Propane as Primary Energy Source for Water Heaters: Radiant Heating Systems and Tankless Water Heaters Further Enhance Opportunities to Create Hyper-Efficient Home Heating Systems

Given the many factors affecting today's energy market, homebuilders are investigating available options for efficient and cost-effective heating systems. The arrival of new tankless water heaters and hydronic heating systems such as radiant floor heating systems are key drivers in this trend. Together, these two heating innovations can deliver incredibly efficient heating systems that cost less than traditional forced air, but deliver a much larger payback in terms of reducing ongoing energy costs while improving the overall comfort and air quality of a home.

This paper is designed to provide an introduction to the factors that support gas (both propane and natural gas) as the primary energy source for both water heaters and hydronic heating systems. Builder market research conducted by the propane industry found that while consumers prefer gas for water heating, they defer the decision to the homebuilder. The research also found that many builders are still recommending that electric water heaters be installed in homes. This paper explains why electricity is the wrong choice for water heaters, and how propane can help a builder to offer a home heating system that is hyper-efficient and delivers tremendous value in reducing a homeowner's ongoing energy costs.

The paper begins by examining the factors that support gas as the preferred energy source for water heaters, then moves on to examine how tankless water heaters deliver even greater improvements in reducing energy costs without any trade-offs in regard to performance. Hydronic heating systems are also examined with a focus on radiant floor heat. The paper closes with an examination of how tankless water heaters can be used for radiant floor heat systems. This new development results in unprecedented efficiency and creates new business opportunities for homebuilders in both new construction and remodels. The discussion presented here is based on the use of professional grade equipment available through established wholesale distribution channels.

1.0 Introduction – Gas vs. electric as a home heating fuel

1.1 The first step toward home heating efficiency – compare the water heater energy source

While this paper explores how tankless water heaters, combined with new radiant floor heating systems, can deliver unprecedented efficiency and comfort to a home, the first step toward home heating efficiency begins with an examination of the energy source for a water heater. An analysis of the hot water heater's "first-hour rating" is key to understanding how an energy source can impact annual fuel costs for a home. This rating tracks how much energy is required to return a standing volume of water to its set temperature once hot water is drawn from a water heater. This rating also tells the homeowner or builder how much volume of hot water the product can be expected to produce per use under worst case conditions such as colder incoming water temperatures that may be experienced during winter months.

This is an important first step in moving toward an efficient home heating system – when electric and gas water heater first-hour ratings are compared, a homeowner can see a significant difference:

Water Heater Type	Energy Source	First-Hour Rating	Annual Fuel Cost[1]
50-Gallon conventional tank	Electric	51	$450
50-Gallon conventional tank	Gas	73	$196
80-Gallon conventional tank	Electric	85	$550
75-Gallon conventional tank	Gas	91	$365
6-Gallons per minute (GPM) tankless	Gas	240	$176

As the table shows, a homeowner can significantly reduce energy costs by replacing a 50-gallon conventional tank water heater powered by electricity with one fueled by gas (propane or natural).

1.2 Recovery rate of gas cannot be matched by electricity

Gas is a much more efficient fuel source for heating water because gas has a much faster recovery rate. Gas can bring cold water back to the set temperature far more quickly than electricity. For example, an electric tank water heater operating at peak performance can only recover hot water at a rate of 20 gallons per hour. Now compare the recovery rates for gas tank water heaters – their recovery rates can range from 50 gallons per hour to hundreds of gallons per hour depending on the efficiency factor (EF) and the firing rate capacity of the heater. For instance a Bock Power Gas propane-fired 50-gallon water heater can produce a whopping 164 gallons per hour of hot water.

1.3 Other factors affecting efficiency

The average life expectancy of an electric tank hot water heater is approximately 10 years. Factors affecting the lifecycle include usage, maintenance, and local water conditions. Deposits in the water can have an impact on the long-term operating costs for a conventional electric water heater because electric water heaters contain electrical elements that can accumulate deposits. These deposits affect efficiency since they are baked onto the element surface. How quickly and to what degree these deposits affect the efficiency of the product is based on the condition of the water. As the elements accumulate sediment and scale, recovery times increase and efficiency decreases. If an electric water heater were to lose just one of the elements, it would drastically impact hot water recovery rates and require a costly repair.

Given the cost-savings gas water heaters can deliver, a first step toward reduced energy costs is to replace conventional electric tank water heaters with gas. This simple step could cut annual home energy costs for making hot water in half. When one considers that energy used to make hot water drives 30 to 50% of a home’s energy needs, replacing electricity with gas can have a significant impact on monthly energy costs.

A new generation of tankless water heaters provides builders and homeowners with even higher efficiency gains that can further reduce annual home energy costs. This further advances the potential for reducing energy costs for a home.

2.0 Examination of key drivers affecting tankless water heater market growth

2.1 The U.S. water heater market

Approximately 9 million conventional water heater units are sold annually. Of these, about half are fueled by gas (propane or natural), with the other half being powered by electricity. However, tankless water heaters, even though they represent a fraction of the market, are gaining ground. A big reason for tankless market share gains is improvement in the technology, but their attractiveness is also supported by the inherent ability of gas to heat water better and faster than electricity. When gas is used to fuel efficient tankless water heaters, homeowners can realize exceptional efficiency gains as noted in the table above.

To understand why tankless water heaters are catching on – and the implications they have for even further gains in reducing home heating costs – a review of how they work compared with conventional water heaters follows, along with an examination of past issues that may impact a homebuilder's perception of the effectiveness of tankless water heaters.

2.2 How they work – Conventional tank and tankless water heaters

Conventional tank water heaters store a volume of water (e.g., 30 gallons, 75 gallons) that is heated to a set temperature and then maintained at that temperature for future use. This requires the energy source to cycle on and off to keep the water at the set temperature. When hot water is drawn from a conventional water heater, the water heater then must "recover" after each draw to be ready for the next demand cycle. This requires additional energy to bring the stored volume of water up to the set temperature.

Conventional tank water heaters cycle on and off in order to offset what is known as "stand-by" loss. The definition of which is the percentage of heat lost per hour from the stored water compared to the heat content of the water. The concept is as simple as understanding what happens to a fresh-brewed cup of coffee once it's removed from the burner – as it sits in the cup, heat loss occurs. The temperature of the coffee can be restored by returning it to the burner or placing it in the microwave. When stand-by loss occurs, conventional water heaters require the energy source to turn on to offset heat loss and maintain the set temperature.

Tankless water heaters operate on "flow only." This means that tankless water heaters are activated when a homeowner turns on a faucet or an appliance that requires hot water. Tankless water heaters are "always off" waiting for a "flow demand." Their fully modulating burners use only the amount of propane needed to meet the demand.

This is the most obvious difference between tankless and conventional water heaters. Tankless water heaters eliminate the need for a stored volume of water – eliminating stand-by losses and the resulting energy needs. As a result, they operate even more efficiently than conventional water heaters.

2.3 A brief history of tankless water heaters

Twenty years ago the first tankless water heaters began to appear in the U.S. Effective operation was a product of the unit's "minimum flow rate" – the amount of water flowing through a hot water valve. Early tankless water heaters had a high minimum flow rate, with some flow rates as high as one gallon-per-minute. These high minimum flow rates meant that many times a sink faucet wouldn't generate hot water because its flow rate didn't meet the flow demand of an early tankless water heater.

Early tankless water heaters also lacked other controls which meant that a homeowner might experience fluctuation in hot water temperatures during use, or that the water heater might experience a flow rate beyond its capacity to heat the water. This would of course lead to reduced temperatures of hot water or worse, none at all. These issues helped to create a negative market perception for early tankless water heater models.

Ten years ago a new generation of tankless water heaters arrived in the U.S market. These products offered advanced technology that included computer control of all operations, much lower minimum flow rates and precise temperature controls. Since then, models have continued to feature advanced technology which has resulted in dramatically improved performance, longer lifecycles (a 20-year lifecycle compared to a 10-year lifecycle for a conventional tank water heater) and superior product safety features never before offered in water heating appliances.

2.4 Tankless water heater and conventional tank water heater cost comparison

With today's tankless water heaters delivering performance rates that meet and exceed conventional tank water heaters, the primary barrier toward consideration is price. Tankless water heaters can cost two to three times more than electric tank water heaters. The challenge for a homebuilder is to help homeowners understand the lifecycle benefit of a tankless water heater and how it offsets start-up costs – tankless water heaters are much less expensive to own over their lifetime.

For example, assuming a tankless water heater installation will cost $3,000 compared to $1,000 for a conventional electric water heater, a homeowner needs to first understand equipment replacement timeframes. Tankless water heaters last twice as long as a conventional water heater – 20-years as compared to 10-years on average. Factoring in the necessary replacement cost for a conventional water heater brings the comparable 20-year equipment cost difference down to $1,000.

Analyzing energy savings, a 50-gallon conventional electric tank water heater has an energy cost of $450 per year compared to $176 per year for a propane tankless water heater. This represents an average annual savings of $274 per year. Given that conventional water heaters last 10 years, a tankless water heater will generate a savings of $2,740 (significantly greater than the $1,000 cost differential between tankless and conventional) during that period. Over the course of the next 10 years, a tankless water heater costs $2,740 less to operate than a conventional electric water heater and eliminates the need for a replacement since tankless water heaters last for 20-years. This more than offsets the up front calculated equipment cost difference of $1,000 within the first five years of ownership.

Note that as of September 2006, most residential tankless water heaters qualify for a $300 federal energy tax credit[2] which can help to offset installation costs. This tax credit only applies to water heaters that have an "Energy Factor" of .80 or higher.

Tankless water heaters free-up usable floor space in a home. A standard 50-gallon tank water heater takes up nine-square-feet of valuable floor space. A home that has a value of $200 per square foot would gain $1,800 in usable space by installing a tankless water heater instead of a tank type water heater.

2.5 Switching out electric water heaters with gas an opportunity for the remodel market

For homes that don't have access to natural gas, propane can be easily retrofitted into a home where gas is currently unavailable. Adding a propane tank and gas piping to the home is typically a very cost-effective alternative to electricity for a heat source. Gas systems can use either the usual black steel threaded piping common to many homes or the newer corrugated flexible piping systems that make pipe installations much faster and reduce installed costs. Propane operates at higher pressure than natural gas and can use smaller diameter gas piping to provide proper pressure and volume. Using smaller diameter piping reduces costs by lowering labor costs (smaller piping is easier to run) and lowering material costs (smaller diameter piping costs less).

If water heaters are a starting point for improved energy efficiency, heating systems are the next issue to consider when building an energy efficient home. Radiant heat is the fastest growing heating system alternative for new homes and renovations. The reasons for its growth are examined in the next section.

3.0 Radiant floor heat – factors driving market gains

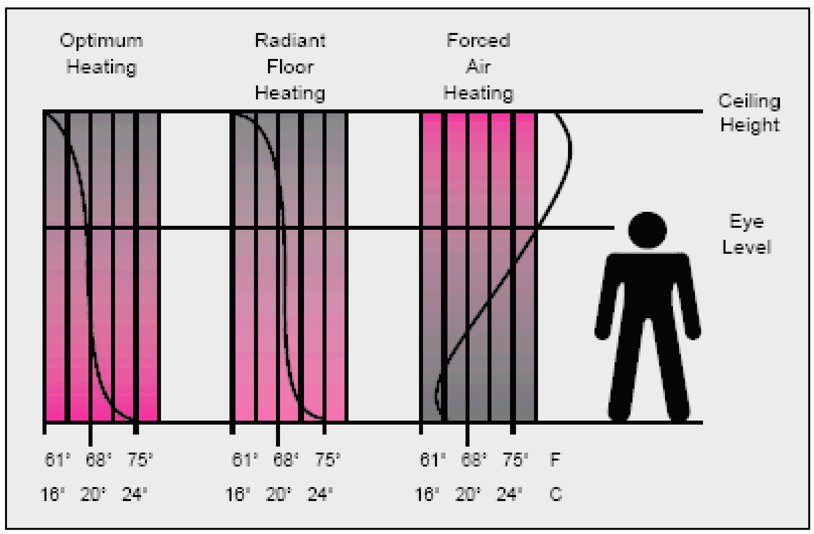
3.1 Radiant heat systems operate at lower temperatures, further reducing energy costs

One of the primary drivers contributing to radiant heat market gains is the simple fact that radiant heat is more comfortable than forced air heat. Radiant heating systems provide heat in an ideal "temperature curve" that results in temperatures that are more in tune with the human body (see side bar – how our bodies stay warm). Comfort is a major factor for homeowners, but the fact that radiant heating systems can operate more efficiently than forced air heating systems also enables homeowners to further reduce their energy bills. When radiant heating systems are combined with gas heating solutions, consumers can realize even further gains in reducing home heating costs without trade-offs in terms of comfort.

Radiant heat can operate more efficiently than forced air systems because radiant heat operates at a lower air temperature than forced air heat. This is important because reducing the air temperature setting by one degree can reduce home heating costs by 5%. Rooms using radiant heat are typically kept at 68ºF, but deliver a comfort level that would match a forced air heating system set at 72º - 73ºF. This difference in temperature setting could deliver a potential savings of 25%. Note that annual savings of between 15 and 50% are common for homes that use radiant heating systems. Other factors also contribute to radiant heat's efficiency advantage over forced air heat.

3.2 Radiant heat is a more comfortable and efficient heating system than forced air heat

Radiant heat remains at the level of human occupation instead of "rushing up" to the ceiling as forced hot air systems do. This can result in significant advantages if a home has vaulted ceilings – hot air stratifying at high ceiling levels adds to the homes heat loss and makes it harder to maintain comfortable temperatures at floor level.



(Chart Courtesy of Rehau)

This issue is examined in the following chart, which features a standard ceiling height of eight to nine feet. The chart compares the ideal temperature curve as compared to how heat is delivered through radiant and forced air heating systems. The optimum heating curve on the left demonstrates that the human body is most comfortable when the temperature is warmer at the feet and cooler at the head. While radiant heating systems follow this curve, forced air heating systems deliver heat in a way that is opposed to the optimum heating curve. In rooms with high ceilings, the forced air-heating curve would widen even further, while the radiant curve would remain mostly unchanged.

Forced air heating systems tend to "pressurize" the space and the human body senses this change to the air pressure. The "drafty feeling" of forced air heating systems is a result of these changes in pressure. Higher pressure results in heat moving through cracks and crevices of the home, and lower pressure causes a reverse effect – cold air is sucked into the room. Radiant eliminates these drafty conditions because it does not change the air pressure in the home.

Radiant heating systems can use a home's thermal mass to deliver a more constant heat source – flooring materials retain heat energy and slowly release heat over longer periods of time. This factor can contribute to much faster recovery of heat in areas of the home that have large doors such as patios and the main entrance to a home. This is referred to as the "Fly Wheel" effect – stored energy in a thermal mass helps a space recover quickly from a rapid heat loss, such as the opening of the front door. This "Fly Wheel" effect also helps the system "coast" through short periods when winter is at its coldest by being able to release stored energy as required.

A final factor related to comfort is that radiant heat is a cleaner heating system – it doesn't promote or distribute allergens, dust, germs or other contaminates, unlike a forced air system.

3.2 Radiant heat comfort advantages are matched by improvements in installation

Radiant heat systems can be installed in any home. Even existing homes built on concrete slabs can have a radiant heat system installed. Because of the myriad of choices available, each system can be designed for the unique needs of the homeowner and accommodate the available budget and construction timeline. A professional plumbing and or heating contractor familiar with radiant systems should be consulted when determining the system for a project.

While the thermal mass in a radiant system can usually be installed in or on any material or surface where heat is distributed, floor installations are most common with installation in the joist bays. In a joist bay installation tubing is routed through the space between the floor joist. This tubing is fastened to the bottom of the subfloor using staples or clips. Other systems use heat transfer plates, which allow for better heat distribution with lower water temperatures thus giving greater system efficiency. Insulation is placed below the tubing to provide an annular air space and to force the heat released from the tubing upward to the floor above. This airspace, along with the flooring materials, creates the thermal mass of the system.

Most modern homes will feature joist bay installations or some combination of joist bay and concrete slab depending on the construction of the house. Joist bay application is the most cost-effective way to install radiant floor heat in new homes with crawl spaces, and for those homes with basements, a slab installation is also very economical.

Another type of installation is a tube and plate system designed to be installed on top of the subfloor to deliver the heat closer to the finished floor. These systems are common where installing the tubing below the floor is not feasible or where faster system response time is desired.

How our bodies stay warm

Human comfort is affected by the rate of heat lost by the body. As long as heat loss is "neutral" between the body and its environment, perfect comfort is achieved.

The human body loses heat in four ways: evaporation of moisture, convection of heat to surrounding air, conduction of heat to objects that contact the body, and radiation. An overview of each follows.

Evaporation of moisture from the body is responsible for approximately 25% of our heat loss.

Convection is where air moves across the skin removing heat. This is why a fan makes you feel cooler on a summer day. The fan does not change the air temperature, but the added convection removes heat from the body faster. How fast air is moving across the body effects the rate of heat lost from convection. Convection accounts for approximately 25 - 30% of the heat lost from the body.

Conduction is best understood if you think of how your arm cools when it rests on a cool surface such as a granite counter top, or how your feet feel on a cold tile floor. This represents a very small amount of heat loss, usually less than 5%.

Radiant heat loss is the primary factor affecting body heat. Heat, including heat released from the body, travels to cold in a straight line. Radiant heat loss is dependent on the temperatures of surrounding surfaces. The colder those surfaces, the faster the radiant heat loss of the body and the less comfortable you feel. This accounts for about 50% of the body's heat loss.

A good example of radiant heat loss is when an individual walks past a large window during a cold winter day. A person "feels" colder because the surface of the window is considerably cooler than the rest of the wall.

If a surrounding surface is warmed to a point where body heat temperature is the same as the heat of the surface, comfort is achieved. This is how radiant heating systems work and why they deliver such a high degree of comfort.

Above floor plate and tube systems are the most efficient of all radiant floor systems and utilize the lowest water temperatures to heat a space. They also tend to have faster system recovery times since there is less mass. The trade off is in the up front cost. Typically, above floor tube and plate systems are more expensive than the joist bay systems. For existing homes with a basement, the above floor tube and plate systems can be a very good way to install a radiant heating system.

The most common tube spacing for radiant floor systems are 6" to 12" for slabs, 8" for joist bay and 6" to 8" for plate and tube above floor. Closer tube spacing is sometimes used along exterior perimeter walls to provide more heat to higher heat loss areas.

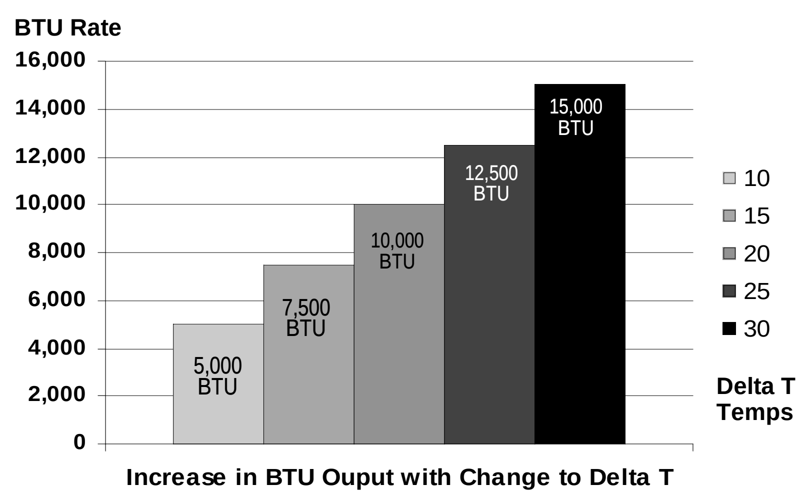
Note that in addition to floors, radiant tubing may also be installed in walls and ceilings with good affect. This solution is best for a situation in which there is not enough floor space to heat a space that is prone to high heat loss. In this instance, the lower 3' of the walls can be used as a radiant panel to provide enough heat for the space.

Remodeling projects such as a kitchen or master bathroom can also take advantage of radiant floor heat to replace forced air systems. In these instances a tankless water heater can help make this an affordable option for a homeowner's remodeling budget.

Radiant heat system costs vary based on the size and technical requirements of a project. For instance, a single-floor home with one heating zone and a concrete slab would be at the lower end of the cost spectrum. Large custom homes with multiple heating zones and accessories such as towel warmers, outdoor patio heat and other devices would be at the opposite end of the spectrum. Ultimately, the needs and desires of the homeowner, combined with the related accessories, will govern overall installation costs.

4.0 Tankless water heaters and radiant heat systems – a discussion of how tankless water heaters can be used to create hyper-efficient heating systems

Tankless water heaters now can serve as an economical alternative to a conventional boiler, with a cost per delivered BTU that can be lower than a boiler, but with comparable output. As a result, tankless water heaters can be considered for use as a heat source for hydronic radiant floor heat systems, or serve as "combo systems" that provide both domestic hot water and heat from a single device. Tankless water heaters can also now be used as a heat source for hydronic coil heating systems, replacements for "Apollo" type systems or as a hot water source for "Heat pump helper" coils.



Because tankless water heaters are not limited to high return water temperatures like conventional boilers, they can introduce added flexibility in heating system design by allowing for use of a higher Delta T (the difference in the supply and return water temperatures). As a result, tankless water heaters can provide more BTU capacity per gallons per minute (GPM flow).

This is illustrated in the chart on the previous page, which shows how a higher Delta T can generate more BTU from a tankless water heater if needed. This concept is important to understand when there is a need for more than the typical 10,000 BTU per GPM to heat a space. For example, increasing the design Delta T from the standard of 20º to 25º delivers an increased output of 2,500 BTU per GPM flow.

As a result this enables the installer to get more usable BTUs from a smaller capacity system when there is only a modest increase needed. For instance, a home needs 87,000 BTUs of heat under design day conditions. (See sidebar for explanation of "Design Days.") If the heat loss was determined using the standard 20º Delta T, many standard residential tankless water heaters would not have enough capacity and a larger, more expensive unit would be needed. By changing the design to a 25º Delta T, an extra 2,500 BTU per GPM of flow from that same tankless water heater can be obtained. If the tankless water heater is capable of 8 GPM it can now have a heating capacity of 100,000 BTU (12,500 BTU per GPM X 8).

Reader Note: If tankless water heaters are considered as a heat source, one must understand that their actual heat output will be limited by their flow rate capacity.

For example, using the standard 20º Delta-T, a tankless water heater that has a maximum flow rate of 8 GPM can deliver 80,000 BTUH (BTUs per hour). (Even though the maximum firing rate may be 199,000 BTUH.) Tankless water heater manufacturers are working to address this issue with new units developed specifically for use as a heat source. The reader is encouraged to watch for these new products in the near future.

See the explanation of the relationship between Delta T and BTU using different design Delta Ts.

4.1 Piping solutions for radiant systems with tankless water heaters

Prior to design or installation, piping and radiant floor diagrams will need to be consulted. Most tankless water heater manufacturers can provide the information upon request. Three reference diagrams, provided by Noritz, are included in the Appendix as an example of what OEMs make available, and to help illustrate the installation discussions.

The following sections are designed to help the reader understand differing approaches to proper piping of a radiant floor heating system, or a combination system delivering both radiant and domestic hot water.

4.2 Primary/Secondary installation overview
(See Diagram 4.2 in the appendix)

Primary/Secondary refers to a popular method of hydronic piping that allows for independent zones to work off of a separate loop of piping that delivers heat from the heat source directly to the zones (secondary loops) of a system. The primary loop circulates water through the heat source. Off of this primary loop any number of secondary loops or zones may be connected up to the capacity of the heat source.

This allows a heating system designer to do several things. First it gives great flexibility in the zones by allowing the use of many different heat delivery systems including radiant floor heat, high temperature zones such as a hydronic baseboard or fan coil units, and even towel warmers. It also makes it easy to use any of a number of mixing devices to control the water temperatures delivered to the different zones. It also provides the ability to have different temperatures in each zone, and it allows for the use of lower power pumps on individual zones since these pumps only need enough energy to supply the flow to the zone they serve. In a multi-zone system, when using a

About Design Days: "Design Day" (Sometimes called "Degree Days") is a term used to represent the coldest or hottest days that a HVAC system is designed to perform under. The design day represents a condition that will only occur during very short periods of time for the home. Under these conditions the house is designed to reach and maintain the desired setpoint temperature chosen, usually between 68ºF and 72ºF indoors.

The actual heating or cooling needs or "load" of the house is proportional to the outside temperature. By choosing systems that can operate at variable rates of output, proportional to the actual heating or cooling load, we can achieve comfort without using more energy than is required to maintain setpoint temperatures.

tankless water heater as a heat source, it is desirable to use the primary secondary method of piping. If this method isn't used, the system would require a large enough pump to move the proper amount of water through all of the system at the same time – even when only one zone is calling for heat.

4.3 Direct pump system installation overview
(See Diagram 4.3 in the appendix)

In some cases, a direct pump system can perform well. The primary difference with this system is that pumps are only shown on the individual zones of the system. However, each pump must be sized for both the pressure loss of the heat source and its respective zone. This results in the system design calling for pumps that are larger than they need to be in order to offset the possible event in which less than one zone requires hot water at the same time. Another issue to be aware of is that in many modern radiant zones, the flow rate required from the heat source for only a single zone may be too low to exceed the unit's minimum flow rate (see section 2.3 for discussion of minimum flow rates), causing the unit not to fire. The system design needs to address this issue, otherwise a single zone won't receive any heat until another zone adds to demand that exceeds the tankless water heater's minimum flow rate.

It is the author's opinion that primary/secondary should be used on multi/zone systems and the direct pump system should only be used on single-zone applications.

Note: Some local codes do not allow the same water used for heating to be used for domestic hot water. In these instances, a separate tankless heater can be installed to perform each task, with one heater specifically for domestic hot water and the other for the heating system. Understanding the tankless requirements is function of knowing the local code and designing the correct heating system. In some cases, design requirements will require that the system have two heaters. For example, if 80,000BTUH is required to heat the home, and the tankless water heater can deliver 8GPM, the system would require another unit to provide domestic hot water.

During the design phase, and depending on local codes, an optional system could be designed to provide "Domestic Hot Water Priority" over the heating system. With this type of control, when there is a domestic hot water demand, the heating system is deactivated to allow for full capacity to provide hot water for bathing or other needs.

4.4 Other factors to consider in terms of reduced installation costs

Tankless water heaters are not subject to damaging internal flue gas condensation that can damage conventional boilers when used with relatively low water temperatures associated with radiant heating systems. This can greatly simplify the hydronic piping for smaller projects. One could also use tankless water heaters as a heat source to lower overall costs of smaller projects where using a conventional boiler of a modern modulating condensing boiler might raise the cost of the job over the allowable budget.

This paper focuses on tankless water heater applications. There are of course a variety of propane fueled equipment options now available to produce super-efficient systems. These include modern modulating condensing boilers and power gas water heaters. These options will be addressed in a future publication.

5.0 Conclusion

Propane water heaters can provide a safe, reliable and viable heat source for domestic hot water and radiant space heating as an alternative to electric tank water heaters and electric heat sources. These products offer the highest delivery rate of usable hot water for either task while delivering exceptional energy savings as compared to the properly sized electric equipment that would be needed to match the capacities of gas water heaters.

Today's tankless water heaters have a history of being the most reliable over time and offer even more potential value to the homeowner based on overall cost of ownership, comfort and performance. Tankless water heaters and radiant heat systems save space in the home because they take up virtually no wall or floor space. Tankless water heaters can also be having the option of being installed outdoors.

When installed in combination, a radiant heating system with hot water supplied by a tankless water heater can deliver lower up-front equipment costs than other hydronic systems, and deliver a hyper-efficient home heating system. The efficiency gains are a result of a true "on demand system" that turns on only when heating levels require more hot water, or to provide domestic hot water as needed in the bath, kitchen or laundry room – eliminating the need for any energy required to offset "stand-by" losses, which are common to traditional tank water heaters.

Energy efficient homes are ultimately a function of the materials used to build the home and the energy sources used to fuel the home. This is why the energy tax credits examine both building envelope, appliances and heating and cooling systems installed in a home. Development of a modern insulation strategy, combined with efficient systems, is essential in building homes that provide increased comfort and are more energy efficient. This is why, heating system designers often refer to insulation as "the fuel you only buy once."

Increasingly, builders are choosing those building materials that deliver exceptional energy reduction benefits with a focus on performance, as well as the material cost to the builder. Builders need to be equally diligent about energy sources. Gas, both propane and natural, should be the primary fuel source chosen for hot water applications, including hydronics heating systems. Builders can reduce building costs by examining how these choices help them qualify for energy tax credits. They can also benefit if they understand how choosing the right mix of energy sources increases the potential value of the home, not just in terms of reducing overall energy costs, but adding value throughout the home, including in the kitchen (e.g., gas range) and in outdoor rooms (e.g., underground propane tanks with custom outdoor installations plumbed for gas).

About the author

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Mr. Gregg is a Noritz tankless water heater installation trainer and author of the book "Profitable Plumbing," as well as "Tankless 101" – a white paper on tankless water heater installation that is available on www.profitableplumbing.com.

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[1] Energy Guide values were referenced for the table on page 1 and serve as the source in this paper for comparing operating costs of electric and propane conventional tank water heaters, and tankless water heaters. The values are based on an estimated use of 2,000 gallons of hot water per month by a family of four. The Energy Guide sticker program implemented over a decade ago by the U.S. Department of Energy has become a valuable resource for builders and homeowners because it standardizes the criteria used to determine operating costs of a given product.

[2] For more details, visit www.energy.gov/taxbreaks.htm, or speak to your tax preparer.