The Basic Physics Behind Emerging Technologies.

Earth has been absorbing heat from the son and radiating heat from its core since its creation, and therein lies a virtually untapped reservoir that has the potential to relieve existing pressures on all other natural resources.

What if you could harness the power of terrestrial heat to warm your home in the winter-drawing from energy that has been absorbed and stored by the Earth over millions of years? Would you do it, knowing you can't be taxed on the "energy" you take from the ground? *(At least not yet.)*

Geothermal

HVAC is not an entirely new technology in that it differs a little, mechanically, from the refrigerator in your kitchen. However, in regard to residential home building, it is a fast-emerging technology that has the potential to become a standard heating and cooling method in tomorrow's homes. Additionally, it can be configured to heat a home's potable water supply.

The idea behind geothermal heating is to transfer heat energy rather than generating it anew.

In Wisconsin that average ground temperature (at roughly six to eight feet below grade) is about 50°F. That temperature remains relatively constant throughout all seasons. Geothermal technology uses a series of polyethylene pipes, filled with a water-based solution, to create underground loops that absorb heat and circulate the warmed solution back to the HVAC system inside the home. From there the heat is transferred to a forced-air or hydronic radiant system.

Because heat always disperses into cold, the ground-to-solution heat exchange reverses during the summer months, with the ground drawing heat away from the home.

There area currently one million geothermal HVAC systems in operation in the U.S. The environmental Protection Agency (EPA) has called geothermal the most energy-efficient, environmentally clean and cost-effective space-conditioning systems available. And the life span of the system is longer than conventional heating and cooling systems. Most loop fields are warranted for 25 to 50 years and are expected to last at least 50 to 200 years.

Geothermal systems do not use fossil fuels, eliminating threats associated with combustion, such as carbon monoxide poisoning. The fluids used in loop fields are designed to be biodegradable, non-toxic, non-corrosive and have properties that will minimize pumping power needed.

In assessing the practicality of geothermal HVAC, there are some details about the technology to be cognizant of. Ground loops can be placed almost anywhere adjacent to the home, so lot considerations are of limited concern. There are several different types of loop fields, with configurations ranging from horizontal to vertical; even pond or lake configurations are feasible. Loops must be located below the frost line and find optimal performance between 6 to 8 feet of depth. Typically, one loop (400 to 600 feet) has the capacity of one ton or 12,000 Btus per house (Btu/h) or 3.5 kilowatts. An average house will range from 3 to 5 tons (10 to 18 kW) of capacity.

Another technology gaining pace in the residential marketplace is dual-fuel HVAC systems. Again, nothing revolutionary here, it's proven that heat pumps are more efficient than furnaces at certain operations temperatures and vice versa. With a tag-team approach, switching between electrical and gas fuel sources based on temperature differentials, the homeowner is able to better control costs over the course of the year. There are a multitude of dual-fuel systems from the leading manufacturers.

Cost.

Yes, there is additional up-front costs for design, equipment and installation of a geothermal system. Dual-fuel systems have less of a price differential. In either case, costs can be directly affected by the installation experience of the contractor.

Calculations on energy savings and cost returns can be calculated over time and range from two years to 10 years. However, don't be dissuaded by these initial construction costs or the fear that offering this technology to buyers will price you of the competition. Buyers are bombarded by energy prices and Earth-conscious technologies daily, and they are doing their own research. Even though the average homebuyer today estimates living about five to seven years in their home, in almost all cases they; bad purchasing decisions on financing and cost of construction and owner-ship over 30 years softening the impact of these upfront costs. In essence, buyers see it as paying for what they use. Moreover, the concept of a significantly more energy-efficient of more *energy-independent* home can be a superior selling point today and far into the future.

Just a few short years ago there were only a small handful of geothermal and dual-fuel products on the market for residential construction. Today the numbers are growing exponentially, and with continued significant rises in energy prices, manufacturers will almost certainly begin to shift more R&D dollars into energy-smart technology. As competition "heats up," the market will produce increasingly valuable products to offer homebuyers.

An obstacle or a just hurdle?

New technologies and processes can look daunting, and some builders will hold back until a technology is widely accepted before offering it to their homebuyers. But you can get ahead of the pack by taking advantage of presentations and seminars offered by the manufactures and seeking market feedback and year-by-year comparisons from contractors who specialize in dual-fuel and geothermal systems. Don't miss this opportunity to establish yourself now as a leader in energy-conscious residential home design.

Providing Comfort to your customers is something that can't be seen or measured. When designing your homes, simply calling for an X-efficiency furnace will do little to match the precision and craftsmanship of the rest of the home.

Proper heating and cooling requires more than rule-of-thumb specifications. Understanding a room's exposure, its volume and its location relative to other rooms and blower will significantly improve comfort throughout all seasons. Proper planning is like an insurance policy against furnace callbacks related to home comfort. Following are some areas that, with just a little attention to detail, can product large results when it comes to overall comfort.

Friction loss ~ As air travels through ductwork, it slows, This is friction loss, and it can be calculated. Blowers must be selected on their ability to handle the greatest friction loss within the system.

Leakage ~ It is reasonable to assume that all ducted systems will have a leak somewhere. Because of Wisconsin's tight design practices, most leakage occurs "within the building envelope," which is preferred. However, any leakage can cause the system to run longer than needed, which reduces the energy efficiency of the overall system. Sealing all ducting seems like an easy thing to do, and in reality it is, but in many cases you still need to specify it in the contract to ensure it gets done.

Choice of ductwork ~ Oval pipe is popular. It is cheaper to install and many think because of the symmetrical sides it is more efficient. However, oval pipe can reduce capacity by up to one-third over box ducts. Therefore, if oval pipe is used, be sure to ask if the blower has been properly sized and rated for the overall design.

Measuring Efficiency – COPs: Because both geothermal and dual-fuel systems incorporate heat pumps, the terms and concepts behind measuring efficiency are a bit different than what you may be used to. Heat pumps are typically measured by the *co-efficient of performance* or COP. For comparison, normal electric resistance heat has a COP of 1. In other words, for 1 kilowatt used, you get 1 kilowatt's worth of heat, or 3413 Btus. A heat pump is also an electric heating device, but due to its design and operations process, it is must more efficient than resistance heat. COP ratings on heat pumps vary depending on outdoor temperature-a temperature drop outside will result in a decrease in the heat pump's COP. ARI rates heat pumps at two outdoor temperatures: 47° and 17°F. A typical COP for a 13 SEER heat pump is 3.25 at 47° and 2.50 at 17° and includes all the electrical usages of the system (compressor, condensing fan motor, indoor blower). If a heat pump has a COP of 3, then for 1 kW used you get three times the amount of heat out of the system, or 10,239 Btus. In terms of energy savings, for the same 3,413 Btus, the heat pump would save you one-third the cost over regular-resistance heat.

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