle cost and life-cycle assessment of various competitive materials from cradle-to-grave. BASF has used this tool since 1996 and has performed hundreds of analyses during that time. An analysis comparing steep slope cool metal roofing against standard (non-cool) metal roofing, standard composite shingles, architectural shingles, clay tile and concrete tiles have been completed. The EEA quantifies the ecological footprint of the various products in terms of energy consumption, resource consumption, air & water emissions and waste & area usage.

Under the "Use" category the cooing/heating energy reduction resulting from the use of a cool metal roof and the resulting reduction in greenhouse gas emissions are quantified in the EEA. In the "disposal" category materials which are readily recycled, such as metal, perform the best. CMRF

Photo courtesy of: Classic Metal Roofing

Photo courtesy of: Classic Metal Roofing

A Breakthrough in Environmental and Health Stewardship

Background: Since 1965, PVDF coatings based upon KYNAR 500® PVDF resin have protected metal components on the building envelope around the world. These types of coatings have become widely recognized as some of the world's most durable metal finishes. Their extreme longevity and low maintenance have made them the first choice among architects and specifiers.

Historically, the manufacture of PVDF resins involved the use of long chain perfluorinated compounds (LCPFCs), including ammonium perfluorononanoate (APFN) and perfluorooctanoic acid (PFOA). In recent years, PFOA and APFN compounds have come under scrutiny by the Environmental Protection Agency and other worldwide organizations. In the coating industry LCPFCs have been used as surfactants, which lower the surface tension of the liquid in which it is dissolved, such as Kynar 500® resin and other competitive PVDF products.

The LCPFC compounds are very stable and resist breakdown in the environment. With regard to health issues, scientists have raised concern over the bioaccumulative and toxic nature of these chemicals. Studies[1] are finding PFCs in humans, which has triggered a call for reducing the sources and transmission of these compounds. The EPA found suggestive evidence that PFOA could cause cancer in humans. As such, the EPA's Science Advisory Board recommended to the EPA that they should classify PFOA as "likely carcinogen in humans." In 2006, Arkema, and five other companies, voluntarily committed to a global phase-out of LCPFCs and related plant emissions by the end of 2015. This program is known as the U.S. EPA 2010/15 PFOA Stewardship Program.

Several companies involved in the EPA Stewardship Program have taken steps to reduce the use of LCPFC's in such applications as stain release for carpet and clothing and in non-stick coatings for cookware. In December 2008, Arkema Inc., an active participant in the EPA Stewardship Program and the originator and leader of high performance PVDF resins for architectural markets, announced its intention to introduce KYNAR 500® PVDF resin manufactured with a new patented fluorosurfactant-free (FSF®) process. The FSF® designation indicates that no fluorosurfactant of any kind is used in the manufacture of Kynar 500® FSF® PVDF resin at Arkema's US and China manufacturing plants today.

In February 2012 Arkema announced that it had amended a licensing agreement with The Sherwin Williams Company for KYNAR 500® FSF® architectural coatings. This made Sherwin-Williams the first Kynar 500® FSF® trademark licensee in the United States.

The change in the Kynar 500® resin manufacturing process illustrates Arkema's commitment to provide products that continue to offer the same critical performance properties with improved health and environmental profiles. By eliminating fluorosurfactants from its process, Arkema has taken a big step toward addressing customers' environmental and health concerns.

Today's green building market is more focused on transparency of chemicals and the ingredients of building materials. This makes the transparency of supply chains more important than ever. CMRF

Photo courtesy of: ATAS International, Inc.

[1]*Calafat A, Kuklenyik Z, Reidy J, Caudill S, Tylly J, Needham L. Serum Concentrations of 11 Polyfluoroalkyl Compounds in the U.S. Population: Data from the National Health and Nutrition Examination Survey (NHANES) 1999-2000. Centers for Disease Control and Prevention. 2007. http://origin.cdc.gov/exposurereport/pdf/ perfluorinated_compounds1.pdf; TaoL, Kannan K, Aldous KM, Mauer MP, Eadon GA. Biomonitoring of Perfluorochemicals in Plasma of New York State Personnel Responding to the World Trade Center Disaster. Environ. Sci.Technol. 2008; Tao L, Kannan K, Wong C, Arcaro K, Butenhoff J. Perfluorinated compounds in human milk from Massachusetts,U.S.A. Environ. Sci. Technol. 2008.; 42:3096–3101. Kannan K,Corsolini S, Falandysz J, et al. Perfluorooctanesulfonate and related eluorochemicals in human blood from several countries. Environ. Sci. Technol 2004; 38(17):4489 – 4495.*

Photo courtesy of: ATAS International, Inc.

Title 24

Whether or not you are building in California, the Title 24 Building Energy Efficiency Standards that cover cool roofing are important to you.

Other states, code bodies and standards organizations are monitoring the activity in California with great interest. Commercial low-slope metal roofing is affected by the present energy standards, and the 2013 revision includes requirements and equivalence for steep-slope residential cool roofing products.

History and Purpose

The California Building Standards (Title 24 of the California Code of Regulations) contain the Energy Efficiency Standards of Residential and Non-Residential Buildings. The standards establish prescriptive and performance-based requirements for cool roof materials in new construction or major re-roofing projects. Energy Efficiency Standards for buildings first became law 1978. The California Energy Commission (CEC) is responsible for overseeing updates and revisions to these regulations.

The purpose of the law is to reduce energy consumption in California—and especially to minimize the impact of peak energy demand. The law is updated every three years to include new energy efficiency technologies. The most recent update went into effect on July 1, 2014. The standard contains regulations for energy efficient roofs. The Title 24 code is a complex combination of prescriptive, mandatory and performance-based requirements. Although the code was developed in California to address that state's energy usage, the requirements are being examined in other states, and within other codes and standards organizations such as ASHRAE and IECC.

What Does it Cover?

Title 24 applies to the entire state of California and covers non-residential and residential buildings with low-slope and steep slope roofing. These can be new or existing buildings, as well as additions. For reroofing, the standards apply when the retrofit roof is at least 50% of the roof surface, or a minimum of 2,000 ft^2. The prescriptive criteria for cool roofing does not cover hotel /motel guest rooms or high rise/low rise residential buildings. Only those buildings with conditioned space must comply with the energy efficiency standards.

Title 24 defines the minimum values for solar reflectance, thermal emittance, and solar reflectance index (SRI) for acceptable cool roofs. The new 2013 standard that went into effect in 2014 has 3-year aged requirements for CRRC-rated cool roof products as in Table 1

How is it Enforced?

The enforcement of the Energy Efficiency Standards is through the permitting process. An energy budget for a construction project must accompany the traditional drawings and calculations when submitting a project for a building permit. CEC establishes baseline energy limits on specific types of building products and systems. When designing a building, the actual energy ratings or characteristics are reported and compared to the limits placed on those components by CEC. If the designed building's total energy usage is equal or below that prescribed by CEC, the energy budget is met. However if the energy budget is not met in California, the permit is not issued.

How Does a Design or Project Comply?

There are several paths to take to comply with the Title 24 standards for cool roofing.

1. **Prescriptive measures**
2. **Building envelope trade-offs**
3. **Whole-building performance trade-offs**

Prescriptive Path

In the 2005 Title 24 code, a cool roof prescriptive requirement for low slope (<2:12) was first introduced. The prescriptive approach defined a cool roof by minimum requirements for solar reflectance (0.70) and thermal emittance (0.75). The prescriptive cool roof must also be a product certified and listed on the Cool Roof Rating Council (CRRC) directory. The 2013 version of the standard now includes steep slope and residential roofing provisions.

These prescriptive criteria limit the choice of cool metal roofing to a white prepainted product. Unpainted metal roofing does not meet the prescriptive thermal emittance criterion. However, a low emittance roof can comply with Title 24 if the solar reflectance is high enough to provide equivalent energy performance. Title 24 provides a calculation for low emittance products to determine the required reflectance to comply.

Unfortunately, in the case of unpainted Galvalume® steel sheet, the required equivalent reflectance is higher than the actual measured solar reflectance values.

Table 1

Roof Slope	Solar Reflectance	Thermal Emittance	SRI
Low slope	0.63	0.75	75
Steep slope	0.20	0.75	16

Photo courtesy of: Classic Metal Roofing

Trade-off Method– Building Envelope

If a metal roof product cannot meet the prescriptive requirements, the building envelope trade-off method can be used to determine if the non-cool roof can still comply. This method allows a roof to have less than the prescriptive requirements for solar reflectance and thermal emittance; as long as the overall heat gain and heat loss for the entire envelope is less than that computed for a similar building using the prescriptive requirements.

Software programs are available for these calculations. The use of energy consultants is also recommended and common. For example the California Association of Building Energy Consultants (CABEC) is a resource for helping a building owner or contractor with these calculations of the energy budget on a building.

The roof product, whether it meets the prescriptive requirements or not, must be a CRRC listed product. If the roof material is not on the CRRC directory, the default reflectance of 0.10 is assigned to the roof in the envelope trade-off or whole building performance approaches. This penalty makes it difficult to compensate with higher energy efficiency building envelope components —such as insulation, window glazing, or window awnings.

Trade-off Approach– Whole Building

The third approach for achieving compliance is a whole building performance analysis that allows one to trade-off improved energy efficient components of the entire building, including interior items, to compensate for a non-cool roof. The trade-offs can be with more efficient lighting, HVAC equipment and interior components, as well as with building envelope materials. This method is the most flexible but also the most complex approach. Again, the use of software and energy consultants are recommended.

Photo courtesy of: Classic Metal Roofing

ALERT!

It is important to note that a cool metal roof is NOT mandatory in the 2013 Title 24 Energy Efficiency Standards. A roof that does not meet the prescriptive definition of cool roof can still be used if either of the two trade-off calculations are successful in meeting the energy budget.

If one chooses to use the simplest method of compliance—i.e. prescriptive, then the cool roof requirements must be met. However, if a trade-off or whole building performance method is chosen, a metal roof with properties that do not meet the definition of a cool roof in Title 24 can be used, provided other components are adjusted to be more energy efficient than the original design.

Who's Responsible?

A building owner is responsible to provide a code-compliant building. He uses an architect or construction project manager to coordinate the project, which includes obtaining the necessary building permits. An energy consultant is often required to perform the Title 24 calculations and to provide the required documentation for the energy budget.

A roofing contractor would install the cool roof system that meets the code. He would also provide the appropriate documentation to the Building Department. The manufacturers of cool metal roofing products must provide those materials that meet code. The products need to be properly labeled as meeting Title 24 standards and certified that they are listed with the CRRC. Building officials then inspect and enforce the Title 24 regulations, by ensuring that all plans comply with the code of regulations and have the required documentation.

For more information about the 2013 Title 24 Building Energy Efficiency Standards, see **www.energy.ca.gov/title24** CMRF

Cool Roof Rating Council

Some 15 years ago, the state of California and their energy commission, got seriously interested in taking the lead for energy conservation and regulation. They insisted that some designated body needed to be formed to monitor and initiate regulations related to cool roofing on homes and buildings in California. Thus, the Cool Roof Rating Council (CRRC) was formed to do just that task.

The original members from industry and elsewhere numbered over 80, with the authors of the forum included. The asphalt shingle roofing industry was petitioning to keep the regulations reasonable and fair. Today the CRRC has developed a consensus-based standard, and has identified and created test methods for measuring the radiative properties of all types of roofing materials. The California Building Energy Efficiency Standards recognize CRRC as the only authoritative organization that can list solar reflectance and thermal emittance values of roofing materials that are used in California. The CRRC organization has a board of directors, a technical committee, and other task groups working on new test methods and other technical activities. The California Energy Commission (CEC) is represented on these CRRC committees and provides guidance on cool roof issues within California .

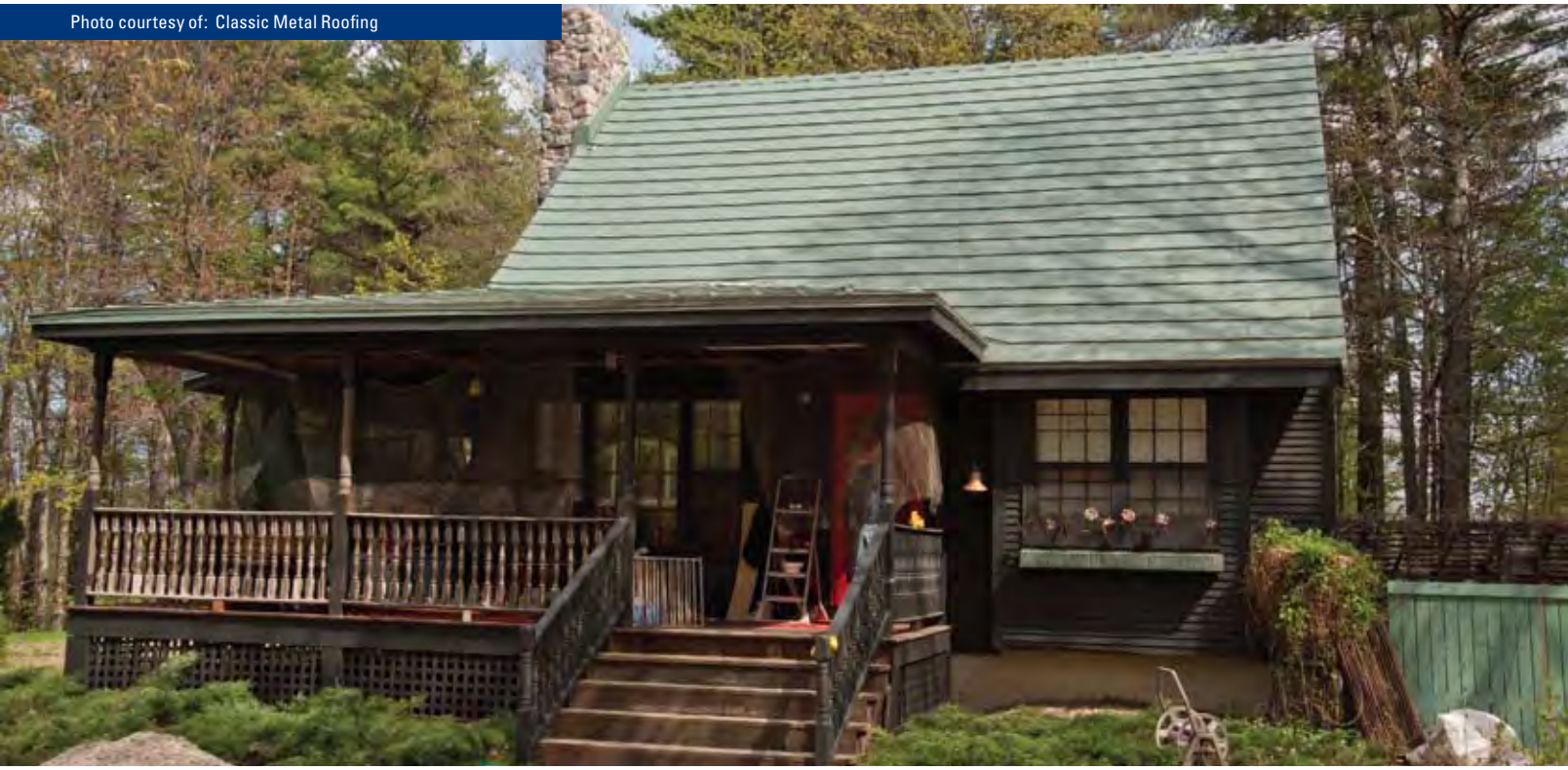
The CRRC has developed rigorous policies and procedures to register a product, accredited laboratories to perform the initial and aged testing of roofing materials, and a process to monitor product performance. The directory of CRRC-listed roofing products is available on the CRRC website **(www.coolroofs.org)** for home owners and building contractors to choose from.

In California, in order to receive a building permit, an energy budget for any building project must meet the CEC guidelines for energy performance. Cool roofing is part of that assessment, and the radiative properties must be chosen from the CRRC directory data.

The CRRC has grown in influence with other states, municipalities and other regulatory entities like Energy Star. In fact, the CRRC is recognized by EPA as a Certification Body to certify roofing products for the ENERGY STAR program. This service is called Evaluation Services CRRC or ES-CRRC®. This program is a separate and distinct program from the CRRC Product Rating Program. The agreement between ES-CRRC and Energy Star allows one to certify their ENERGY STAR products without having to rate the products through the CRRC Product Rating Program. With changes in the upcoming new version of Energy Star, this arrangement is a benefit to companies who need to get their products labeled with Energy Star.

The influence of CRRC, with what they have accomplished, resonates with other state and national regulators and code bodies resulting in CRRC and its standard being included in many codes and public policy. CMRF

Photo courtesy of: Classic Metal Roofing



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What Is Emittance?

Cool metal roofing is defined in many policies, programs, codes and standards in terms of two surface properties: solar reflectance and thermal emittance (sometimes referred to as "emissivity"). One of the more misunderstood physical properties of a material is its emittance. Simply put, the thermal emittance of a material is a measure of its ability to re-emit or re-radiate absorbed solar energy to the night sky in the form of infrared radiation energy. Note that it is not re-emitting heat, but IR energy.

The solar reflectance of a product's surface comes into play during daylight when the sun's energy is striking the roof surface. However, thermal emittance is a property unrelated to the daylight. In fact, the effect of emittance on lowering surface temperature and heat gain is more pronounced in the evening hours when the energy is released to the night sky. Roof products' thermal emittance values fall into two basic levels—very high or very low. There are few exceptions, but primarily a roof product with a non-metallic surface will display an emittance value near 0.90. In contrast, a metallic surface displays a very low emittance, typically around 0.10. Emittance is usually reported as a decimal from 0 to 1.00, where the higher the number, the greater is the emittance. The property itself is measured with an industry-recognized test method - ASTM C1371.

For a given solar reflectance value, a roof product with high thermal emittance is cooler than one with a lower thermal emittance. The combination of solar reflectance and thermal emittance allows for cool metal roofing to work 24 hours a day. CMRF

Photo courtesy of: Kassel & Irons

Cool Roof Standards And Programs

The Global Cool Cities Alliance works at the national and international level to promote cool roofs through code and standards development and implementation. They focus on mitigation of the heat island effect and public health impacts from the use of cool roofing. (www.globalcoolcities.org)

The ASHRAE Standard 90.1-2010 and 2013 (Commercial Energy Code), recognizes the Cool Roof Rating Council (CRRC) CRRC-1 Standard as the only radiative standard for which roofing products will be tested. **(www.ashrae.org)**

The ASHRAE Standard 189.1-2011 and 2014 (High Performance Green Building Standard), recognizes only the CRRC-1 Standard as the only radiative standard for which roofing products will be tested. **(www.ashrae.org)**

The International Energy Conservation Code-2015 (Commercial provisions), references the CRRC-1 Standard, and other ASTM test standards, to demonstrate compliance to the energy provisions for cool roof requirements. **(shop.iccsafe.org/2012-international-energy-conservation-code-soft-cover.html)**

The International Green Construction Code-2012 and 2015, refers to the CRRC-1 Standard and other ASTM test standards, to demonstrate compliance to urban heat island provisions concerning cool roof requirements. **(www.iccsafe.org/CS/IGCC/Pages/default.aspx)**

Effective July 1, 2014, the California Energy Commission updated the 2013 Building Energy Efficiency Standards, also known as Title 24, Part 6 which pertains to cool roofs. The new language removed the roofing density requirements for nonresidential buildings and increased the low-slope cool roof requirements for new construction and alterations. Those changes increased the aged solar reflectance from 0.55 to 0.63. Details of the 2013 Building Energy Efficiency Standards for Residential and Nonresidential Buildings can be found at **www.energy.ca.gov/title24** CMRF

Photo courtesy of: Classic Metal Roofing

Can Insulation Be As Effective As A Cool Metal Roof?

In most cases, the minimum level of insulation for construction is dictated by the building code. The required minimum R-values for ceiling insulation depend on the climate zone, where warmer climates require less insulation than cooler climates. Heat flows naturally from a warmer to a cooler space. During the cooling season, heat flows from outdoors to the building's interior Insulating ceilings or attics provides an effective resistance to the flow of heat.

A cool metal roof is designed to reflect away solar energy that strikes the roof surface. By reducing the solar heat gain at the start, a cool metal roof also effectively reduces heat flow. Lower attic temperatures from the use of a cool metal roof can actually improve the effectiveness of the insulation. Studies show that the R-value of insulation can exhibit variations as the temperature and humidity levels change. In all cases, a higher temperature leads to a lower effective R-value. Also, when insulation is compressed, the R-value is lower than the rated value. If a roof leaks, or allows air flow or condensation to form, the thermal efficiency of the insulation can be diminished.

Thus, the synergy between roof/ceiling insulation and a weather-tight, cool metal roof is very important. Increasing the thickness, and the R-value, of roof insulation can certainly help to reduce heat gain and cooling energy requirements—but only up to a point of diminishing economic returns.

An effective and long lasting passive cooling system can be created by the combination of roof insulation and a cool metal roof. This combination will maximize the solar reflectance, reduce the roof surface temperature (as well as heat gain through the roof deck) and optimize the thermal properties of insulation.

It should be noted that the role of insulation on the interior side of the roof has little effect on mitigating urban heat island effects. Lowering the ambient air temperature by reducing the temperature of the roof surface with a product that has higher solar reflectance and thermal emittance is a more effective way to address the heat island effect. CMRF

Photo courtesy of: Kassel & Irons

Photo courtesy of: Classic Metal Roofing

Kynar Aquatec®
A Water-based PVDF Coating System for Metal Restoration
Designed to outlast conventional coating products With PVDF Technology and Cool Pigmentation

There is a new aqueous polyvinylidene fluoride (PVDF) latex resin technology that is available from Arkema Inc. under the Kynar Aquatec® brand that is appropriate for field application of metal restoration coatings.

Building Off the Kynar® Performance

Arkema Inc., the licensor of the time-tested Kynar 500® PVDF resin used for premium prepainted metal roof and wall panels for 50 years has introduced a long-lasting emulsion product for field-applied applications, named Kynar Aquatec® based coatings.

The strength of the product is the Kynar® PVDF resin platform, which for five decades has become the product of choice for architects specifying a premium exterior coating system for buildings.

The primary features of the new product are its ability to offer an extremely high solar reflectance which is retained longer than conventional spray coatings, and its availability in a palette of colors that can be used for restoration applications.

Whereas Kynar 500® resin based coatings are relegated to factory application on metal due to the high cure temperatures, Kynar Aquatec® latex based coatings can be factory or field applied to a wide variety of substrates, such as metal, TPO, PVC, EPDM, SPF, fiber cement and more, to enhance the performance or extend their useful lives.

The Key – The Kynar® Technology Platform

Kynar 500® PVDF homopolymer, is universally known within the architectural community as the world's most weatherable coating resin. The excellent durability is a result of the chemical composition of the resin relying on the carbon-fluorine molecular bond - one of the strongest bonds known to mankind. Kynar 500® PVDF resin was first introduced commercially in 1965 by the Pennwalt Corporation (known today as Arkema Inc.).

A Kynar 500® PVDF based paint finish has displayed superior color retention due to the fact that the resin is transparent to ultraviolet solar radiation. Conventional resin based exterior paint finishes are normally attacked from UV energy, heat and moisture. In these types of finishes, the UV energy is absorbed by the film and degrades the molecular structure which can cause attack of the resin and the colored pigments resulting in fading, chalking and film erosion. This type of comparative superior weathering performance has been documented for fifty years since the introduction of the premium exterior finish.

Hence, the strength of the Kynar 500® technology platform used for prepainted metal roofing and wall systems has been well established and documented. And now coatings made with Kynar Aquatec® latex offer the same level of performance including:

- Superior long term color and gloss retention
- Superior resistance to chalking
- Outstanding resistance to dirt pick-up and stain
- Excellent resistance to algae and fungal growth
- Excellent resistance to abrasion
- Superior retention of high solar reflectance and thermal emittance

In addition to the above virtues, Kynar Aquatec® based coatings have excellent color stability and diversity in vibrant colors that make the product a main choice for architects and building owners in the roof and wall restoration market.

Product Development Strategy and Performance

The testing of Kynar Aquatec® emulsion based coatings in South Florida environments has been under way for 14 years prior to the introduction of the product. Figure 1 shows the performance of mass tones in a variety of colors after 13.5 years in Florida. Comparing the original colors to the exposed surfaces shows excellent performance similar to that seen on panels featuring Kynar 500® based paints.

"Similar to the extreme weatherablity shown by Kynar 500®-based coatings in harsh climates, coatings based on Kynar Aquatec® emulsions last longer than conventional roof coatings, making them a durable and energy-efficient solution for any roof coating application," said Eric Bennung vice president of Acrymax Technologies Inc.

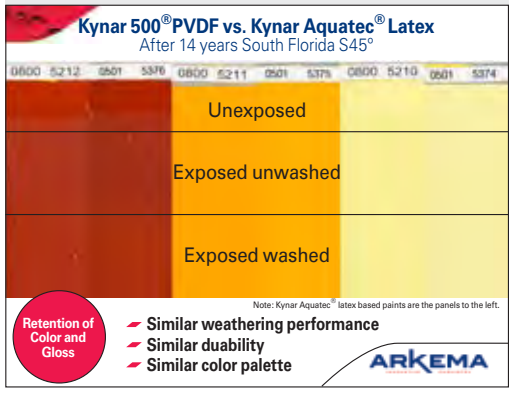

Figure 1

Cool Coating Technology

With energy efficiency on the mind of all building owners, a cool roof that displays high solar reflectance over the useful life of the roof is an attractive product to consider. Cool roofing is an area where

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ENERGY STAR® is a registered trademark of the Environmental Protection Agency

Photo courtesy of PPG

Kynar Aquatec®-based coatings excel with their high initial solar reflectance which is retained over time. After 14 years in south Florida, white coatings based on Kynar Aquatec® latex maintain 76% total solar reflectance (TSR). Typical acrylic coatings drop to 55% TSR after only 3 years. An increase in the solar reflectance of a roof helps to lower the surface temperature of the roof and lower the heat gain into the space below the roof. Any reduction in heat gain lowers the air conditioning load, and can help to reduce peak utility electricity demand in summer afternoon periods.

Metal Restoration

A new field application for Kynar Aquatec® -based coatings is metal restoration, in particular, metal roofing and walls.

A building owner may prefer to recoat their structure for a number of reasons:

- Recoating is more cost effective than retrofitting
- Color change
- New corporate identity

Kynar Aquatec® based coatings can be formulated with cool pigment technology which reflects infrared solar energy. In some areas, recoating your structure with a system based on Kynar Aquatec® latex can qualify the building owner for energy rebate such as in Florida through Florida Power and Light. Textured Coatings of America Inc. offers 6 non-white colors that qualify for such a rebate. Jay Haines, president, states, “these low-VOC coatings provide outstanding water repellency and retain color and gloss like no other

Kynar 500®, FSF® and Kynar Aquatec® are registered trademarks belonging to Arkema Inc.

Photo courtesy of: Classic Metal Roofing

conventional water-based coating making them ideal for field applications, including metal restoration, with our cool roof and cool wall technology."

The Kynar Aquatec® -based topcoat is part of an overall system. Just like any paint restoration, surface preparation is important. All surfaces must be sound, clean, dry and free of contamination. The system usually requires a primer. This means that the applicator should follow the topcoat manufacturer's recommendation for primer selection and coating application. Kynar Aquatec® -based coatings can be applied with a brush, roller or commercial spray systems.

Kynar Aquatec®-based coatings carry the long-established Kynar® trademark, which is recognized by the architectural community as a gold standard in durable exterior paint systems. The proprietary new platform is truly cutting edge technology that creates a new standard in the area of field-applied air dry coatings for roof and wall restoration.

Field application of Kynar Aquatec® emulsion based coatings is practical and economical when compared to coil coating or prepainting of metal roofing. The features of the coating make it a sustainable product as part of a green building practice.

Kynar Aquatec® -based coatings are available in North America and worldwide through licensed coating formulating companies. For a full list, visit the Kynar Aquatec® website, **www.kynaraquatec.com**.

Summary

Arkema Inc. has done the unthinkable–taken the industry's recognized superior exterior paint resin available only as an oven-baked paint system on metal and made it available as an air-dried field applied coating with the same outstanding durability and attractive benefits.

The properties of Kynar Aquatec® -based coatings make it a product of choice for field- applied cool roofing and wall applications on a number of substrates, and for metal restoration. The durable performance of Kynar 500® PVDF resin has been specified by architects for over 50 years. That same performance with even more flexibility in applications is now available in a field applied coating system. Those properties are retained over time, making the life cycle cost of a structure even lower when compared to traditional coatings that have been shown to degrade over time.

For more information contact Arkema Inc. and visit www.kynaraquatec.com. CMRF

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LEED

Architects, design professionals and contractors are more focused on sustainable building materials today than ever before. The United States Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) certification program is gaining acceptance and popularity, now being required for building projects by many states, cities, municipalities and federal agencies.

In the LEED program, a cool metal roof can contribute directly to a few points and indirectly to many more. Changes in the program are making it easier for a LEED registered project to achieve points toward LEED certification.

Data from the USGBC show that its goal of capturing the top 25% of the building market is on track. By 2020 the USGBC hopes to have 1 million LEED buildings and 10 million LEED homes. USGBC has also joined with organizations like BOMA, ASHRAE and AIA to support the 2030 Challenge which is an initiative to make all buildings carbon neutral by 2030.

Commercial building owners in the United States spend almost $100 billion per year on their energy bills. (Source: LBNL) New and existing buildings require significant amounts of energy and materials to construct them and to operate within them. The building sector in the United States accounts for 40% of the total energy used in the country. With today's concern about resource depletion and global climate change, designers and architects have placed a greater emphasis on green building practice. The reason is simple if we can lower the energy requirements of buildings we can reduce our dependence on finite sources of energy and also minimize the emission of greenhouse gases associated with the generation of the power needed to operate those buildings. McGraw-Hill Construction predicts that green building construction will grow to 48% of the non-residential market by 2015.

Perhaps one of the reasons for this anticipated explosive growth comes from a quote from a 2003 report from the California Sustainable Building Task Force which says, "An upfront investment of 2% in green building design, on average, results in life-cycle savings of 20% of the total construction costs more than 10 times the initial investment." **www.usgbc.org**.

The Basics

The USGBC created the LEED rating system as a voluntary national standard for developing highperformance sustainable buildings. LEED uses a whole-building approach to focus on integrated design and construction processes. A building project is awarded points in distinct credit categories for compliance with established sustainability standards. Architects, designers and building owners plan a project in order to acquire points in the program to achieve a level of certification for the building project. There are many LEED programs for different types of building projects such as Building Design & Construction, Interior Design and Construction, Existing Buildings- Operation and Maintenance, and New Construction & Major Renovation. Over the years, new versions of the LEED program have been introduced. The most recent version was launched in November 2013 as LEED version 4. Even though the LEED 2009 program will be available for registering until June 1, 2015, projects can now be registered in the LEEDv4 program.

The credit categories of LEEDv4 include:

- Integrative Process
- Location and Transportation
- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality
- Innovation
- Regional Priority

Each category awards points for compliance, with a total of 110 points available in the rating program. LEED designates levels of certification as:

Certified	**40-49 points**
Silver	**50-59 points**
Gold	**60-69 points**
Platinum	**80+ points** CMRF

Photo courtesy of: Classic Metal Roofing

How Cool Metal Roofing Can Earn Points

Leed-Bd+C Version 4

LEED 4 was a transformational change to the LEED program. Single attributes of materials were replaced with whole building performance criteria and transparency issues. Twelve new credits were introduced, along with four new prerequisites. Some credits from the LEED 2009 version were removed and others were combined together to create an expanded credit.

Environmental impact, health of building occupants and material ingredient optimization were added to the Material and Resources section. Credits for recycled content and regional impacts were removed, but the topics were addressed differently in new credits. **(www.usgbc.org/leed)**

Sustainable Sites Category

A cool metal roof on a building project can directly or indirectly contribute points in the LEEDv4 program. In the Sustainable Sites category, the Heat Island Reduction credit is a combination of criteria on heat island effects from non-roof materials and roof surfaces. The Solar Reflectance Index requirements were increased and now include aged SRI and solar reflectance values. A weighted average calculation methodology for SRI is also added as an option. The change in this credit is that it combined the Roof credit and the hardscape credit from LEED 2009 into one expanded credit in LEED 4. A cool metal roof can comply with the SR and SRI values. But any type of roof can be part of the equation that takes into account the solar reflectance of many types of material surfaces on a building project.

To comply with the prescriptive low-slope SRI requirement, a prepainted metal roof with a solar reflectance greater than 0.66 would be required. This is a very light color. Unpainted metal roofing does not meet the SRI requirement for low slope roofing.

For steep slope applications, the minimum SRI requirement of 29 would allow unpainted metal roofing to be used, as well as painted metal with solar reflectance greater than 0.30, which could limit certain dark brown, green, blue and red colors.

Water Efficiency Category

Integrating a rainwater collection system with a metal roof can allow a building project to comply with several credits in the Water Efficiency category. Credits in this group are intended to reduce landscape watering or irrigation, indoor potable water use, and metering of water usage. In many cases, a rainwater collection system with a metal roof can become part of the irrigation system or as gray water usage inside the building to offset uses of potable water.

Energy and Atmosphere Category

The energy efficiency that can be achieved with cool metal roofing is a contributing factor for a LEED registered project gaining points in the Energy and Atmosphere category. Credits in this group encourage lower energy consumption, reduction of heat gain, and use of renewable energy sources. The energy performance criteria in this category are based on the ASHRAE 90.1-2010 standard.

A prepainted cool metal roof with high solar reflectance and thermal emittance will have a favorable impact on the modeling and calculations of the building's energy performance. The ability to mount solar technologies on a metal roof without penetrating the metal roof membrane is a key advantage for implementation of rooftop photovoltaics and other solar thermal technologies that can gain a building project points in LEEDv4.

Materials and Resources Category

This category saw the most significant change over LEED 2009. Credits based on a single attributes of building materials, such as recycled content, regional environmental impacts, and recyclability were replaced with a series of credits on Building Product Disclosure and Optimization. The recyclability of cool metal roofing can be addressed in this category through credits that encourage waste reduction and planning of construction waste management.

Other credits focus on the transparency of the materials use in the building. These include the environmental impact of the products, the sourcing of raw materials, and reporting of the materials' ingredients that may be a concern to the occupants' health. Cool metal roofing is a product that has been analyzed for its environmental impact through a cradle-to-gate Life Cycle Assessment conducted by the Metal Construction Association. Likewise, an Environmental Product Declaration (EPD) document also exists for this product, which allows it to be used by the building product team towards compliance with a credit in this category for EPDs.

If a manufacturer can report on the sourcing of their raw materials, such as providing information on land use practices, extraction locations and labor practices, the product's report can be used by the design team toward points in this credit.

A new concept being introduced in LEEDv4 is disclosure and optimization of the chemical ingredients in the materials being used on a proposed building project. This credit rewards the use of building products being reported in Health Product Declarations and the Cradle-2-Cradle program, as well as other programs. Disclosure alone will qualify for a point in the credit. But optimization of the ingredients, as determined by the listing of chemicals on authorized listings is required for additional points.

Within many of the credits in the Materials and Resources category, a product's recycled content and regionality are

Photo courtesy of: Kassel & Irons

taken into account. Those products that have high recycled content, such as cool metal roofing, receive an advantage in the calculation of the credit's points. Similarly, those products that are sourced within 100 miles of the jobsite are weighted differently for the calculation of costs used in the criteria of the credit.

Who's Responsible?

The building owner and design team first register the project during the design phase. As they select the qualified or certified products and green building technologies, they document the information. This documentation is then submitted at or near the point of building occupancy. The USGBC is responsible for registering the project at the beginning of the design phase, and then certifying the building. During the process, USGBC provides technical support to the team. A manufacturer of a cool metal roofing product provides the building team with those products that have been tested by accredited facilities and labeled appropriately.

A building with higher points or certification level is considered to be more energy efficient and sustainable over the life of the building. That fact sometimes allows the building to qualify for tax and/or utility incentives.

Who Uses Leed?

LEEDv4 projects can now be registered. The LEED 2009 version is also still available and valid for registering projects, up until June 1, 2015.

A growing number of federal, state and local governments are requiring that newly constructed public buildings be LEED certified. In some cases, the requirement is at least a level of Silver certification.

The Federal government has requirements for its new buildings to be LEED Silver certified in the LEED 2009 version, or in the Green Building Institute's Green Globes building rating program. The federal agencies affected include GSA, Department of Defense, Department of State, Department of the Interior, Department of Energy, NASA, Homeland Security and the EPA.

Summary

USGBC's LEED program continues to set the standards for energy and environmental ratings of buildings. Its growth is a direct result of the nation's interest in improving energy efficiency of buildings, and reducing the environmental impact from greenhouse gas emissions associated with the production of electricity. A cool metal roof has many features that make it a good choice to the architect, designer, contractor or building owner. In addition to its inherent energy efficiency, the sustainable features of metal roofing can allow a building project to achieve many more points in the LEED program.

Useful tools:

USGBC – www.usgbc.org
LEEDUser – www.leeduser.com
Athena Impact Estimator – www.athenasmi.org
Cradle2Cradle – www.c2ccertified.org
Health Product Declaration Collaborative – www.hpdcollaborative.org
The Pharos Project – www.pharosproject.net
GreenScreen – www.greenscreenchemicals.org
ASHRAE Advanced Energy Design Guide – https://www.ashrae.org/standards-research-technology/advanced-energy-design-guides CMRF

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Kynar Aquatec® is a new innovative platform of emulsions, which are used by paint formulators to make premium weatherable water-based coatings. Coatings formulated with these emulsions can provide the durability and performance of traditional Kynar 500® based coatings. They can be easily applied to a variety of substrates including: metals, plastics, wood, concrete, textiles and previously painted surfaces.

Kynar Aquatec® latex based coatings offer the extreme weatherabilty of Kynar 500® based coatings in a field- or factory-applied, ambient air-dry system. Additional benefits include tremendous resistance to dirt pick-up, outstanding water repellency, and high initial and long term total solar reflectance and emissivity.

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- Field Applied, Air Dry Kynar® PVDF
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- >10 Year Weathering in South Florida

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For more information contact:
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