

# Water-to-Water Heat Pumps

Improve your HVAC-energy utilization



 **YORK**<sup>®</sup>  
A JOHNSON CONTROLS COMPANY

# Improving HVAC-energy utilization

## Reducing water-heating costs in large CII facilities

At a time when fossil-fuel costs are high and continue to rise, energy bills are scrutinized for ways to trim costs. One smart option is to improve the energy utilization of your facility's HVAC system by repurposing heat that would otherwise be discarded. This can be accomplished with a water-to-water heat pump (WTWHP) from YORK®, a Johnson Controls Company.

## What is a WTWHP?

A WTWHP is a water-cooled chiller that has been designed to produce hot water at a specified temperature. Heat is extracted from a low-temperature source, and its temperature is raised to a level which is useful.

## Benefits of using heat pumps

Water heaters are typically used to heat water for hydronic heating and domestic hot water. Unfortunately, they are not very efficient: their coefficient-of-performance

(COP) is less than 1.0. Heat pumps offer a number of advantages when compared to fossil-fuel water heaters:

- Higher COPs offer energy cost-savings of as much as 80%
- Simple payback of the heat pump can be less than 1 year
- Can provide low operating-cost supplement to water heater, if heating requirement exceeds heat pump capacity
- Heat pumps can also be used as water chillers, which means lower first-costs, because one piece of equipment does both cooling and heating
- Comply with ASHRAE Standard 90.1-2004
- Reduced CO<sub>2</sub> emissions from fossil fuel use; heat pumps are a highly efficient electric alternative

YORK heat pumps offer an additional benefit: environmentally responsible HFC-134a refrigerant, which has zero ozone-depletion potential and no phase-out date.



Model	Heat Pump Capacity	Leaving Hot-Water Temperature
MaxE™ Model YS	Up to 5,600 MBH (1,600 kW)	Up to 130°F (55°C)
MaxE™ Model YK	Up to 30,000 MBH (8,800 kW)	Up to 155°F (68°C)
MaxE™ Model CYK	Up to 38,000 MBH (11,000 kW)	Up to 155°F (68°C)
Titan™ Model OM	Up to 74,000 MBH (22,000 kW)	Up to 170°F (77°C)

*YORK offers a variety of water-to-water heat pumps, designed to meet a range of heat and temperature needs.*

# How much can a heat pump save?

## Compare the efficiencies

The best way to compare the efficiencies of a heat pump and a water heater is to do a COP analysis. COP equals the energy output (useful heat generated) divided by the energy input (energy supplied to the equipment). Accordingly, the higher the COP, the more efficient the system. Figure 1 shows that the COP for a typical water heater is only 0.85, which is rather low.

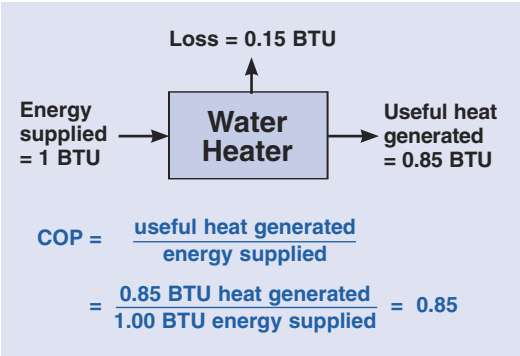


FIGURE 1: COP of water heater

On the other hand, the COP of a heat pump is much higher. The unit illustrated in Figure 2 has a COP of 3.83, which is 4.5 times more efficient than the water heater — and many heat pumps can be even more efficient!

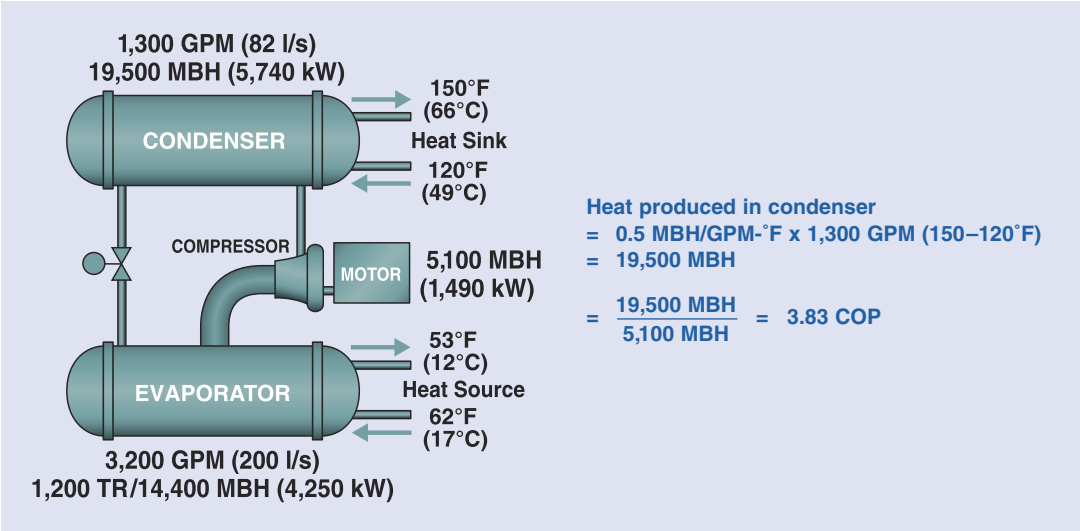


FIGURE 2: COP of a heat pump

## Calculate the savings

Knowing the COP, it is easy to calculate the operating cost to generate 100,000 BTUs (106,000 kJ) with different energy sources: electricity for heat pumps, and oil or natural gas for water heaters. Divide 100,000 BTUs by the COP and the heat value, then multiply by the price of the fuel.

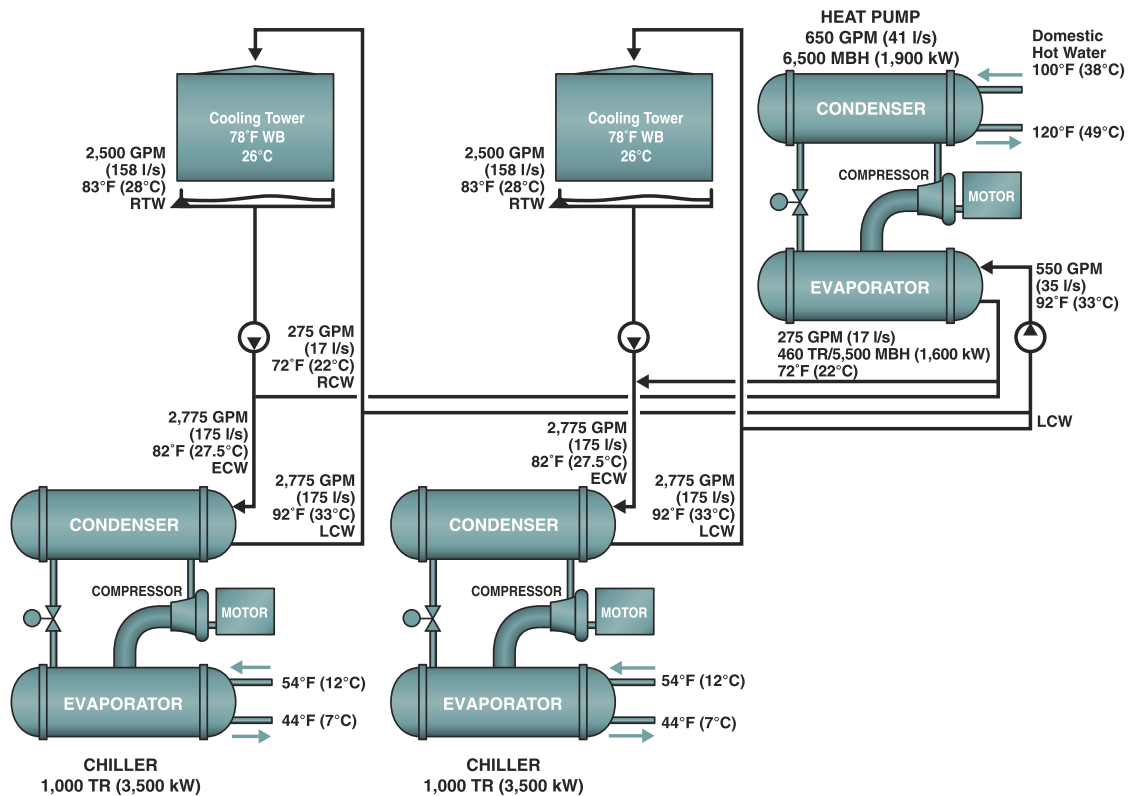
Table 1 shows typical operating costs for the three options.

Energy Source	Equipment	COP	Heat Value	Cost of Source	Cost of 100,000 BTU (106,000 kJ)
Natural Gas	Water Heater	0.85	1000 BTU/ft <sup>3</sup> (37,500 kJ/m <sup>3</sup> )	\$10.75/1000ft <sup>3</sup> (\$0.38/m <sup>3</sup> )	\$1.26
No. 2 Fuel Oil	Water Heater	0.85	140,000 BTU/gal (32,500 kJ/l)	\$1.79/gal (\$0.392/l)	\$1.50
Electric	Heat Pump	3.83	3,415 BTU/kW (3,600 kJ/kW)	\$0.07/kWh	\$0.54

Because of its superior COP value, a heat pump can reduce water-heating energy costs by as much as 80%!

TABLE 1: Comparison of energy cost from various water-heating devices

# Real-world heat pump savings



**FIGURE 3: Schematic of a heat pump system in Texas**

## Institutional application with 6-month simple payback

A university in Texas had a year-round need for both chilled water and domestic hot water. Instead of operating a fossil-fuel water heater, a heat pump was installed to utilize the chillers' leaving condenser water (LCW) as a heat source (see Figure 3). A portion of this water at 92°F (33°C) LCW is piped to the heat pump instead of the cooling towers. The heat pump raises the temperature high enough to heat the domestic hot water (DHW) from 100°F (38°C) to 120°F (49°C), at a COP which ranges between 5.5 and 6.5. The 72°F (22°C) return condenser water (RCW) is then mixed with the 83°F (28°C)

return tower water (RTW) to produce a lower entering condenser water (ECW) temperature of 82°F (27.5°C). Thanks to the lower temperature of the ECW, the water chillers' efficiency improves, which increases the efficiency of the entire system.

In this application, the capital investment for the heat pump came to \$220,000. The annual operating-cost savings totaled \$260,000, providing a very attractive ROI.

For more information on heat pump applications, or the innovative adaptability of YORK chillers, contact your local YORK/Johnson Controls sales representative at 800-861-1001 or visit [www.york.com](http://www.york.com)

