Energy efficiency is, and has always been, one of the key reasons for building a home with radiant heat. Given the rapidly escalating cost of energy, the efficiency of radiant has never been more important.

### Radiant Heat And Energy Efficiency?

#### Parasitic heat loss
Parasitic loss refers to energy lost due to inherent inefficiencies of a system.

For example, duct work can be large in diameter, difficult to seal and insulate, and is frequently located in unheated crawl spaces or basements. As hot air is blown through these ducts, heat is lost through the walls of the ducts and potentially wherever there may be leaks at joints.

When hot air is blown into a room with a door closed, there may not be a good return path for that hot air which causes a slight increase in the pressure in that room. This pressure is then released to the outside around the weather stripping on windows. The blowers used in forced air systems typically require 9x as much electricity as the pumps in radiant system. All of these parasitic losses add up in forced air systems, making them upto 30% less efficient than radiant floor heating.

#### Zoning reduces energy usage
Most forced air heated homes have a single thermostat, and therefore a single zone. This is because forced air systems are inherently difficult, and expensive, to zone. Most radiant homes have numerous zones because they are relatively easy and inexpensive to create. It makes sense to heat bedrooms perhaps to 65°F (18°C) while maintaining 70°F (21°C) in a family room or even turning off the heat in a guest bedroom until it is needed. Directing the right amount of heat to the right rooms based on their usage is be a big energy saver.

#### Low ceiling temperatures
When air comes out of a forced air heating system duct, it is typically between 120–140°F (49-60°C). This hot air rapidly rises creating a heated layer of air near the ceiling. This can often be over 10 degrees warmer than the air temperature at the floor. This stratification effect becomes greater as the ceiling height increases and can be easily felt by those living in a two-story home, with the downstairs too cool and the upstairs too hot. When ceilings are hot and just below a cold roof, heat loss increases dramatically. This is precisely why ceiling and attics require so much insulation.

Radiant floors stratify much less for two reasons. First, at least 50% of the heat transferred is from infrared, a form of invisible light. Like all lighting, its effect is greatest the closer you are to the source. In other words, it concentrates much of its output near the floor, where you and your children live instead of near the ceiling. Second, because the temperature of a radiant floor is quite mild (typically 75-80°F / 24-27°C), it only warms air into the mid-70s, far less than the 120-140°F (49-60°C) temperatures from a forced air system. It is not unusual for the ceilings in a radiant home to be 10-20 degrees cooler than a forced air home.

#### Lower air temperatures
On a spring day when the sun is shining, we may be comfortable outside in shirtsleeves when the air is only 60°F (15°C) because the radiant warmth of the sun allows us to be comfortable at lower temperatures. The same is true in a radiant home. With the warmth of the infrared “shining” on us from the floor, studies have shown that the same comfort is achieved in a radiant home when the thermostat is set a couple of degrees lower as compared to a forced air home at the higher setting.

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**How to incorporate radiant heat into your energy efficient home**

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**Build A Home Like A Car That Gets 100MPG**

Energy efficiency is, and has always been, one of the key reasons for building a home with radiant heat. Given the rapidly escalating cost of energy, the efficiency of radiant has never been more important.
Blowing hot air paradoxically cools us

When outside on that same mild spring day we may be comfortable until the wind picks up. Even though the air temperature has not changed, the mere fact that there is air moving across our skin causes evaporative cooling. Paradoxically, blowing hot air from a duct can cause you to set the thermostat to a slightly higher temperature to maintain the same comfort achieved in a radiant home at a lower set point.

KSU study

It is difficult to precisely quantify the savings from these last three effects because actual savings can vary greatly depending on the design of a home, the climate zone, the type of fuel used to heat the home and many other factors. Nonetheless, a thoughtful study of all of these effects was done at Kansas State University in conjunction with the American Society of Heating Refrigeration and Air-conditioning Engineers (ASHRAE) that established that a “typical” radiant heated home in the US can expect a 25% savings over a conventional forced air home.

More Savings With Warmboard

Warmboard panels are the most conductive radiant assemblies on the market. Both Warmboard-S and Warmboard-R have a thick top surface (0.025") made of the highly conductive 1060 aluminum alloy. The modular pattern of channels are fully lined by this continuous aluminum plate to maximize the contact area with the hydronic tubing. The aluminum plate covers the entire panel and is in direct contact with the finish floor materials. This makes for a highly conductive assembly.

The basic equation for heat flow is:

\[
F = \frac{\Delta TKA}{L}
\]

It is a principle of thermodynamics, established by this formula, that as conductivity goes up, water temperature can go down. It is always less expensive to heat water to a low temperature than a high one. It is well accepted in the boiler industry that for every 3º that you lower the water temperature, you save 1% of the heating cost. This means that compared to a less conductive radiant floor system, our water temperatures are as much as 60 degrees lower for the same heat output. Compared to the commonly used thin slab systems, Warmboard uses as much as 30º lower water temperatures. That’s an additional 10–20% savings over the more antiquated radiant panel assemblies.

Maximize the efficiency of condensing boilers

Most modern ultra high efficiency boilers are termed “condensing boilers” because when they operate below 140ºF (60ºC), the water vapor in the flue gases condense into water droplets on the heat exchanger thereby extracting the maximum amount of energy from every gallon of fuel oil or cubic foot natural gas. Because Warmboard systems typically operate well below 140ºF (60ºC) they can increase the efficiency of these boilers by up to 8% when compared to radiant systems that require these higher water temperatures.

Low mass and temperature set back

Many state energy codes require that programmable (set back) thermostats be allowed to energy savings at night when occupants are sleeping. High mass systems are unable to make use of this feature because it takes so many hours for them to change their output. Fast response Warmboard works quite well with night time set back, saving additional energy in the process. Vacation setback is another important means for saving energy. If you’re going to be away from your primary home on vacation during the winter, it makes sense to set your thermostat back to perhaps 50ºF (10ºC) which will save considerable energy while you are gone. Or if you have a vacation home perhaps on the ski slopes you would similarly want to set the home back when not occupied, but with a high mass system it may not be worth your while to save that energy if you’re going to wait a day or so for your home to get warm. But with Warmboard, you can be comfortable in an hour or two after returning home which will encourage many homeowners to save all the energy possible with vacation set back.

Prevent overshoot

High mass systems have been known for producing less than the desired amount of heat all morning and more than the desired heat in the afternoon. The afternoon overshoot problem is often resolved in a high mass system by simply opening windows to dump the excess heat. While it is difficult to exactly quantify the savings that come from Warmboard being able to accurately and quickly adjust its heat output to match changing loads, it makes simple sense to have a heating system that does not require opening windows in the winter to provide the desired temperature.
Low water temperature for alternative heat

There are a number of innovative means of heating water, such as ground source heat pumps, solar, fuel cell cogeneration, etc., that are highly efficient but only work well with moderate (under 120°F / 49°C) water temperature requirements. While most radiant systems require warmer water than these technologies can supply, Warmboard’s high conductivity make it a perfect match for these technologies.

Save thousands on fuel costs each year

Modern homes are well insulated, have excellent glazing, low energy lighting and a variety of other energy efficient solutions to make them seem more like the 40 mpg economy car than the gas guzzlers of the past. But if you add a Warmboard, you can start approaching the ownership of a home that behaves, by comparison, more like a car that gets 100MPG. We say this not only because of the theoretical savings detailed above, but because we have many homeowners living with the comfort of Warmboard heat in their homes who report heating bills as much as 60% lower than similar sized homes in the same community. If you might normally expect to pay $5,000 to heat your home through the cold months, bills in the $2,000 range are what many Warmboard homeowners are experiencing. But remember, your mileage may vary.