

What Do Consumers Want from Their Hot Water Systems?

A SERIES ON HIGH PERFORMANCE HOT WATER SYSTEMS

PART ONE: CONSUMER EXPECTATIONS



About the Author:

Gary Klein has been intimately involved in energy efficiency and renewable energy since 1973. One fourth of his career was spent in the Kingdom of Lesotho, the rest in the United States. He has a passion for hot water: getting into it, getting out of it and efficiently delivering it to meet customer's needs. Recently completing 19 years with the California Energy Commission, his new firm, Affiliated International Management LLC, provides consulting on sustainability through their international team of affiliates. Klein received a BA from Cornell University in 1975 with an Independent Major in Technology and Society with an emphasis on energy conservation and renewable energy.



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Story by Gary Klein

Let's talk about high performance hot water systems. We'll discuss the mechanics of making the heat for hot water and how much of it we may need in a moment, but first we'd better figure out what customers actually care about. To provide context for this discussion, since the mid-1990s I have spoken with and interviewed more than 20,000 people from all walks of life throughout the United States and from many countries around the world to learn what they want and expect from their hot water systems. In this series, I will be sharing with you what I have learned from these hot water users and from research that has been conducted in the lab and in the field, and later how we can apply this knowledge to define the characteristics of high performance hot water systems.

What People Want and Expect

The first question we should ask any prospective client is "What do you want from your hot water system?" What they have told me they want are clean clothes, clean hands, dishes, body, relaxation, enjoyment — in other words, the service of the hot water. Well, these are the things that people actually want, in the simplest of terms: warm house, cold beer. They don't really care how the house gets warm or the beer gets cold, they just want it to be that way when they want it.

The next question we need to ask is, "What do you expect from your hot water system?" The

customer expects safety, reliability and convenience.

■ **SAFETY:** Customers expect the water to be neither too hot, nor too cold. They also expect it to contain no harmful bacteria or particulates, although quite a large number of people put up with hard water and other physical water issues. In food service and health services, customers expect sanitation.

■ **RELIABILITY:** Customers expect that the entire hot water system will require little or no maintenance, that it will last forever and that it will be low in cost, both when they buy it and to run and maintain it over its operational life.

How many of you have a water heater in your facility or your home? Have you ever maintained the water heater in your facility? Drained it out, checked the anode, made sure that the temperate and pressure relief valves were working properly? You know, if you do that you can make a water heater last a really long time, but if you put the water heater in the back corner and ignore it, well, it probably won't last as long as you might like it to.

■ **CONVENIENCE:** Customers also expect the ability to adjust both temperature and flow, although most showers only give the option of adjusting temperature. They expect that the system will be quiet — no water hammer, no sounds in the middle of the night from their recirculation system, no significant noise from a water heater (gurgling or fan noise from power vented systems). They also expect to

**IF YOU HAVE A PROBLEM
DO NOT
RETURN THIS
WATER HEATER
TO THE PLACE OF PURCHASE.**

Call 1-877-817-8770

For ALL installation, warranty and performance questions.

Check for problems around the tank before consumer purchase.

ENERGYGUIDE

Model: 5-12-A-10-10000-0000X

Estimated Yearly Operating Cost: **520**

Cost Range of Similar Models: 520

Estimated Yearly Energy Use: **4879**

Your costs will depend on your utility rates and use.

Visit www.energysaves.com for more information on energy-saving tips.

IMPORTANT

This water heater should be located in an area where leakage of the tank or connections will not result in any damage to the area adjacent to the water heater or to lower floors of the structure. Due to the normal corrosive action of the water, the tank will eventually leak after an extended period of time. Also any external plumbing leak, including those from improper installation, may cause early failure of the tank due to corrosion if not repaired. If the homeowner is uncomfortable with making the repair a qualified person should be contacted. When such a location cannot be provided, you should install a suitable drain pan under the water heater. Such pans must limit the water level to a depth of 1/4 inch inside of the pan, have a minimum length and width of at least 2 inches greater than the diameter of the water heater, and must be piped to an adequate drain.

Install temperature and pressure protective equipment required by local codes, but not less than a combination temperature and pressure relief valve certified as meeting the requirements for relief valves and automatic gas shut-off devices for hot water supply systems, ANSI Z21.22-1996 by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment or materials. The valve must be oriented, provided with tubing or otherwise installed so that the discharge can exit only within 6 inches above, or below the structural floor, and cannot contact any live electric part.

Notice: When a supplemental heat source is connected to the Certified Household Electric Storage Tank Water Heater, provision must be made to limit the heat source temperature not to exceed that of the water heater thermostat setting.

Caution: If the water heater has been retrofitted with supplemental heating equipment, you must adjust both the thermostat controlling the supplemental heat source (located in the water piping) and the thermostat on the water heater (behind the access panel) to the same temperature. Failure to adjust both thermostats to the same temperature can cause loss of proper temperature control.

Notice: The internal parts of this tank have been constructed and tested to withstand 400°F temperature.

STATE OF CALIFORNIA NOTICE

This water heater must be braced, anchored, or strapped to avoid falling or moving during an earthquake. See instructions for correct installation procedure.

Gama

TEST PRESSURE AND WORKING PRESSURE

MODEL NUMBER: EIF50RD

SERIAL NUMBER: 090

PRODUCT NUMBER: 08

THE DATE:

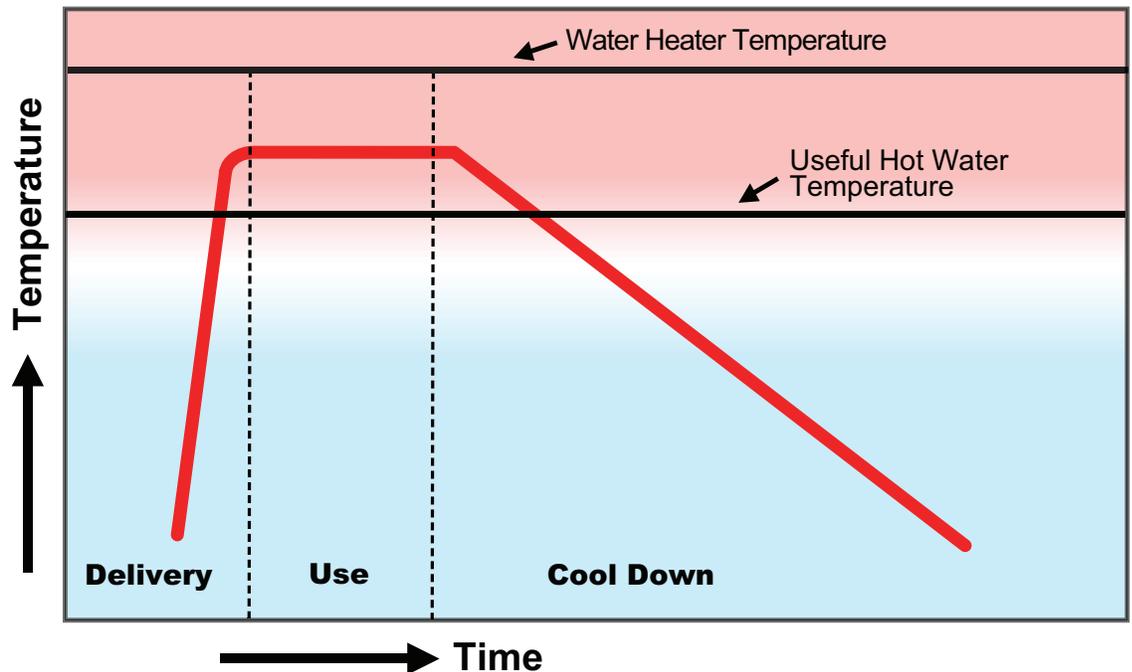
DANGER



Water temperature over 125°F can cause severe burns instantly or death from scalds. Children, disabled and elderly are at highest risk of being scalded. See instruction manual before setting temperature at water heater. Feel water before bathing or showering. Temperature limiting valves are available. See manual.

Figure A: Typical hot water event.

GRAPHIC PROVIDED BY
GARY KLEIN



never run out of hot water — a problem that many have experienced, but which actually seems to happen relatively infrequently. While it would be nice to have the ability to have several hot water devices operate simultaneously, this is not usually expressed as a big concern. They already have that ability, although tank volume and the burner or element capacity limits the duration of simultaneous events; and they generally schedule their hot water use so that big hot water uses do not overlap.

In addition, faucet, shower and appliance flow rates have been declining, effectively increasing the water heater's ability to sustain simultaneous events for a longer time.

Finally, they expect that hot water will arrive very quickly after they turn on a tap, although the vast majority complain about the length of the time-to-tap, which they describe as a random event, varying from 10-15 seconds at fixtures near the water heater to well more than two minutes at the fixture furthest from the water heater. Less than five percent of the people say they get hot water everywhere in less than five seconds after they turn on the tap. Most of these have a recirculation system; the others have a small house with a short distance from the water heater to the fixtures. In commercial buildings, such as restaurants, most people do not actually expect to get hot water in the public bathrooms, even though it is required by health codes!

Depending on the specific application, I suspect you and your customers want most, if not all, of these same services and have very similar expectations, too. Of all of the issues raised above, what the people I have interviewed want the most is to reduce the time-to-tap, followed by never running out in their shower — theirs, not their children's!

Typical Hot Water Event

Figure A shows a typical hot water event. There's a delivery phase, a use phase and a cool down phase. People would like the delivery phase to be short. According to those I have interviewed, a few want hot water to arrive immediately after they open the tap, which I explain is possible, but rather expensive. Well more than 90 percent say they want the time-to-tap to be between two and three seconds. We will see later on that this level of performance is achievable at reasonable costs.

The use phase is the use — washing dishes, taking showers, whatever it might be.

And then when you turn off the tap, the temperature of the water in the pipe starts to cool down, all the way from the water heater to the hot water outlet. It takes on the order of 10 to 15 minutes for the water in uninsulated pipes to cool from about 120° F down to 105° F when the pipes are located in air at a temperature between 65° F and 70° F, which is typical for most buildings. The water cools

down more quickly when the surrounding temperature is colder, such as in a basement or a crawl space, or when the pipes are located under or in a concrete slab. The water cools down more slowly when the pipes are in a hot attic in mid-summer or when they are insulated. We will discuss this further later in this series.

The water heater temperature must be higher than the mix-point temperature you'd like to have, and the useful hot water temperature needs to be less than the point at which you mix it. Why? You need to have some head-room from the mixing point down to the useful hot water temperature point because of variations in desired temperature for any given application on any given day.

The Hot Water System

Now, let's talk about the hot water system. There are five components of hot water use in the building:

- Water heaters
- Pipes
- Faucets, showers, appliances and other fixture fittings
- Hot water running down the drain
- Behaviors

Which is the biggest variable in determining water and energy use? I ask this question of lots of people and get all sorts of answers, but the fact is behaviors are the single biggest variable and that is what's going to determine water and energy use.

How much do behaviors make a difference? Well, let's just pick on your home for a minute. Was today's hot water use *exactly* the same as yesterday's? Will it be *exactly* the same as tomorrow's? I get up at about the same time everyday, but I don't take a shower at exactly the same time, nor is it exactly

the same length. I wonder if this happens to you in your home and in your facilities? I suspect it does.

Again, based on my large sample, there are probably an infinite number of hot water use behaviors and patterns. In homes, they often fall within "windows of opportunity" — morning rush hours and evening plateaus; and on weekends, all bets are off! The pattern varies depending on the facility you're in, but the concept of windows of opportunity still applies.

All of these behavior patterns boil down to two possible results: when you turn on the tap, either hot water comes out pretty darn quick or it doesn't. Which is it in your home, at your place of work, your favorite restaurants? I suspect for many of you and your customers, the answer is "it doesn't."

Another factor is how do the interactions among these components affect system performance? Imagine you have long uninsulated pipes between the source of hot water and the fixtures that are being used a lot. Do people wait a long time for hot water? What if you could move the water heater closer, make the pipes better insulated or deliver hot water quicker by use of a pump or electric heat trace? Do you think that that would improve system performance?



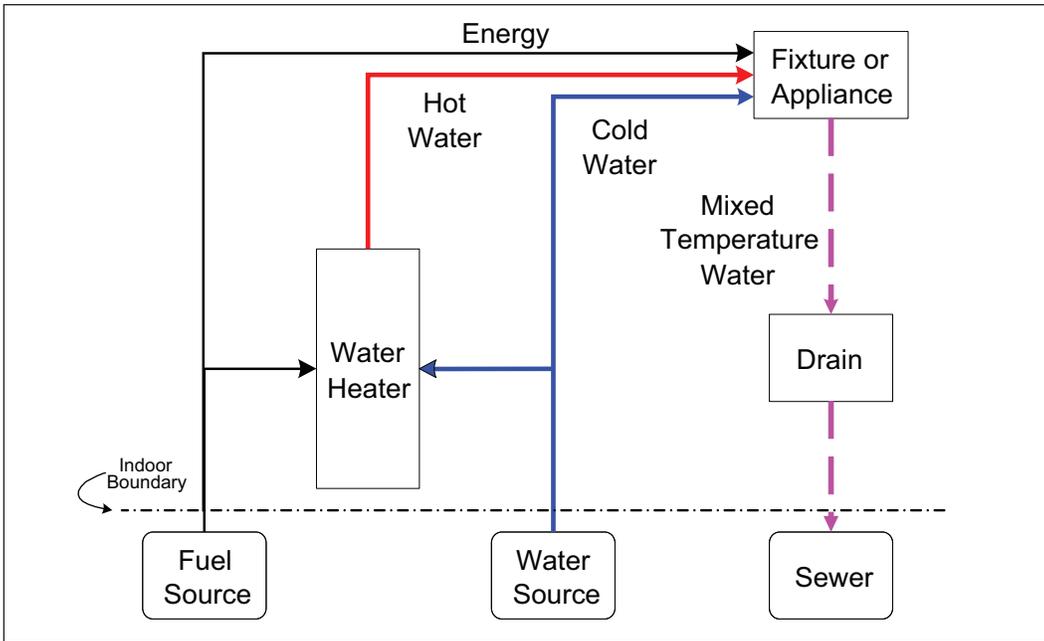


Figure B: Typical “simple” hot water system for single-family or single unit applications.

What about single lever valves on faucets or on showers where, when you turn on all hot, you actually get some hot and some cold? What if the valves performed differently so that when you wanted all hot water, you got all hot water? What about when you wanted cold water, you got all cold water? Well, all of these interactions affect the system’s overall performance and you as a consumer pay for the system inefficiencies or, conversely, its efficiencies.

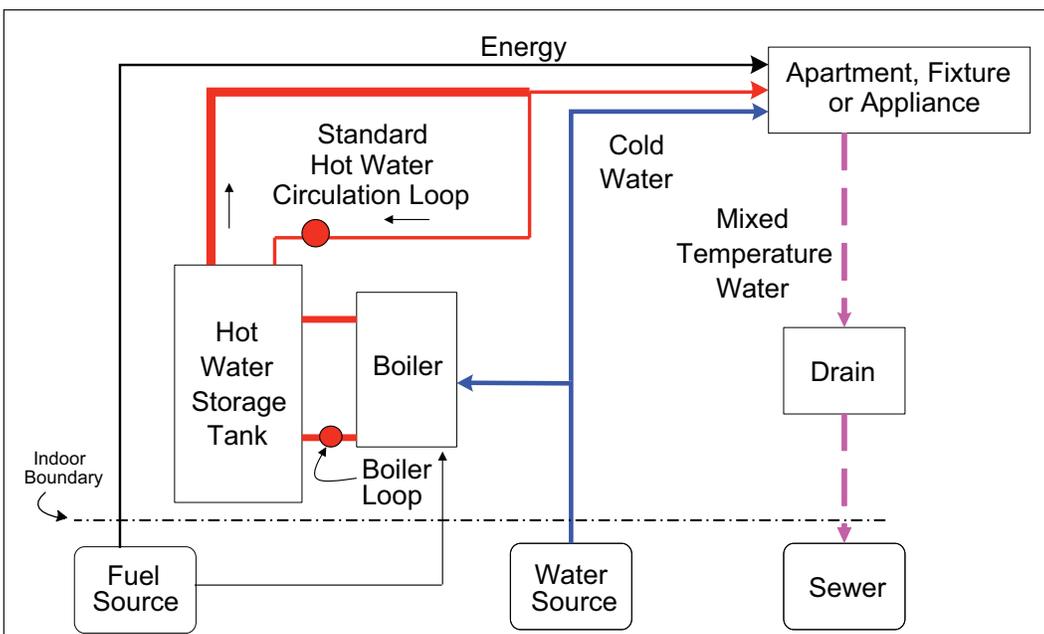
What if we could capture some of the waste heat? Wouldn’t that be a good idea, too? We’ll discuss how to do that later in this series.)

Figure C is a typical central boiler hot water system. You generally see these in bigger buildings, whether they are residential or commercial. Often there is a boiler to make the heat, a hot water storage tank to store the heat for capacity and peaking, and then there’s a circulation loop, most often using a 24/7 pump (sometimes controlled with a timer or an aquastat) to deliver hot water out to the far reaches of the building. 📍

Figure C: Typical central boiler hot water system.

GRAPHICS PROVIDED BY GARY KLEIN

Figure B shows a typical simple hot water system. You see it in single-family housing, or single unit applications in multi-family buildings. You see it in commercial facilities.



What’s Next:

In future installments, we will discuss the hot water distribution system: how to improve existing ones and how to build them more efficiently to begin with; the uses of hot water; drain water heat recovery; the ways to make hot water more efficiently and effectively; and how all of these components come together in a high performance hot water system.