

Energy Efficiency FACTSHEET

Heat Pump Water Heaters - Commercial



Description: Heat pumps use a well-established technology for space heating. The same principal of transferring heat is at work in heat pump water heaters (HPWHs) except that they extract heat from air (indoor, exhaust or outdoor air) and deliver it to water. Some models come as a complete package including tank and back-up resistance heating elements, while others work as an adjunct to a conventional water heater. Because it extracts heat from air, the HPWH delivers about twice the heat for the same electricity cost as a conventional electric resistance water heater.

The simplest HPWH, and the focus of this Technology Brief, is the indoor ambient air-source unit, which removes heat from surrounding air, providing the additional benefit of space cooling and dehumidification. Some are ducted and others draw air from the immediate vicinity, while some draw heat from an exhaust air stream.

Applications: Commercial heat pump water heaters are ideal in situations such as a commercial kitchen or laundry where there is a steady simultaneous need for cool air and hot water. They are widely used in supermarkets, hotels, and restaurants, including a number of fast food chains. One manufacturer has a large market in Hawaii, with many units installed outside—not even using the cooled air byproduct.

The best applications for HPWHs have some of the following characteristics:

- ◆ The need for both hot water and space cooling/dehumidification is large and steady, such as in a laundry or restaurant kitchen.
- ◆ Electric resistance water heaters are the alternative, electric rates are high, and alternate fuels such as natural gas are not available.
- ◆ Climate is mild and there is a need for continual mechanical ventilation, such as for humidity/moisture control or indoor air quality.

Facility managers should observe the following cautions:

- ◆ HPWHs should not be installed in unventilated closets or small rooms unless a ducted air supply can be provided.

- ◆ Exhaust air design HPWHs should not be used near open-flame devices such as gas appliances unless those devices have dedicated makeup air supply.
- ◆ HPWHs are not recommended for installation in outside or unconditioned spaces where the potential for freezing conditions exists.

There are quite a few variations in the physical configuration of the HPWH. Several alternative configurations of integral and remote components are shown in the diagrams below. Some water heaters use waste heat or water as a heat source, and some water heaters perform air conditioning or dehumidification as their primary function and water heating as their byproduct. One manufacturer sells only components, i.e. a tank and heat exchanger that can be plumbed into a refrigeration system ahead of the condenser section. Another manufacturer sells an indoor pool heater variation that heats the pool while performing ambient air dehumidification as a byproduct. Others provide wastewater heat recovery to heat potable water. HPWHs can work any time there is a need for hot water heating and a cooling load or opportunity.

Performance/Costs: Performance varies with the situation. First costs are in the range of \$2,000 to \$2,500 per ton (sized on cooling capacity). An economic comparative analysis must be benchmarked against some alternative arrangement. Energy performance is fairly straightforward. Units tend to have a Coefficient of Performance (COP) around 2. This means they produce about twice as much hot water per kWh as electric resistance water heaters.

Maintenance costs are greater than simple resistance water heating. The maintenance requirements and cost are more similar to that of conventional air conditioning equipment of similar tonnage.

Example: A kitchen planned for a new mess hall will require 500 gallons per day of water heated from 50°F to 120°F, and the cost of electricity is \$.07/kWh.

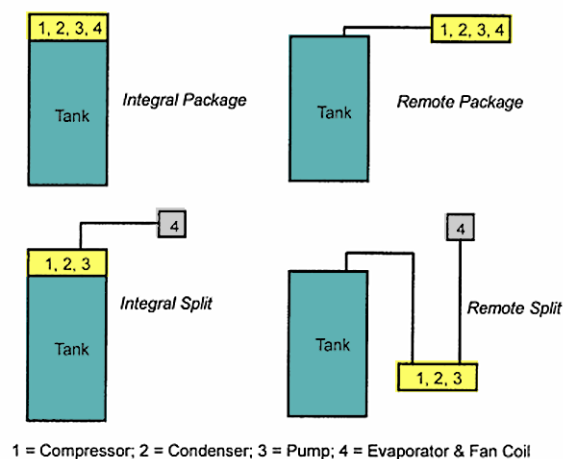
Cost of Water Heating: By using a HPWH rather than an electric resistance water heater, the annual electric bill of 31,329 kWh/year can be cut in half, saving \$1,100.

Cost of Cooling: The HPWH also provides 3 tons of cooling, four hours/day, worth about \$90 over a three-month cooling season.

Cost of Equipment: A 3-ton HPWH costs about \$6,000, but this is offset by reducing the air conditioning needed by three tons, worth \$1,500. Note that if the application was a retrofit rather than new construction, this benefit wouldn't apply.

Simple Payback: Cost (\$6,000-\$1,500) / Annual Savings (\$1,100 + \$90) = \$4,500 / \$1,190 per year = 3.8 years

Availability: Commercial heat pump water heaters have been available for 20 years, but they have been somewhat slow gaining acceptance. In recent years the market has slowed for stand-alone commercial heat pump water heaters. Competition with gas water heaters is strong because of recent good gas prices. Also electric rates have not risen as fast as projected in many areas. Meanwhile, variations on the product concept have proliferated and the better-designed products have improved and continued to survive in the marketplace. There is a wide range of unit capacity from a size for single family residences, up to at least 27 tons.



Commercial Heat Pump Water Heaters

A FEMP Federal Technology Alert that gives an overview of the technology, types of systems, information on manufacturers and more.

http://www.eren.doe.gov/femp/prodtech/pdfs/FTA_HPWH.pdf

Heat Pump Water Heaters for Residential and Commercial Buildings

A paper from Greentie, the Greenhouse Gas Technology Information Exchange. Examines the international markets, the equipment available, performance characteristics, and cost benefit analyses for residential and commercial applications.

<http://www.greentie.org/HPWH.htm>

Heat Pump Water Heaters Solve Heat and Humidity Problem

A summary of a case study at a Florida hotel, from the Southern Company, and a southeastern utility. A summary of a case study at a Florida hotel, from the Southern Company, and a southeastern utility.

<http://ebiz.southernco.com/success/dunes.asp>

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