While insulating and cool roof coatings have been popular in terms of the energy savings they offer, a new evolution is underway.

For many years, cool roof coatings could only be applied to existing roofs, but now homeowners seek the option to purchase and install a new roof that already includes the cool roof technology.

This means big business for the manufacturers of energy-saving roof coatings. They have begun to enter into agreements with roofing materials manufacturers to make available a factory-applied option of the technology.

Developing New Ways to Keep Our Cool
According to the U.S. Department of Energy (DOE), white roofs have been popular since ancient times, when people in warm climates, such as Greece, realized the comfort difference made by painting their roofs white.
Fast-forward to the 20th century, where one of the first groups formed specifically for assessing “cool roof” reflective coatings was the Cool Roof Rating Council. This independent, nonprofit, educational organization was created in 1998 to “develop accurate and credible methods for evaluating and labeling the solar reflectance and thermal emittance (radiative properties) of roofing products” (coolroofs.org).

The DOE identified cool roofs as a way not only to lower energy consumption in the summer and hot climates but also to reduce the heat island effect. In crowded urban areas, the dark buildings, roadways and hard surfaces tend to absorb, retain and generate heat into the atmosphere, raising air temperature; lighter surfaces and vegetative roof systems are acknowledged ways of mitigating this effect.

However, those in northern climates know quite well of one limitation to using a reflective technology for energy efficiency: a “heating penalty” in the winter or in colder climates.

Reflecting the sun doesn’t have the same impact on lowering heating bills as it does on lowering cooling bills. This penalty can either give a net-zero effect or actually cause heating bills to increase in particular regions, depending upon the experts you speak with.

**Nanotechnology-Based Solutions**
To solve this dilemma, advanced nanotechnology-based cool roof coatings in the form of thermal insulation coatings (TICs) began to be developed in 2004 to insulate against both hot and cold weather.

The main difference in the mechanism was that these TICs act as insulation, not as
ules. A network of nanoscale tunnels make up the inner architecture of the material and cause the reduction of heat energy as it transfers through the material. The hydrophobic nature of the nanomaterial gives the coating its mold, mildew and moisture resistance.

To recap the benefits of both technologies: Reflective coatings, also known as cool roof coatings, offer an energy-saving benefit by reflecting the sun’s radiant heat to keep roofs and the underlying building cooler. These are very economical and assist in hot climates and summer months but have limitations in the winter. They have also been known to reduce heat island effect.

Thermal insulation coatings do not reflect; instead they reduce direct heat conduction (both radiant and conductive) much like other traditional forms of insulation. Heat always transfers to cold, so with a thermal barrier coating you can reduce heat conduction from the exterior to the interior in the summer (lowering cooling costs) and also reduce it from the interior to the exterior in the winter (lowering heating costs).

This technology expansion significantly increased the geographical market options of energy-saving roof coatings.

Advances Create New Markets
The addition of color options beyond white...
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was another significant development that expanded the market for cool roof coatings in the 2000s. This expansion included not only multiple reflective color options but also clear TICs.

Infrared-reflective pigments, which absorb visible light and reflect the infrared radiation, began to be used in IR-reflective coatings. They provide similar reflective benefits as white coatings, but in darker colors.

These options further opened the market, since not everyone was willing to paint their roofs white. The clear and IR-reflective pigment options allowed energy-saving benefits no matter where people lived, and without restricting color in relation to the overall visual appeal of their home or building.

These developments were also of great interest to roofing materials manufacturers, as their many color options can often be a key selling point for products.

Additionally these new coatings tended to be thinner and more breathable than the earlier white coating technology, which further enhanced the coating technology without negative impacts.

Benefits Cover Many Levels

The key benefit of these reflective and thermal insulation roof coatings is by far the energy efficiency. They reduce energy consumption, and thus the load on the local power company, and the consumer enjoys reduced energy costs.

The newly developed technologies also offer many other cost-saving benefits, such as resistance to mold and mildew, which reduces the costs associated with power washing. Resistance to UV and moisture enhance the longevity of the underlying roof as well.

As the DOE, product manufacturers and distributors promoted the benefits of energy-saving and protective roof coatings, home and building owners began to request the option for newly installed roofs.

Having the coating already applied to the roofing material when first installed would significantly lower the cost to the consumer.

The concrete roof tile industry was the first roofing material industry to notice the potential benefit of applying the clear nanotechnology-based TIC onto their products.

By offering their tiles with an energy-efficient, mold- and weathering-resistant coating as an upgrade, they could stand apart from the competition and offer customers something they were already asking for.

This also allowed them to further solidify their relationships with roofing contractors who sold their products. It gave them the opportunity not only to offer the enhanced tile product, but also to offer upgrades to existing roofs by applying the same energy-efficient coatings.
Performance Backed by Independent Data
In order to satisfy the need for high-quality performance, the manufacturer of the patented nanotechnology-based clear TICs performed multiple tests. This supported a 10-year warranty and provided data to back the performance.

Thermal insulation testing was performed to ASTM E1530, Standard Test Method for Evaluating the Resistance to Thermal Transmission of Materials by the Guarded Heat Flow Meter Technique.

Tested over a sample of concrete roof tile, the clear TIC was found to reduce heat conduction, as measured in BTUs, by 29.7 percent at the typical two-coat coverage.

Mold-resistance testing was performed to two ASTM standards: D5590, Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay, and G21, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

Additionally, special long-term testing showed resistance to *Gloeocapsa magma*, the specific type of prehistoric bacteria that causes the green and black streaks often seen on roofs.

UV-resistance testing was another important component to acceptance of energy-saving coatings by the roof tile manufacturing industry. This same clear TIC was tested in a UV-aging cabinet, passing the 10-year equivalent with no discoloration or loss of adhesion.

Moving to Manufacturing
As with any new idea, there is a lot of work involved to bring it to fruition, and this marriage of energy-efficient coatings to concrete roof tiles was no different.

The development took somewhere between three to four years and involved detailed testing for proper application and dry times, tweaking the formulation for the best application in factory, as well as building special spray equipment for the manufacturing line.

However, the payoff was worth it for all involved — including the tile manufacturers, the coatings manufacturers and the consumers.

The first energy-efficient coated tiles were publicly available at the end of 2014, representing the advancement in the energy-efficient roof coatings industry. The industry evolved from simply painting a white color onto a roof in a warm climate, to...
factory-applied coatings on roof tiles in any desired color or style that would save energy in any climate and resist mold/mildew, UV and moisture.

At Work in the Field …

Besides the manufacturers of the coatings and roof tiles, contractors that install both see the advantages of this evolution. Joseph K. Lamb, Jr., president of Gulf Western Roofing in southern Florida, shared what this advancement means for his industry.

“The development of coatings for the roofing industry (especially the residential part of the roofing industry) in the past decades has been a long and sometimes painful experience for end users and contractors,” he told me.

“I was introduced to coatings like fibered-aluminum roof coating (for flat decks) and ‘roof paint’ (for cement tile) in the early ’80s. Although these products had useful properties for certain applications, they were unfortunately presented to the market as a cure-all for UV and mold/algae resistance into geographies such as South Florida, where they did not perform to the standards to which they were presented to the end user, adding to the already notorious reputation the roofing industry had created for itself.

“The combination of the manufacturers now making better products suited for particular purposes and unique climates with their enforcement of rigid application and inspection methods is leading to a renaissance for the coatings industry in which end users actually get what they pay for, whether it’s extending roof/building envelope life, preventing water intrusion/migration or condensation problems, and now even insulating properties on building materials that had none before the application.

“The latest chapter of the renaissance is nanotechnology.”

… And at Home

The real winners are of course the end consumers, who now have more options than ever before. They can use this technology to upgrade existing roofs to make them more energy-efficient and resistant to mold and weathering, or get the same
benefits on their newly installed roof, with the roofing material pre-coated at the factory.

The energy-saving benefits are a key reason that people seek out energy-efficient roof coatings. While typical energy savings are dependent upon individual climate and energy use, many customers report savings between 20 percent and 40 percent on their heating and cooling.

The maintenance savings can vary according to climate, with mold-prone climates saving more, but can be anywhere from $500 to $1,000 per year in savings from power washing.

More choices continue to be on the horizon as manufacturers of energy-saving coatings work to form partnerships with other roofing materials manufacturers beyond tile, such as asphalt shingle, composite, and metal roofing, not to mention for other areas of the building envelope. And the potential reaches far beyond only U.S. companies.

As we see more stories in the news about extreme weather, energy efficiency and reduction of carbon emission, the future looks bright due to the leading-edge work being done by those in the energy-efficient coatings industry and building materials manufacturing industry.

With both working together to provide sustainable and cost-effective solutions for roofs and building envelopes, the choices for home and building owners will only increase in exciting ways this century.

About the Author
Francesca Crolley is vice president of business development for Industrial Nanotech, Inc. She has worked with Industrial Nanotech since 2004, developing the company’s network of distributors and overseeing marketing and technical support for their patented nanotechnology-based coatings. She has authored articles focusing on energy savings, nanotechnology and sustainability, which have appeared in such magazines as Journal of Protective Coatings & Linings, Asia Pacific Coatings Journal, Dairy Foods, Sustainable Plant, and Facility Management, among others.

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