BY LEE McGINLEY

Electric Water Heating for a Low-Load Home

Five years ago I read an article in which the author predicted that electricity would become the residential fuel source of the future, displacing on-site fossil-fuel consumption. "Sure," I thought. "He must be wrong." But as I designed my house and did more research, I realized that the author who foresaw electricity's predominance might be right.

In the 1960s and '70s, many houses were built with electric resistance heating and electric hot-water heaters. The systems were inexpensive to install but very expensive to operate. Not surprisingly, all-electric homes fell from favor.

When I started designing my new, super-insulated home, one of my goals was to provide heat and domestic hot water as economically as possible. My plan was to use R-80 insulation in the attic, R-45 in the walls, and triple-pane windows.

A heat-loss analysis predicted that an electric air-source heat pump (mini-split) would provide comfy room temperatures in our Vermont winters with a projected annual heating and cooling bill of $400 to $500. That was substantially less than the $1,800 to $2,000 I had been paying for heating alone with an oil-fired boiler. Fine, so far.

To further contain utility costs, I needed to decide on an energy-efficient source for domestic hot water. Improvements in electric water-heater design and insulation have enabled some heaters—such as the Marathon heater (marathonheaters.com) with its thick wrap of foam insulation—to keep 50 gallons of water heated for stand-by use. But for a household of just one with a lifestyle that includes laundering in cold water, taking brief showers, and using a dishwasher with a built-in water heater, that seemed both unnecessary and expensive.

1. The author installed a Stiebel Eltron Tempra 24 Plus on-demand water heater, which has a water-temperature dial and LED ridge. He included an Aqua-Pure AP430SS Scale Inhibition System, which has a consumable water-treatment (white) canister.

Photos: Lee McGinley

GAS-FIRED OR ELECTRIC?

I considered a propane-fired tankless water heater, but that would have required using a second fuel source, running a copper line inside the house, and direct-venting the heater through an exterior wall—a disadvantage in this tight house. I'd also have to find a place outside for the 100-pound propane tank. The heaters were noisy, too, and expensive to install.

So I investigated electric alternatives. Electric air-source heat-pump water heaters that work on the same principle as a mini-split are expensive and require a large volume of indoor air to work efficiently. According to a local plumber who installed one in his house, Vermont is too cold to maximize the water heater's potential. These units are also noisy—a compressor is attached to the heater, unlike a mini-split's compressor, which is outside—worrisome because the utility room in this house is on the second floor.

Then I researched electric on-demand water heaters. Common in Europe and South America, they're rarely recommended in the U.S. by HVAC guys, who tend to promote gas-fired tankless heaters that afford them greater profit margins.

At an energy trade show, I saw and instantly fell for a Stiebel Eltron electric on-demand water heater. Made in Germany, it was compact, easy to install, and required no through-the-wall penetrations or second fuel source.

There are three leading manufacturers of electric tankless heaters: Bosch (bosch-climate.us), Rheem (rheem.com), and Stiebel Eltron (stiebel-eltron-usa.com). I did online research focusing on user experience. Stiebel Eltron came out on top for performance and reliability.

Folks who wrote about switching from a traditional electric hot-water heater to an instantaneous one noted

2. The author installed a 7-port closed-end Sioux copper manifold behind an access door. Printed sheets on the back of the door indicate which manifold port is connected to the various plumbing fixtures in the house.

3. The red knob is part of the Watts mixing valve and can be rotated to adjust the mix of hot and cold water to achieve 120° F. Above the mixing valve is the hot-water supply line to the manifold, complete with a dial thermometer to measure the mixed water temperature and a ball valve to isolate the hot-water manifold.

4. Installing the tankless electric heater on a pair of 2x4 cleats made it easier to install using threaded fittings.

reduced electrical bills. One woman claimed a savings of $100 per month.

For retrofit installations, where larger electric tankless units require two 240V/50A circuits, there were many posts from folks who did not anticipate the potential extra expense of upgrading their electrical service or running power cables from the panel box to a distant water heater.

I would have neither of those problems. My house was new, with a 200-amp service, and the distance between the electrical panel and the heater would be 6 feet. A plumbing manifold would separate them.

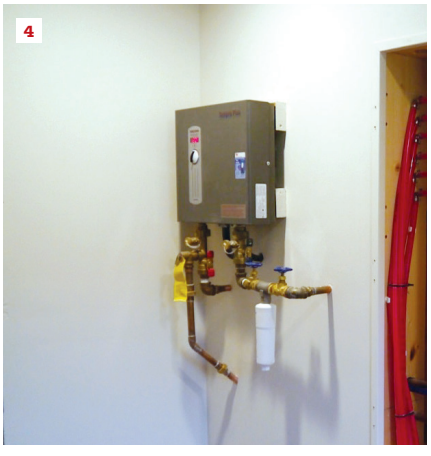
Some users complained about not having enough hot water, but I suspect that their problems were the result of incorrect unit sizing, rather than any inherent defect in electric instantaneous heaters. Indeed, there were several postings from families with teenage girls who were pleased to report having plenty of hot water. One person posted that he had plumbed his system so he could add a traditional electric hot-water heater should the tankless unit fail to keep up with demand; his plan was to preheat the water to 80° F. Following his lead, I laid out my utility room to accommodate a hot-water tank if it was needed.

TEMPRA 24 PLUS

I chose Stiebel Eltron's Tempra 24 Plus **(1)** model, which has a dial to adjust water temperature between 86° F and 140° F and a digital screen that allows users to read the setting. The whole unit measures just 16 ⅝ inches wide, 14 ½ inches high, and 4 inches deep.

The Plus series also has a proprietary Advanced Flow Control, which maintains the set point temperature but slightly reduces the water flow when demand is greater than the unit can handle—no more sudden blasts of cold water. The company's lower-priced standard Tempra model has


3


4

the dial temperature adjustment but not the LED screen or the Advanced Flow Control technology. In addition to the unit, I installed a Watts (watts.com) LFTWH-FT-HCN Service Valve Kit with purge ports that allow regular cleaning to remove scale buildup; the hot-water side comes with a pressure relief valve.

Since scaling is a potential problem with any tankless water heater, I doubled up with an Aqua-Pure AP430SS Scale Inhibition System (aquapurefilters.com), which uses a consumable water-treatment canister (shown at lower right in the photo on page 37) as a continuous method for minimizing scale. Local code requires a mixing valve—or anti-scalding valve—set to 120° F or lower, which I plumbed just before the manifold **(2)**.

I'm not a big fan of plastic manifolds, so I modified a 7-port closed-end Sioux (siouxchief.com) copper manifold **(3)** by replacing the intake PEX barb with a brass union, and I ran rigid copper pipe from the water heater to the manifold. Generally, when plumbing, I like to isolate replaceable components with unions and ball valves to facilitate future servicing and replacement.

LEAK-FREE CONNECTIONS

The electrical wires, tank, plumbing valves, and fittings all reside in close quarters. To facilitate installation, I stood the tank off the wall with 2x4 cleats **(4)**. Since I prefer threaded fittings, close nipples allowed me to squeeze all the parts together.

The challenge came in creating leak-free connections. The Environmental Protection Agency mandated that all plumbing fittings be lead-free after Jan. 1, 2014. The lead component in the old fittings had actually made the brass or bronze more malleable and therefore Teflon tape wrapped around threads typically resulted in a watertight connection. The absence of lead in the new ones and the preponderance of low-quality Chinese fittings led me to seek another solution.

I found it in Oatey's Great White Pipe Joint Compound With PTFE (oatey.com). This white paste "greased" the connection, allowing me to make two to three more complete turns than I could with Teflon tape, assuring me a leak-free connection. I now use it for all threaded connections: brass, copper, iron, chrome.

To run the hot-water lines from the manifold to my appliances, I used Aqua-PEX, which is made by Uponor (uponor-usa.com) and is a PEX-A tubing that's more flexible and therefore easier to bend than PEX-B. Crimp fittings and stainless steel crimp rings completed my installation. Shutoff valves were placed at each appliance, with no ball valves at the manifold. I protected the tubing with nailing plates wherever an errant drywall screw could easily puncture it.

BACK TO THE FUTURE

My initial impression of electric tankless water heaters is very favorable. For less than $1,000, I was able to purchase the materials (heater, service valve kit, scale inhibition system, electric cable, and fittings) and one hour of my electrician's time to install the Tempra 24 Plus. That does not include my time to hang the unit and plumb the valves nor the time to run the PEX—all of which I estimate to be an additional four to six hours. A comparable propane installed tankless system would run $3,000 or more. A comparable propane installed tankless system would run $3,000 or more.

My utility room is centrally located and all runs to water appliances (sinks, dishwasher, clothes washer, showers, and the like) are short, keeping tubing lengths to 25 feet or less. Hot water arrives quickly: One shower with a home run distance of 16 feet yields warm water in less than 10 seconds and 120° F water in less than 30 seconds. An in-line dial thermometer shows that the outgoing water temperature is within 2 degrees of my set point. I have no stand-by losses (which can consume 15% to 20% of kilowatt hours used) nor am I heating water to a higher temperature than my set point in order to account for stand-by losses.

This system is very quiet; there's no boiler roaring awake to heat my water, no rumblings from a propane tankless heater—only the sound of running water when I need it.

Because my house has a crawlspace, I plumbed the pressure relief valve with rigid copper tubing to an outside wall, hiding the outlet behind a 4-inch screened dryer vent. Next time, I'll use ¾-inch PEX-AL-PEX tubing, which will allow me to zigzag between framing members without fittings.

In a future article, I'll write about my yearlong experience, including annual maintenance and electricity use. Perhaps the all-electric home with low utility costs has arrived.

Lee McGinley is a Certified Passive House Tradesperson who designs and builds high-performance homes. He lives in Addison, Vt.