Radiant barrier plywood sheathing, such as Thermostat by Georgia Pacific (shown), can make attics cooler and is economical to install.

Courtesy Georgia Pacific

The Role of Radiant Barriers

Understanding the science behind radiant barriers makes it easier to spec the right product.

By Steve Easley

One of most misunderstood energy-saving technologies on the market today is radiant barriers. Radiant barriers are reflective materials that reflect the radiant heat from the sun. They come in a variety of product configurations:

Foil-like materials on rolls, which are draped across rafters, or spread across the attic floor. There are also radiant barrier building wraps; sheet goods where a reflective material is laminated to plywood or OSB sheathing; or spray-on materials.

Do these products save energy? Yes, but be careful because it's easy to confuse manufacturer claims for reflectivity and reductions in radiant heat transfer to energy savings. For example, just because a product claims that it reflects 90+% of the radiant heat does not means it will reduce your cooling bills by 90%.

How Do They Work?

To explain how radiant barriers work, let's first start with a science lesson about heat transfer. This understanding will help you sort fact from fiction and help you determine the value for your specific application.

There are three mechanisms for heat transfer: conduction, convection, and radiation. Heat always goes from warmer areas to colder areas. When you touch something warm, that's heat transfer by conduction—heat conducting from one molecule to the next. Insulation reduces conduction because it traps air, which retards the flow of heat.

When you use a fan to cool yourself by blowing air across a warmer surface, that is heat transfer by convection. We use air barrier wraps, and caulk, spray foam to seal to reduce air infiltration. Both heat transfer by conduction and convection require air or fluid to transfer heat.

The third method is heat transfer by radiation. It's a bit harder to get a handle on radiant heat flow. (Einstein spent the majority of his career trying to understand light and electromagnetic radiation.) Radiation is the emission of energy as electromagnetic waves or as moving subatomic particles, especially high-energy particles transmitted as heat, light, electricity, etc.

The sun, for example, heats the earth by radiation. Between the sun and the earth's atmosphere there is no air to conduct or convect energy. Outer space is a vacuum. Energy from the sun radiates through space and is not converted to heat until it hits matter like air in our atmosphere, your car seats, or a home's roof.

Unchecked, this energy can really heat up our homes and drive up air-conditioning costs. In fact, on a sunny day, the amount of energy that strikes one square foot of surface is about 250 BTUs. So for every 48 square feet of surface, that's 12,000 BTUs or 1 ton of a/c that has to be supplied!

That's why many energy codes and Energy Star require low-emissivity (high-reflectivity) glass in windows. Low-e windows have the ability to reflect heat. They call them low-e because the silver in the low-e coating does not emit heat energy very well.

About half the heat energy from the sun comes in the visible spectrum, the light we can see, and about half comes in the infrared spectrum, heat that we can't see but can feel. Radiant barriers reflect some of this heat. How well they work much depends on a number of factors such as placement, levels of existing insulation, and whether they get covered with dust.

How Do These Products Work In Your Attic?

Heat from the sun is absorbed by roofing materials and reradiated to

the air in your attic. That's why attics get so hot, often in excess of 130 F. This heat energy then gets absorbed by attic insulation and ceiling drywall. This heat is reradiated into the living space making to room warmer.

In general shiny surfaces reflect radiant heat energy. Shiny aluminum foil facing a heat source reflects over 90+% of the radiant heat that strikes it. So a foil like material draped over the trusses will reflect the heat energy back to the roofing materials as long as there is an air space between the two. In order for radiant barriers to work, the shiny side must face an air space.

You maybe wondering how radiant barrier sheathing products like GP's Thermostat and Tech Shield from LP work since the shiny side faces down toward the attic space instead of facing up toward the bottom side of the hot roof deck.

Remember earlier when I mentioned the low-e properties of windows? Emissivity is a measurement or ability of a material that indicates how well it emits heat. Shiny surfaces reflect heat, but they can't give off their heat energy very well. So the shiny surface facing down works fine because the heat absorbed by the roofing material is not easily emitted or transferred to the attic space. In general, the lower the emissivity of a material the higher its reflectivity.

Proper Placement Tips

If the shiny surface of a radiant material gets dusty it loses a lot of its ability to reflect heat and becomes less effective. That's why you should never place a radiant barrier material flat, shiny side facing up on an attic floor. Over time the dust can reduce its reflective properties. Also, many radiant barriers are also vapor retarders because they are made of foil or Mylar so they can trap moisture rising from living spaces beneath them. This is why I do not recommend radiant barriers installed directly over the attic floor because it could trap moisture and also it gets dusty, which reduces its performance. When using radiant barriers on walls be sure to use it only where you can also have an air space between the radiant barrier and the cladding. Brick veneer with its 1" air space would be a good place to use a radiant barrier housewrap. Remember: Unless it has an air space it won't save energy.

Radiant barrier OSB sheathing by Louisiana Pacific is one example of a radiant barrier sheathing product. It can reduce temperatures by 25 to 35 degrees.

How Much Do They Save?

Energy savings depend on your climate, shading from trees, orientation, how much insulation you already have in your attic, and to some extent how well ventilated the attic is.

Some manufacturers make outlandish savings claims that I don't believe. So don't get your expectations too high.

The DOE labs that have studied radiant barriers indicate the most energy saving benefits are in homes that have duct work or HVAC equipment located in the attic. Most always ducts and air handling equipment leak air. Leaky ducts draw in this super hot attic air. Your system has to work a lot harder to cool 140 degree than air from your attic than living spaces. So if you have cooler attic your A/C system does not have to work as hard to air condition your building. Radiant barriers can reduce attic temperatures 20 degrees to 35 degrees. The radiant barrier creates a cooler attic which helps reduce cooling costs. There are also some comfort improvements.

Overall, when installed properly radiant barriers can provide reduced energy costs and cooler attics. The sheathing products are pretty cost effective because they add little additional cost. They also have spray on products and the breathable housewrap radiant barriers.

Spray-on Radiance by BASF is spray-on radiant barrier product, which can be used in new or existing construction.

I sprayed the bottom side of my attics roof deck with a spray-on radiant barrier called Radiance and found that my attic temperatures were reduced by 20 degrees. In addition, the ceiling temperatures in the rooms below were about 2 degrees cooler. GB

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Top Courtesy LP; Bottom Courtesy BASF