

# Water Heating

## Efficiency upgrades help reduce water consumption and save energy

Upgrading hot water system efficiency can produce both energy and water savings, leading to financial savings for business owners. Hot water use varies by building use, thus the priority of this project will depend on your hot water demand (*Figure 1 & Table 1*) and your existing water heating and distribution systems. Reducing energy and water costs associated with water heating can be accomplished through the following three measures:

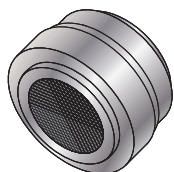
- Reduce consumption
- Improve water efficiency
- Improve distribution efficiency

Reducing consumption should be your first priority. This FACT SHEET covers water heater selection and system design. For additional information on reducing hot water consumption, review the *Water Fixture Efficiency fact sheet*.

## Lower cost improvements

### REDUCE HOT WATER CONSUMPTION

The simplest way to achieve immediate hot water savings is to reduce hot water consumption in your building. This can be accomplished by installing inexpensive low-flow aerators on existing faucets for less than one dollar each and upgrading to WaterSense labeled low-flow fixtures for kitchen faucets, bathroom faucets and shower heads, as well as WaterSense labeled pre-rinse spray valves for kitchens. WaterSense labeled fixtures use a fraction of the hot water without compromising on performance.



Secondly, occupant behavior changes can greatly reduce water consumption. Encourage building occupants to take shorter showers, reuse towels and run full loads in dishwashers and clothes washers. For more information on occupant behavior change and education refer to the *Occupant Behavior fact sheet*.

Plumbing codes in some states permit the exclusion of hot water for hand washing in public restrooms, enabling a complete discontinuation of hot water supply to your facilities' restroom faucets. Before discontinuing the hot water supply, it is important

### Small Commercial Hot Water Use

Highest Users	Lowest Users
Lodging	Office
Health Care	Religious Facility
Food Service	Food Sales
Education	Public Assembly
	Retail
	Warehouse

Figure 1: Hot water use by building use-type (Source: EIA, 2003)

Fixture Type	Older	Standard	Water-Sense	Ultra-Efficient
	Gallons Per Minute			
Bathroom Faucet	2.5+	2.2	1.5	.5
Shower Head		2.5	2	.75
Pre-Rinse Spray Valve		1.6	1.28	.5

Table 1: Flow rates for older, standard, WaterSense and ultra-efficient fixtures

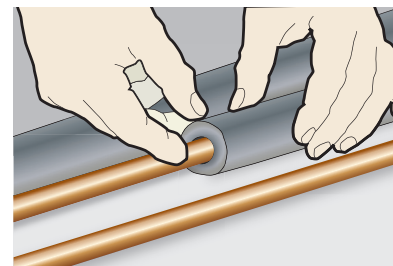
to understand the health needs of your occupants. Individuals with joint issues or other health conditions may find cold water uncomfortable or painful to use.

### INSULATE!

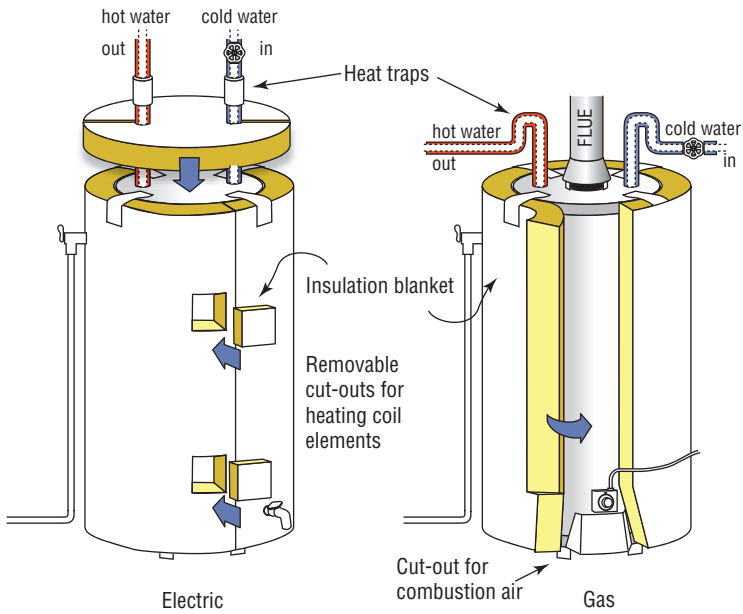
Adding insulation to the following critical areas will reduce standby and transmission losses, saving energy and reducing the wait time for hot water.

#### Insulate Water Pipes

Hot water pipes and return pipes on recirculation loops should be insulated to a minimum of R-3. Priority should be given to pipes in unconditioned spaces. However, we recommend insulating all hot water pipes in the system



(including cold water pipes) to reduce idling losses. For a snug fit, match the pipe insulation sleeve's inside diameter to the water pipe's outside diameter, and tape or cinch pipe insulation with cable ties every 1-2 feet. On gas water heaters, keep pipe insulation at least 6 inches away from the exhaust flue.



### Insulate Storage Tanks

Adding an insulating blanket of R-11 or higher around your storage tank is an inexpensive way to reduce heat loss through the walls of the tank. Most new water heaters are equipped with integral insulation but may still benefit from an insulation blanket. Adding insulation to older water heaters with a tank R-value below 20 can reduce standby losses by 25-45 percent.<sup>1</sup> Follow the manufacturer's guidelines for insulating, and be sure to provide cutouts for access to controls and to never block air flow to the burner. Tip: Touch your water heater. Is it warm? If yes, you need insulation.

For more information and to do it yourself, visit the [Department of Energy website](http://www.energy.gov/energysaver/projects/savings-project-insulate-your-water-heater-tank) at [www.energy.gov/energysaver/projects/savings-project-insulate-your-water-heater-tank](http://www.energy.gov/energysaver/projects/savings-project-insulate-your-water-heater-tank)

### Cold Water Pipe Insulation

Insulating cold water pipes prevents condensation from forming on the pipes. Condensation on cold water pipes can cause moisture damage leading to poor indoor air quality and discolored ceiling tiles, wall boards and floors.

### TURN DOWN WATER HEATER SET POINT TO 120° F

A set-point temperature of 120-125° F will still satisfy laundry, dishwashing and bathing needs while preventing wasted energy through overheating. If your building is located in a region with a history of legionella pneumophila contamination, adjust your water heater set-point to 125° F, as the bacteria cannot reproduce at temperatures above 122° F.

### RECIRCULATION PUMP TIMER

Running a hot water circulation pump continuously consumes large amounts of energy by causing your water heater to fire more frequently. Furthermore, the pump itself also consumes electricity during operation, and excessive use will shorten its lifespan considerably. Demand-based controls allow users to dictate when the pump is running. If your system cannot integrate demand-based controls, at least install a timer to modulate pump run. Timers can be set to trigger the hot water pump to start circulating hot water before anticipated use, such as morning showers or evening meal preparation.

### COVERS FOR HEATED POOLS AND SPAS

Pool covers reduce pool water heating costs by a staggering 50-70 percent.<sup>2</sup> Covering an indoor pool or spa when not in use reduces pool makeup water needs as well as climate conditioning demands including ventilation, heating and air conditioning. More information on pool covers may be found at [www.energy.gov/energysaver/swimming-pool-covers](http://www.energy.gov/energysaver/swimming-pool-covers).

## Equipment Replacement

The life expectancy of an average water heater is between 10 and 15 years. Eventually, your facility will need to find a new water heating system to service your hot water needs. Rather than waiting until the unit fails, weigh all of your options in advance to find the most efficient water heater for your facility.

### Which Water Heater is Right for You?

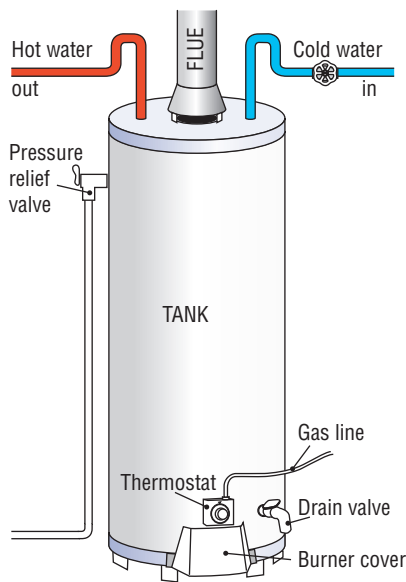
When replacing water heaters, always select the highest efficiency available. Always look for the Energy Guide label to compare energy factors and find the best, most efficient unit.

Usage Description	System Type			Fuel Type		
	Tank	Tankless	Point of Use	Gas	Electric	Solar
<b>Office/Retail:</b> Handwashing, dishwashing, cleaning; no gas appliances			X		X	
<b>Lodging:</b> Handwashing, showering, clothes washing, dishwashing	X	X		X		X
<b>Food service:</b> Heavy kitchen use	X	X		X		X
<b>Education:</b> Hand washing, dishwashing	X		X	X		
<b>Laundromat:</b> Heavy laundry use	X					X

## Common Use-Type

## Key Considerations

System Type			Fuel Type		
Tank	Tankless	Point of Use	Gas	Electric	Solar
<ul style="list-style-type: none"> <li>▶ High demand for short period of time</li> </ul>	<ul style="list-style-type: none"> <li>▶ Continuous demand for extended period of time, and/or</li> <li>▶ Intermittent demand</li> </ul>	<ul style="list-style-type: none"> <li>▶ Short, intermittent demand</li> </ul>	<ul style="list-style-type: none"> <li>▶ Buildings with multiple other appliances using gas</li> </ul>	<ul style="list-style-type: none"> <li>▶ Buildings with no or limited appliances using gas (e.g., just boiler/furnace)</li> </ul>	<ul style="list-style-type: none"> <li>▶ Sites with good solar access and room for water storage</li> </ul>
<ul style="list-style-type: none"> <li>▶ Space constraints</li> <li>▶ Central location needed</li> <li>▶ Water temperature recovery time</li> <li>▶ Insulation needed</li> <li>▶ Maintenance</li> </ul>	<ul style="list-style-type: none"> <li>▶ Central location</li> <li>▶ Integral buffer tank</li> <li>▶ Flow-rate demand capacity</li> <li>▶ Fuel/electricity service capacity and demand rates</li> </ul>	<ul style="list-style-type: none"> <li>▶ Flow-rate demand capacity</li> <li>▶ Location near fixture for installation</li> </ul>	<ul style="list-style-type: none"> <li>▶ High-efficiency</li> <li>▶ Sealed combustion</li> </ul>	<ul style="list-style-type: none"> <li>▶ Electricity demand fees</li> <li>▶ Heat pumps and heat pump ventilation</li> </ul>	<ul style="list-style-type: none"> <li>▶ Freeze protection</li> <li>▶ Recovery time</li> <li>▶ Storage</li> <li>▶ Maintenance</li> </ul>



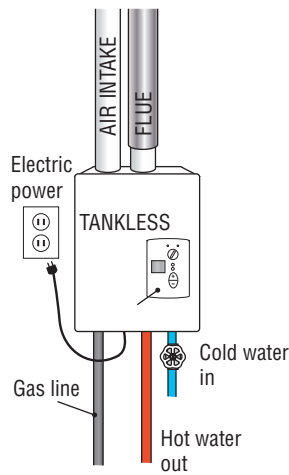
### Storage Tank Water Heaters

#### Pros

- ▶ Least expensive up-front cost
- ▶ Smaller service lines required for gas/electricity

#### Cons

- ▶ Stand-by losses
- ▶ Capacity limitations



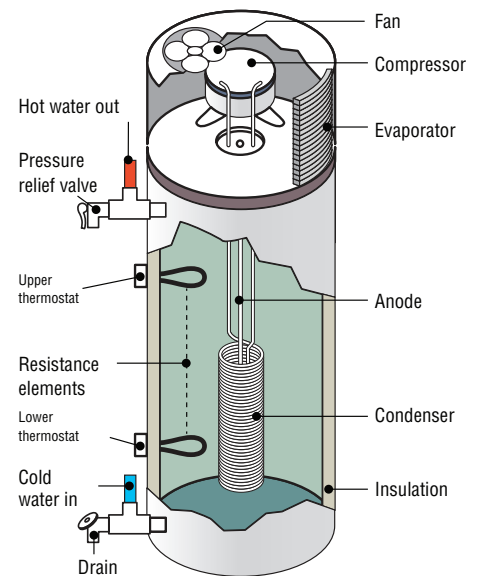
### Tankless Water Heaters

#### Pros

- ▶ Decentralized
- ▶ No stand-by losses
- ▶ Endless hot water within flow-rate limits

#### Cons

- ▶ Potential delay in generating hot water
- ▶ Larger fuel service size required
- ▶ Higher up-front cost



### Heat Pump Water Heaters

#### Pros

- ▶ Higher-efficiency than electric resistance
- ▶ Capable of Demand Side Management (DSM)

#### Cons

- ▶ Higher up-front cost
- ▶ Capacity limitations

## Tank Water Heaters

Water is heated to a set temperature and stored in an insulated storage tank ranging in capacity from 20 gallons to over 80 gallons. Tank water heaters are typically cheaper to buy and install than other water heating technologies and require a smaller heat input rate than tankless units (i.e., smaller electrical or gas service connection which can be important in retrofit applications).

One drawback to storage water heaters is unused hot water will eventually cool down, triggering the system to heat the water back up. These “standby losses” can be a significant source of wasted energy. Also, tank water heaters can only supply a limited amount of hot water before fully depleting, making these heaters less than ideal for heavy-use applications.

Once installed, high efficiency water heaters typically require less maintenance than traditional water heaters. Routine maintenance

on tank systems including flushing a few quarts of water from the bottom of the storage tank every three months to one year, checking water temperature and pressure relief valve every six months to one year, and inspecting anode rod every three years will extend the water heater life and maximize efficiency.

### Heat Pump Water Heaters

Heat pump water heaters (HPWH) are more than twice the efficiency of electric resistance storage water heaters. Heat pump water heaters function by moving heat from the surrounding air into the water in the storage tank, making them ideal for warmer climates as well as restaurant kitchens or laundry rooms where internal heat loads are high.<sup>3</sup> Depending on the control setting, they can also function as electric resistance water heaters during periods of high demand. Exhaust air from the HPWH can add minimal supplemental cooling and dehumidification to areas of high load, such as kitchens and server rooms. Federal tax credits of up to \$300 are available for HPWH.<sup>4</sup> Their maintenance is unique in that an HVAC company, rather than a plumber, would service the heat pump.

### Solar Water Heaters

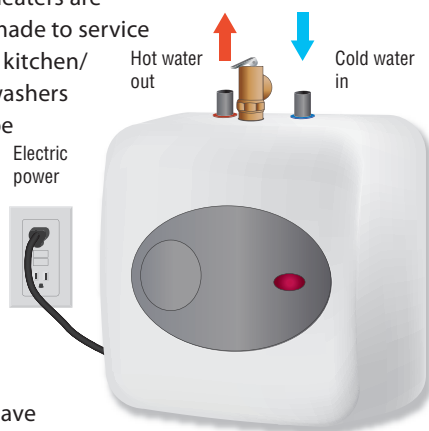
In many cases, the most energy efficient method for heating water is to install a solar water heating system. Solar water heating systems use free energy from the sun to pre-heat hot water before storing it in a storage water heater, thereby reducing water heating operating costs by up to 80 percent. Savings are highly dependent on utility costs as well as timing of hot water demand and solar insolation at the site.

### Tankless Water Heaters

Unlike storage water heaters, tankless water heaters heat water only as it is needed, thus eliminating a large storage tank and avoiding standby losses. They are available in both gas and electric models. When a hot water faucet is turned on, water is passed over a heat exchanger allowing for continuously flowing hot water within the capacity range of the water heater. Tankless water heaters are available in many different sizes and can be appropriate for serving a single sink or several uses.

### Point of Use Water Heaters

Point of use (POU) water heaters are typically electric and are made to service individual fixtures such as kitchen/bathroom sinks and dishwashers and are small enough to be installed in cabinets, on the wall above a fixture, or directly in-line with the fixture. For applicable remote fixtures, we recommend a small (2.5 gallon) tank POU water heater since it will have minimal standby losses and still provide hot water at low fixture flow rates.



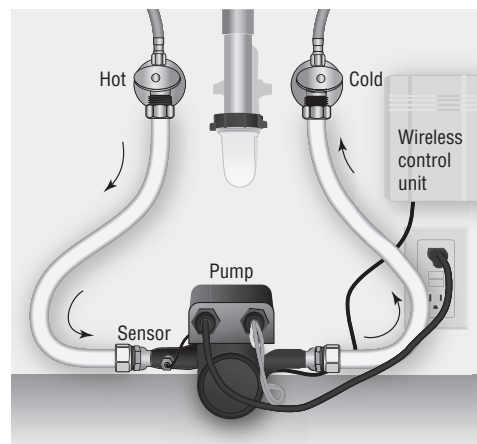
## Higher cost improvements

At the time of renovation, additional hot water saving technologies may be deployed. Water heater selection and equipment replacement is covered under the previous section, though often classified as a capital improvement. This section covers improvements to hot water distribution systems.

### IMPROVE DISTRIBUTION EFFICIENCY

The manner in which hot water is distributed throughout your building plays an important role in energy consumption. During its journey from the water heater to the point of use fixture, hot water will lose heat, which translates into wasted energy. Minimizing distribution energy loss requires that the piping distance and piping diameter are kept to a minimum. Improving distribution efficiency may allow for a reduction in temperature set points, and further energy savings.

### INSTALL HOT WATER ON-DEMAND OR TIMER-BASED RECIRCULATION PUMP



Hot water recirculation systems can be installed on central water heaters to allow cool water sitting in the hot water line to recirculate through the hot water system. Hot water recirculating systems add convenience by reducing the wait time for hot water. Occupancy sensor triggered or manual button pushing can activate the pump, thus ensuring pump operation only occurs when needed. Combining recirculation pumps with appropriate timers, switches and sensors is discussed in the above sections.

### REFERENCES AND RESOURCES:

- 1 [energy.gov/energysaver/projects/savings-project-insulate-hot-water-pipes-energy-savings](https://www.energy.gov/energysaver/projects/savings-project-insulate-hot-water-pipes-energy-savings)
- 2 [energy.gov/energysaver/swimming-pool-covers](https://www.energy.gov/energysaver/swimming-pool-covers)
- 3 [www.energystar.gov/ia/new\\_homes/features/WaterHtrs\\_062906.pdf](https://www.energystar.gov/ia/new_homes/features/WaterHtrs_062906.pdf)
- 4 [www.energystar.gov/products/water\\_heaters/high\\_efficiency\\_electric\\_storage\\_water\\_heaters](https://www.energystar.gov/products/water_heaters/high_efficiency_electric_storage_water_heaters)