

# Choosing a **Tankless** WATER HEATER

by Doug Puffer, with Erin Moore Bean

If you're like many of us, the words "tankless water heater" might sound like a contradiction in terms. But in much of the world, tankless (also called "instantaneous," "demand," or "on-demand") water heaters are the norm—they are compact, never run out of hot water, and can be more energy efficient than familiar tank-style heaters. Certain tankless models can be a good choice as a backup heater for solar hot water systems as well. If your old water heater is failing, or if you're building a new home, this increasingly popular and efficient technology might be the right choice for you.

According to the U.S. Department of Energy (DOE), water heating is an average household's third largest energy user, accounting for about 13 percent of its energy consumption. So no matter how you heat your water, efficiency is critical if you're planning on saving energy and whittling down your utility bills. A tankless water heater can help you achieve some energy savings, depending on your circumstances.

## **INSTANTANEOUS BENEFITS**

If you've ever been last in line for your morning ablutions—and the recipient of a chilly shower—the appeal of a tankless heater's endless hot water supply is seductive. (Of course, where efficiency's concerned, endless hot water isn't always a good thing. Running out of hot water is an effective deterrent to those among us who enjoy indulging in long showers.)

Besides providing lots of hot water, tankless heater systems can also be long-lived. Properly maintained heaters may last for as long as 20 years, and failed heater components can be replaced.



Courtesy www.takagi.com

Tankless water heaters heat water directly and at the time of use, instead of maintaining a large amount of water at a prescribed temperature, as a tank-style water heater does. Turning on a faucet cues a tankless heater to activate—cool water enters the heater, circulates through a heat exchanger, and is sent through the hot water plumbing to your fixtures. After the initial startup, the system continues to heat water as long as the tap stays open. When you turn off the faucet, the water heater shuts down.

Because it has no tank, an instantaneous water heater eliminates "standby losses"—heat loss through the walls of a tank-style heater and, in gas-fired tanks, through both



**This Stiebel Eltron whole-house electric tankless water heater easily fits into a small area in the bathroom.**

them good partners for a solar hot water system, since with a solar storage tank, finding space to locate an additional gas or electric-fired backup tank can be a challenge in some installations.

## **GAS OR ELECTRIC?**

Tankless water heaters are available as gas (either natural gas or propane) or electric models. Larger gas tankless models can provide more hot water than electric tankless heaters because electric models are limited by the size of a home's electrical service (usually 200 amps).

Gas models with constantly burning pilot lights may undermine efficiencies expected from tankless heaters. You can avoid this energy loss by choosing a model with an intermittent ignition device. Some models use Piezo igniters, similar to those used in gas ranges, which spark the flame only when needed. Bosch offers a unit that uses a tiny hydro-electric turbine-powered igniter in place of a standing pilot light, and other models come with electronic ignitions. Finally, gas tankless heaters are technically somewhat less efficient than their electric counterparts because some of the heat generated is lost through the exhaust venting, but fuel costs (gas vs. electric) will determine which approach will shave the most off your utility bills.

Electric tankless heaters use heating elements to boost water temperature, require no venting, and can be located almost anywhere indoors. Gas tankless heaters are available as atmospheric-vented (natural draft) and power-vented.

the tank walls and the flue. The DOE estimates that standby losses for tank-style water heaters represent between 10 and 20 percent of a household's total water heating costs.

Perhaps the biggest boon for installing a tankless water heater is its small size. Most models are about the size of a suitcase, and they work well in tight spaces. This makes

## **On-Demand with Solar Hot Water**

If you plan to use a tankless water heater in conjunction with a solar hot water system, be sure to buy one that can sense the incoming water temperature from the solar storage tank. You won't want to heat your water with the sun, only to have your tankless heater fire up and *overheat* the same water! Thermostatically controlled units register incoming water temperature and apply heat as needed to reach the desired output water temperature. If the solar thermal system is producing hot water at the specified temperature, no additional boost from the tankless heater is required. Eemax and Bosch are among several manufacturers that offer thermostatically controlled tankless water heaters.

**This Bosch AquaStar tankless heater is suitable for solar backup.**



Courtesy [www.boschhotwater.com](http://www.boschhotwater.com)

Atmospheric-vented models that use a pilot light for ignition do not require an external electric power supply and will be able to produce hot water during a utility electrical outage. However, these models must be provided with sufficient combustion air, and are not recommended for closet installations or in places where the combustion air is contaminated (grease from cooking, lint from laundry, etc.). In these situations, choose a sealed combustion unit (also referred to as direct vent or two-pipe system).

Power-vented tankless heaters require a “special gas vent”—a single-wall, sealed vent pipe made of a highly corrosion-resistant stainless steel. This vent cannot be shared with any other appliance. Power-vented units require an external electrical source to power the blower and electronics. The sealed vent pipe can be run horizontally or vertically, venting to the nearest suitable location, and allows the heater to be located closer to the water heating loads in some installations. In either case, clearance to combustibles must be maintained on all types of exhaust venting.

## SIZING YOUR SYSTEM

Different models of tankless heaters provide different flow rates at different temperatures. Make sure the heater you choose can provide the capacity (flow and temperature) that you need. Minimum activation flow ( $1/2$  to  $3/4$  gpm) must be met at any faucet that’s connected to the unit. For proper operation, water pressure should be 30 psi or better.



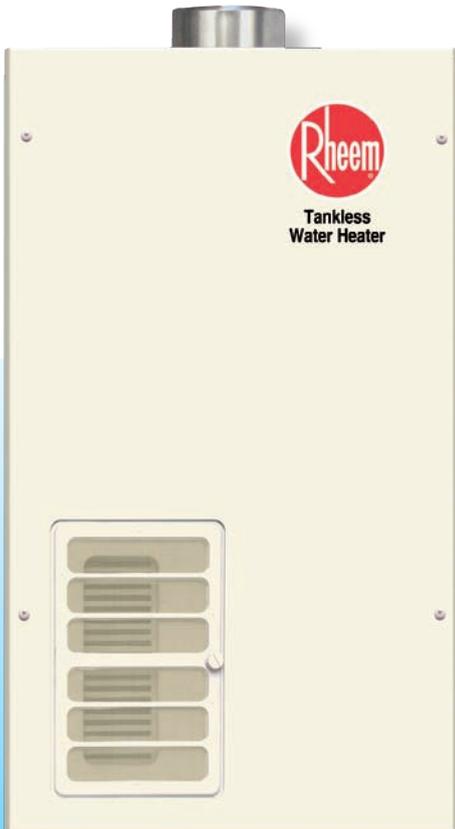
Courtesy www.stiebel-eltron-usa.com

The Stiebel Eltron electric tankless heater, with cutaway showing a three-stage heating system.

Doing laundry, washing dishes, and running a bath all at once can overtax improperly sized tankless water heaters (as well as tank-type heaters), resulting in reduced water flow or water temperature. This is the most common complaint related to on-demand heaters.

To estimate your household’s hot water use, list the number of hot water fixtures you typically use simultaneously, and add up their flow rates. For example, let’s say you’ve chosen a tankless heater that is capable of 4 gpm (based on your

Courtesy www.rheemtankless.com

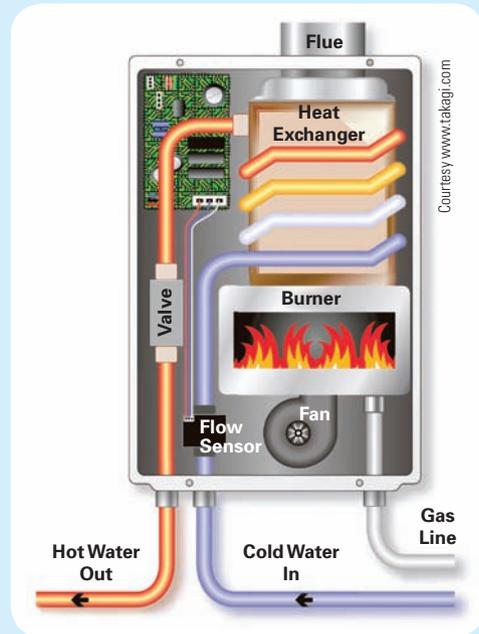


## Flow Rates for Typical Household Water Uses

Item	Flow Range (gpm)	
	Low	High
Low-flow faucet	0.5	1.5
Standard faucets	0.8	2.5
Low-flow showerheads (2.5 gpm or less)	1.2	2.5
Standard showerheads	2.5	3.5
Dishwashers	1.0	2.0
Washing machine	2.0	4.0
Standard bathtub	4.0	5.0

# How Does a Tankless Water Heater Work?

- A hot water tap is turned on.
- Cold water enters the heater.
- A sensor detects the water flow.
- Heater controls automatically activate the burner or heating element.
- Water circulates through the heat exchanger.
- Water is heated to the designated temperature.
- When the tap is turned off, the unit shuts down.



incoming water temperature and desired outlet temperature). If you're washing dishes (0.75 gpm), while another family member is taking a shower (2.5 gpm), the flow rate through the tankless heater would need to be at least 3.25 gpm (0.75 + 2.5), but would not support somebody also turning on an additional hot water faucet at a rate greater than 0.75 gpm.

Besides knowing maximum flow rates at peak times in your household, you'll need an idea of how much your incoming water must be heated to reach the target hot water temperature. To ensure an adequate supply of hot water, tank-style heaters are typically set at 120°F, which is higher than required for the majority of hot water needs. In contrast, tankless water heaters can provide an infinite amount of hot water at the specified end-use temperature.

The colder your incoming water, the lower the heater's output volume will be. To account for this, manufacturers provide performance estimates at a variety of incoming temperatures, called the "temperature rise." Your water temperature's rise is calculated by subtracting the incoming temperature from your desired hot water temperature. For example, if you want a 2 gpm shower at 105°F, and the incoming groundwater is 45°F, a 60°F rise at 2 gpm is required.

Small gas-fired tankless heaters (117,000 Btu/hr.) can typically achieve a 70°F temperature rise at a flow rate of about 2.6 gpm; a larger gas tankless heater (236,000 Btu/hr.) can achieve 5.2 gpm. In contrast, an electric tankless heater (installed north of the Sunbelt) would require 120 amps and be limited to 2.6 gpm for the same 70°F temperature rise.

Faster flow rates or cooler incoming water temperatures can reduce the output temperature of some tankless heaters.

To remedy this, certain models will automatically limit flow to maintain the desired output temperature. With these units, if you are filling your bathtub and the flow rate is beyond what the heater can keep up with, the heater will reduce flow rate so you get the water temperature you require (although it takes a little longer to fill the tub).

## POINT OF USE OR WHOLE HOUSE?

The entire world of tankless water heating is divided into two sectors—"point of use" and "whole house." Point-of-use units are typically electric and commonly installed in powder rooms (sink only) that are so far removed from the home's primary water heater that it would take forever to get hot water to that



An inside view of a gas-fired tankless heater.



Courtesy www.toyotomusa.com

**The Toyotomi heater, available for kerosene and oil, may be modified for use with biodiesel.**

## TANKLESS CONSIDERATIONS

If you want to save money by installing the smallest tankless heater possible, plan to limit your flow demands by staggering the timing of your major water draws. Washing machines, and bath and shower fixtures typically have the highest flow rates, and these are the uses you should closely monitor—for example, don't run the dishwasher when somebody is showering.

Another important variable in the tankless equation is how often you need hot water. For example, if you hand-wash dishes, every time you turn on the hot water to rinse, you'll activate the heater. Repeatedly turning the tap on and off means firing the water heater's ignition over and over, which will reduce overall efficiency. The start cycle in a tankless heater ranges from a fraction of a second to a full 5 seconds, depending on the model. All of the gas power-vented units are on the high end of this delay to purge the exhaust of any gas before providing a spark.

If your water is mineral-rich ("hard"), installing a water softener to decrease scale buildup will prolong the life of the tankless heater (and help preserve the terms of the warranty, which may include a disclaimer regarding scale deposit buildup in the unit), and also protect your washing machine, dishwasher, and all hot water valves and piping. Also consider installing bib drains inboard of the dual shutoff valves, so you can isolate the tankless heater and periodically flush it with descaling fluid.

## INFRASTRUCTURE UPGRADES?

Tankless water heaters can cost two to three times as much as their tank-style cousins—whole-house units start at about \$500. When calculating costs for a tankless system, you'll also need to include any necessary upgrades to your electrical, gas, plumbing, and venting system.

Tankless water heaters draw a lot of instantaneous power, either in the form of gas or electricity. Small gas units (117,000 Btu/hr.) may possibly be installed without gas pipe modifications, but none of the larger units (165,000 Btu/hr. and greater) can be effectively accommodated with a 1/2-inch natural gas line.

A whole-house electric tankless water heater can draw four to five times as much power as an electric tank-style heater. Replacing a tank-style heater with an electric tankless heater generally requires additional circuit wiring, heavier cable, and possibly upgrades to the service entrance.

For gas heaters, consider all loads before sizing gas pipe runs to ensure an adequate supply of gas for all appliances operating simultaneously. Tankless water heaters supplying high-use applications will require upgrading gas lines to 3/4-inch pipe. Many gas-powered heaters must also be situated near an electrical outlet to provide energy for the unit's ignition, combustion blower/power vent, and regulating controls. While these aren't insurmountable issues, they do make an installation more complex, and will generally require a professional's help.

Because of some hurdles to installing tankless water heaters in existing homes, the technology may be best suited for new homes, where gas lines, electric wiring, and water heater placement can be optimized. Heaters can be located

location. If you really plan ahead, it is unnecessary to even run a hot water line to that "remote" location. You can use a small point-of-use tankless heater instead.

Some smaller tankless heaters won't be able to keep up with a household's simultaneous water heating demands. To remedy this problem, you can install a "whole house" tankless system, have separate tankless heaters for appliances that use a lot of hot water (automatic dishwashers and clothes washers, for instance), or install two, ganged whole-house heaters to handle periods of high demand.

## TANK VS. TANKLESS

People often ask what's more efficient—tank-style or tankless water heaters. The answer: It depends. If there are several occupants who frequently draw from your water heater throughout the day—showering, dishwashing, and clothes washing—a tank-style heater still can be worth considering. Although tank-style heaters lose energy through standby losses, frequent draws upon the system mean that a larger percentage of the energy consumed for water heating is being utilized.

If your household consumes less hot water, a tankless water heater can suit your needs with less waste. The DOE estimates that for homes that use 41 gallons or less of hot water daily, tankless water heaters can be 24 to 34 percent more energy efficient than tank-style water heaters. The efficiency gap narrows in homes with greater consumption. For a household that uses 86 gallons of hot water a day, a tankless heater will be about 8 to 14 percent more energy efficient.

centrally in new homes to minimize hot water runs and maximize efficiency.

### TAKING ADVANTAGE OF TANKLESS TECHNOLOGY

Through December 31, 2008, if you install a natural-gas or propane tankless heater with an energy factor (EF) of 0.80 or greater, you can take advantage of a one-time tax credit of up to \$300 toward the full purchase price. For a list of approved gas-fired tankless heaters, visit the Gas Appliance Manufacturers Association (see Access). Electric tankless water heaters don't qualify for the tax credit. Rebates and other incentives may be available in your state. (Don't forget that solar hot water systems qualify for a federal tax credit equal to 30 percent of the system's cost—up to \$2,000 for residential installations; no cap for business applications.)

If you are thinking of buying an on-demand heater, do your homework first. Plan well, run through some calculations to determine your actual hot water needs, and then match your needs with the system that makes the most sense—in terms of efficiency and your budget—for your household.

### ACCESS

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*Thanks to Bill Loesch at [www.solar1online.com](http://www.solar1online.com) for his expert review of the text.*

List of approved gas-fired tankless heaters that qualify for the federal tax credit • [www.gamanet.org/gama/inforesources.nsf/vAttachmentLaunch/B9F3B9CF3BC4C7F585257107005DE622/\\$FILE/taxcredit\\_rwh\\_ef.pdf](http://www.gamanet.org/gama/inforesources.nsf/vAttachmentLaunch/B9F3B9CF3BC4C7F585257107005DE622/$FILE/taxcredit_rwh_ef.pdf)

### Select Tankless Water Heaters:

Bosch (AquaStar) • [www.boschhotwater.com](http://www.boschhotwater.com)

Bradford White • 800-523-2931 • [www.bradfordwhite.com](http://www.bradfordwhite.com)

Eemax • 800-543-6163 • [www.eemaxinc.com](http://www.eemaxinc.com)

Noritz • 866-766-7489 • [www.noritzamerica.com](http://www.noritzamerica.com)

Paloma • [www.palomatankless.com](http://www.palomatankless.com)

Rinnai • [www.foreverhotwater.com](http://www.foreverhotwater.com)

Rheem • <http://waterheating.ruud.com>

SETS Systems Inc. • 877-649-8589 • [www.sets-systems.com](http://www.sets-systems.com)

Stiebel Eltron • 800-582-8423 • [www.stiebel-eltron-usa.com](http://www.stiebel-eltron-usa.com)

Takagi • 888-882-5244 • [www.takagi.com](http://www.takagi.com)

Toyotomi • 203-775-1909 • [www.toyotomiusa.com](http://www.toyotomiusa.com)

