Hot Water Distribution

Distribution Designs and On-Demand Systems

Touchstone Energy® Cooperatives

SKILL SET

Be sure you have the experience needed for this job. If you are in doubt, hire a contractor.

SAFETY

These maintenance tasks may require working in tight clearances and under task lighting. Disconnect power sources when working on electrical appliances. Turn off gas at cut-off valves before working on gas lines. Be sure to relight pilot lights.

TOOLS

Adjustable wrenches, utility knife, screw driver, drill

MATERIALS

On demand pump and fixture connections. “T” connector, teflon thread tape.

COST BENEFIT

On demand pumps cost from a few hundred to over a thousand dollars - depending on the application. Payback comes in savings on water saved and not sent down the drain.

PRIORITY LEVEL

LOW MED HIGH

SKILL LEVEL

DIY PRO

Hot Water Distribution

While the efficiency of a heater is certainly important, the manner in which hot water is distributed throughout the home can be equally important. Homes with centrally located water heaters and relatively short piping runs to fixtures usually save energy, waste less water and provide hot water quicker. As the piping distance and diameter of the piping increases energy costs, water waste and wait-time for hot water increase.

Basic Distribution Designs

Water efficient home design features a centrally located water heater and plumbing that radiates outward to each fixture. The runs are typically short with small diameter pipe, usually 1/2” diameter, and the time it takes to deliver hot water to an individual fixture is quick.

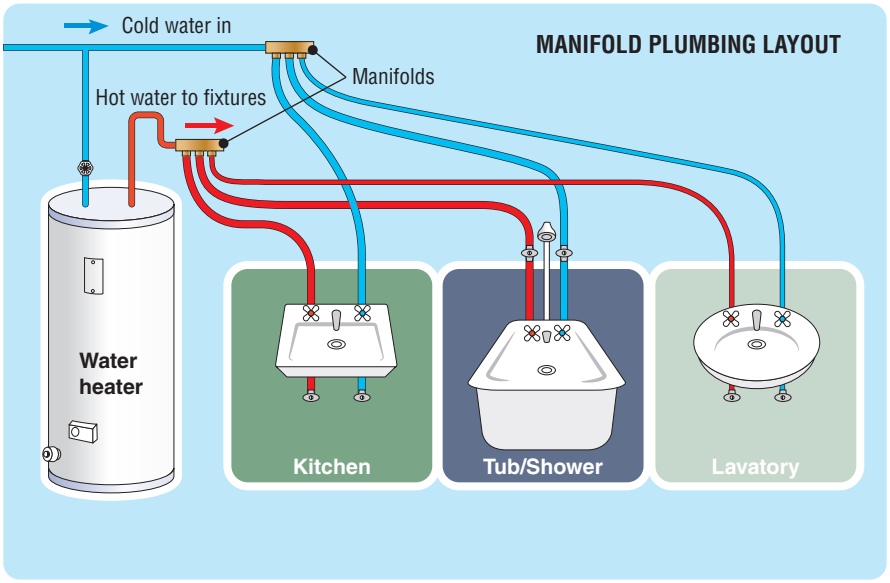
Homes with single and multiple trunk and branch distribution systems rely on a larger diameter (3/4” to 1”) trunk line with smaller (1/2”) diameter branches leading to each fixture. The volume of water contained within the piping is greater and the resulting wait-times and water waste is generally greater. For example, wait-time with an efficient distribution system could be 5 seconds, while in an inefficient system 90 seconds or more.

Manifold or “home run” systems deliver hot water from the water heater through a single larger pipe (generally 1” diameter) to a manifold that then routes a smaller line (3/8” to 1/2” diameter) directly to every fixture in the house. Depending on the hot water usage patterns and home configuration, this may be an efficient distribution design. It is crucial that the manifold be located as close as possible to the water heater since the volume of water in the 1” connecting pipe plus the volume in the manifold itself must be heated every time a single fixture calls for hot water. Insulating the connecting line and manifold is also a critical step.

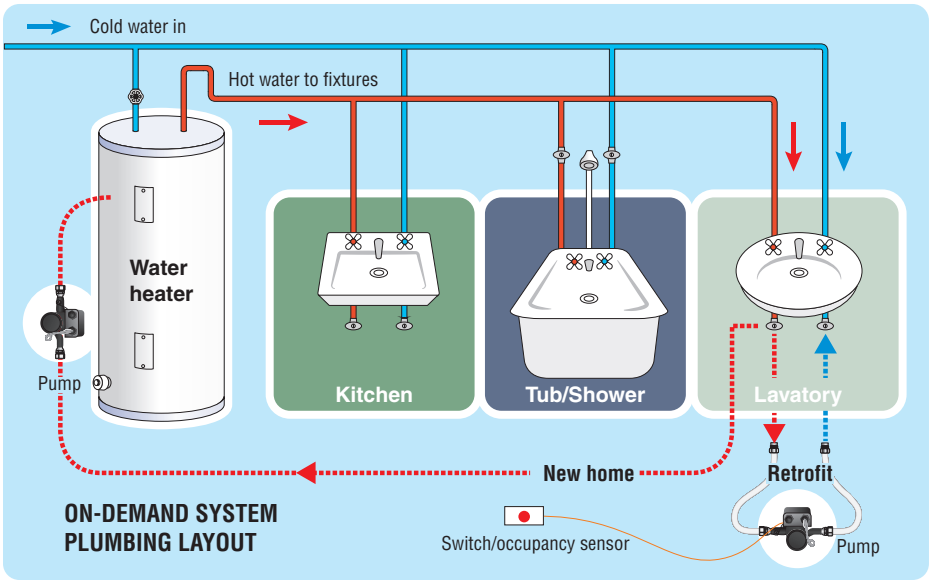
To compensate for longer wait-times, some homes operate a circulation pump to keep hot water always available in a loop. Unfortunately, it is costly to keep a loop of water constantly hot and to run a circulation pump. Using a timer to turn the circulation system off at night when there is no hot water use will save money and water. Another option is to switch the control to demand-based rather than a continuous operating system.

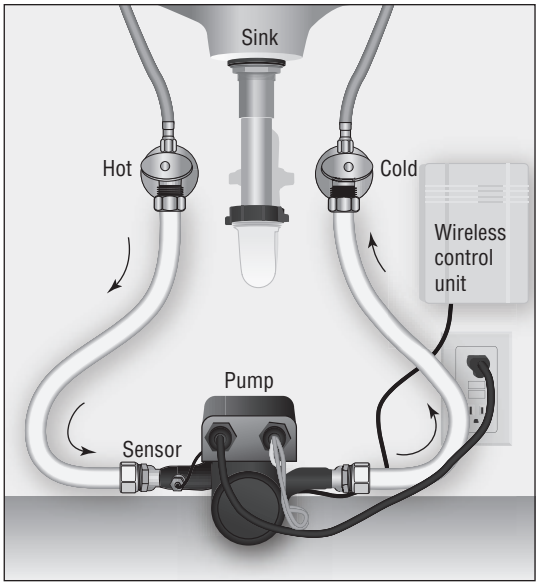
EPA WaterSense

Recirculation systems in new homes must be demand-initiated to qualify for the Water Sense label.



A plumbing manifold system provides cutoff valves at the main terminus with flexible plumbing hoses that connect to the fixtures. Insulating the manifold and connecting lines is critical to reduce standby losses.





An on-demand hot water distribution system can be installed easily in new homes. As a retrofit solution, an on-demand pump can be installed at the furthest fixture from the water heater. A do-it-yourselfer can install such a unit under a lavatory sink. It involves shutting off the water main, adding hose "T" extensions to the cut-off valves and connecting bypass hoses to the pump (note: a GFCI electrical outlet is required to power the pump).

Strategies to Improve Hot Water Distribution

Two of the best ways to reduce hot water distribution losses are an on-demand circulation system and hot water pipe insulation. With an efficient distribution system, the water heater temperature setpoint may be lowered. Reducing a tank water heater setpoint temperature by only 5˚F will result in 10% lower standby losses (a good target is a tank temperature of 120˚F).

If the hot water pipes are not insulated, it is common to find between a 5-10˚F reduction in temperature from the water heater to the farthest fixture. Also, because the heated line cools quickly if not insulated, the second user of the fixture typically has to start the distribution cycle all over again. By insulating the hot water piping, the heated line will stay hot after the first use for upwards of an hour, so any near-term second, third, and fourth usage will benefit from the quick delivery of hot water from the insulated piping.

An on-demand system typically places the circulation pump and a temperature sensor at the farthest fixture. When hot water is desired at any fixture, a button is pushed or a motion sensor will activate the pump. The pump, which operates at a much higher flow rate than a normal fixture, will quickly draw hot water from the water heater to replace the room temperature water in the hot line, sending its volume of water back to the water heater through the cold line or through an added return line. A temperature sensor at the last fixture detects when hot water has arrived and shuts off the pump, typically after only 5-30 seconds. At any point, the hot water tap can be opened and water can be drawn into the fixture.

The energy savings of an on-demand circulating system comes from the fact that the pump runs for a short time period and the water that is returned to the tank is generally warmer than the cold water that is normally introduced into the water heater. The water savings comes from the fact that little to no water runs down the drain while waiting for hot water. Since many municipalities bill customers for both water and sewage based on the incoming water meter, the economics of the water savings could even outweigh the energy savings.

Changing a continuously operating system to on-demand saves energy in two ways: first, the pump energy is greatly reduced and second, the heat loss from the hot pipes is cut dramatically – it is possible to save over 90% of the energy of a continuous loop system by switching to on-demand.

Economics of Hot Water Distribution

Hot water savings from improving the distribution system depends on the behavior of occupants, fixture flow rates and usage patterns. If only one or two fixtures are used frequently for a short time, the piping may not cool down much, reducing the potential for savings. In a well-designed distributed system, a small volume branch line minimizes water waste, the on-demand pump primes the line just before the hot water is drawn and the insulation keeps the distribution piping hot for the subsequent user.

- Conservative savings for insulating hot water lines are approximately 10% energy savings
- Retrofitting an on-demand circulation pump provides around 20% energy savings
- Incorporating both upgrades yields a conservative 30% energy savings

The cost to run the pump for an on-demand system is about $1-2 per year.

The water savings is a function of the number of fixtures as well as pipe run and pipe diameter (accounting for volume of water that would have been lost down the drain). Savings can be as large as 12,000 gallons of water annually, depending on home size and water usage.

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