



## HEAT WATER WISELY Step 5

**Once space heating and cooling has been addressed**, water heating methods – the second largest opportunity for efficiency improvement – must be considered. To optimize energy efficiency in a zero energy home, builders and designers should look at the type and location of water heating system they install as well as strategies for minimizing the use of hot water by residents. Water heater efficiency is expressed by energy factor (EF), which is essentially the percentage of fuel converted to useful heat. EF is expressed as a decimal, where .90 EF is 90% efficient. Selecting the right type of water heater depends on the amount of hot water to be used, the climate, and the building design.

## Minimize Hot Water Use in the Home

The less hot water used, the less hot water has to be produced. Install water-saving faucets (1 gallon per minute or less) and shower heads (1.5 gallons per minute or less). And select appliances, such as dishwashers and clothes washers, that use hot water sparingly. Consult the [ENERGY STAR appliance website](#) for energy and water use ratings for the best choices.

## Solar Water Heating

Until recently, solar thermal water heaters were a standard element of zero energy homes, and they may still be a good choice for large households. If your home provides hot water for more than 5 people and will continue to do so for the next 20 years or so, then it pays to evaluate the cost-effectiveness of a solar thermal system. Smaller households will find that upfront costs to install an electric water heater, along with enough PV capacity to run it, will be much lower.

## Heat Pump Water Heaters

In moderate and warmer climates consider the cost-effectiveness of using a heat pump water heater (HPWH). A list of [efficient heat pump water heater](#) models is maintained by the Northwest Energy Efficiency Alliance. With EF ratings between 2.0 and 3.0, HPWHs are two to three times more efficient than standard water heaters, making them the most efficient technology, but not always the most cost effective or appropriate choice.

HPWHs draw heat from their surroundings, cooling the space, so it's important to choose its location carefully. If you live in a warm climate that requires more air-conditioning than heating, the HPWH can be placed in the conditioned area of the home. In a heating-dominated climate, the best spot for a HPWH is a buffered space that is not heated directly, but stays warmer than the outside thanks to "waste heat" from the house. A good example is an unheated garage or basement. HPWHs operate efficiently in spaces with temperatures between 40°F and 90°F. Some models can be vented so that the cold air exhausts to the outside. HPWHs also need a location with a minimum volume of air from which to draw heat. This varies with the model and can be as little as 1,000 cubic feet (12'x11"x8'). More volume is definitely better.

Because HPWHs heat water slowly, larger tanks are needed for larger households. Two people can get by with a 50-gallon tank. Larger households should size the tank according to their expected needs, either an 80- or 120-gallon tank. Avoid upsizing the water heater for occasional crowds. HPWHs can operate in three modes depending on demand. Heat pump mode uses only the compressor. This is the slowest yet most efficient mode. Hybrid mode allows the water heater to switch automatically to electric resistance elements if the compressor can't keep up with demand. Electric resistance mode relies only on the heating elements. While you'll get the greatest efficiency with heat pump mode, other modes will help carry residents through short periods of high demand.

## Electric Resistance Water Heaters

An electric resistance water heater uses heating elements in the tank to convert electricity to heat, much like an electric oven or toaster. A well-insulated, electric resistance water heater may be a good choice. Look for a model with an EF of .93 or higher. In most cases, it costs less to install a well-insulated electric resistance water heater and add a few more PV panels to the array. This can simplify zero energy home maintenance for the homeowner and lower costs for builders. In a heating-dominated climate, the best location for an electric water heater would be an interior closet or utility room where any heat loss from the tank can flow into the living space.

## Locating the Water Heater

It's best to locate a water heater close to sinks, showers and appliances where the hot water will be used. Shorter hot water pipe runs will save energy and water. In addition, all hot water pipes must be insulated. This includes those that run inside the conditioned space, with the exception of pipes that are embedded in building insulation.

## Circulating Hot Water Systems

After turning on a hot water faucet there is always a bit of a wait for hot water to arrive. Sometimes it's a long wait. Modern home design often places one or more hot water use points at far distant ends of the floor plan. For example, the kitchen may be on one end of the floor plan and the master bath on the other end. When it becomes impossible to reconcile the goal of short pipe runs with a distant fixture, many builders install a hot water recirculation system that uses a pump to rapidly push hot water to the furthest point. Re-circ systems themselves use energy for the pump and they accelerate heat loss from the water pipes. Operating such a system when it's not needed is a significant energy waste that works against the zero energy goal. Even placing the system on a timer results in many hours a day of unnecessary operation. If a recirculation system is installed, be sure to choose a [demand system](#) that engages the pump by a simple push-button or an occupancy sensor to determine when someone is actually waiting for water.

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