

Heat Pump Water Heaters

Latest generation of an old technology may signal the rebirth of an energy-saving way to heat water

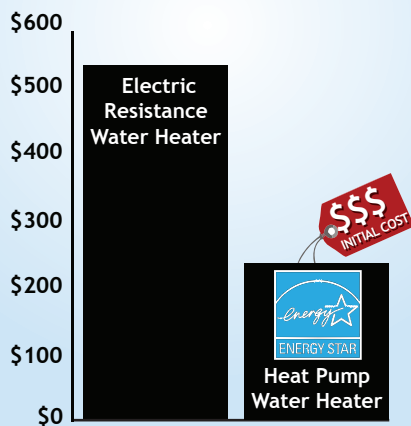
By Alice Clamp and Pam Blair

Heat Pump Water Heaters Cost More Initially, But May Trim Electric Bills

Energy Star-qualified heat pump water heaters cost almost **twice as much** as standard electric resistance models, but may cut energy costs in half.

Annual Energy Costs (\$/Year)

Based on average household of 2.6 occupants, U.S. Census Bureau, 2006



Source: Energy Star

This graphic shows the difference in energy costs between standard electric water heaters and heat pump water heaters, while highlighting the increased price tag for the heat pump version.

Cold showers aren't a pleasant way to start the day. Hot water plays a big role in cooking and cleaning, too. As a result, water heating has become the second-largest user of energy in an average home, accounting for about 20 percent of residential energy consumption.

To save energy, consumers have wrapped water heaters in blankets or hot water pipes in insulation. While those practices should continue, a heat pump water heater promises to lower energy consumption and save consumers money.

It is the only type of electric water heater to earn the Energy Star rating.

Major water heater manufacturers and appliance companies have introduced a new generation of the water heaters.

According to the U.S. Department of Energy, a qualified integrated heat pump water heater uses one-third to one-half the electricity of a standard electric resistance model. As a result, it can save the average household almost \$300 a year on its electric bill compared with a conventional model. Larger families—which typically use more hot water—can save even more.

This added efficiency comes with a hefty price tag. Integrated heat pump water heaters sell for \$1,400 to \$2,000—well more than twice the cost of a standard electric resistance water heater.

DOE says the payback can be as little as three years. It is fastest in areas with high energy prices, where a heat pump water heater replaces a lower-efficiency water heater, where more hot water is used, or where cooling and dehumidification is of value. Cool exhaust air can be released into the area surrounding the water heater, helping cool the home, or simply be returned outside via ducts.

In areas with low electricity rates and limited financial incentives, payback can be much longer. The technology does not offer peak efficiency in all climates.

A Bit of Background

A patent for a heat pump water heater was recorded in 1950, but the technology failed to achieve commercial success.

A few small companies produced units in the 1980s and 1990s, but random failures and other issues—such as the need for utilities to install special electric service to power the devices—left consumers sour on the technology.

Because they had no capability to store heated water, heat pump water heaters also posed a problem for electric utilities that offered load management programs dependent on briefly shutting off water heaters during times of peak demand.

Those programs helped keep electric bills affordable, while not inconveniencing consumers, because standard water heaters can store hot water for hours.

How They Work

To understand the concept of a heat pump, imagine a refrigerator working in reverse. A refrigerator removes heat from an enclosed box and expels it to the surrounding air. A heat pump water heater takes the heat from surrounding air and transfers it to water in an enclosed tank.

A low-pressure liquid refrigerant is vaporized in the heat pump's evaporator and passed into the compressor. As the pressure of the refrigerant increases, so does its temperature. The heated refrigerant runs through a condenser coil within the storage tank, transferring heat to water stored there. As the refrigerant delivers its heat to the water, it cools and condenses, and then passes through an expansion valve, where the pressure is reduced and the cycle starts.

A more expensive "integrated" heat pump water heater replaces an electric resistance water heater with one that combines a heat pump and a storage tank. A second type adds a heat pump



unit to an existing electric water heater.

The electric resistance element in the tank takes over when outside air becomes cold or consumers need extra hot water.

Because a heat pump water heater uses electricity to move rather than generate heat, it consumes less electricity.

Factors to Consider Before Buying

As the air temperature decreases, less heat can be captured. That compromises the efficiency of a heat pump water heater.

In the Pacific Northwest, for example, if the water heater is designed to work at an ambient air temperature of 45 F or higher, the electric element will operate whenever air temperatures drop below that level.

That reduces performance and savings.

According to DOE, heat pump water heaters require installation in locations with a year-round temperature between 40 and 90 F. That excludes Alaska.

They have proven to be most efficient in warm, damp climates, such as Hawaii.

At least 1,000 cubic feet of space is needed around the heat pump water heater to ensure adequate air exchange, so installation is recommended in an open basement, utility room or garage.

Noise should be considered when selecting where to place it. An electric resistance water heater operates quietly, but the noise of a heat pump water heater is similar to a window air conditioner.

Utilities are testing the new heat pump water heaters to determine if they have overcome the problems of the past, and whether they can help consumers save energy and trim electric bills. ■

Alice Clamp is a technology writer for the Cooperative Research Network, which monitors, evaluates and applies technologies that help electric utilities control costs, increase productivity and enhance service to consumer-members. Pam Blair is an assistant editor for Ruralite.

A heat pump water heater needs at least 1,000 cubic feet to ensure adequate air exchange. An open basement, a utility room or garage—as with this GE Hybrid Water Heater—usually will work.