

## Building America *Technical Highlight*



### NREL Tests Integrated Heat Pump Water Heater Performance in Different Climates

Researchers at the National Renewable Energy Laboratory (NREL) completed thorough laboratory testing of five integrated heat pump water heaters (HPWH). These water heaters have the potential to significantly reduce water heater energy use relative to traditional electric resistance water heaters. These tests have provided detailed performance data for these appliances, which have been used to evaluate the cost of saved energy as a function of climate.

The performance of HPWHs is dependent on ambient air temperature and humidity and the logic controlling the heat pump and the backup resistance heaters. The laboratory tests were designed to measure each unit's performance across a range of air conditions and determine the specific

logic controlling the two heat sources, which has a large effect on the comfort of the users and the energy efficiency of the system.

Unlike other types of water heaters, HPWHs are both influenced by and have an effect on their surroundings. Since these effects are complex and different for virtually every house and climate region, creating an accurate HPWH model from the data gathered during the laboratory tests was a main goal of the project.

Using the results from NREL's laboratory tests, such as the Coefficient of Performance (COP) curves for different air conditions as shown in Figure 1, an existing HPWH model is being modified to produce more accurate whole-house simulations. This will allow the interactions between the HPWH and the home's heating and cooling system to be evaluated in detail, for any climate region. Once these modeling capabilities are in place, a realistic cost-benefit analysis can be performed for a HPWH installation anywhere in the country.

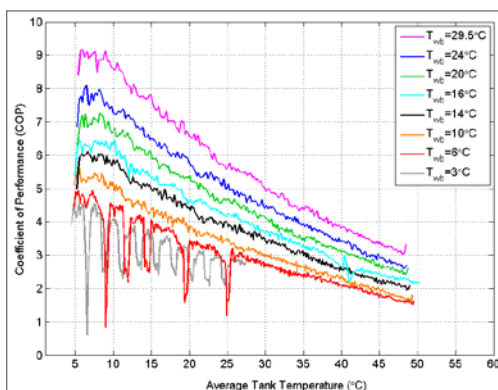


Figure 1: Instantaneous COP as a function of average tank temperature and ambient air wet bulb temperature for one of the HPWHs tested.

### For more information

Maguire, J. (2011). A Parametric Analysis of Residential Water Heaters. Master's Thesis. Boulder, CO: University of Colorado.

Sparr, B.; Hudon, K.; Christensen, D. (2011). Laboratory Performance Evaluation of Residential Integrated Heat Pump Water Heaters. NREL Report No. TP-5500-52635.

[www.nrel.gov/docs/fy11osti/52635.pdf](http://www.nrel.gov/docs/fy11osti/52635.pdf)

### Key Research Results

#### Achievement

Tests performed by NREL are used to capture heat pump performance across a wide range of ambient conditions for five heat pump water heaters (HPWH).

#### Result

Performance maps and control logic verified during testing will be used to improve the accuracy of HPWH models in whole-house simulation tools. All manufacturers have also been given detailed feedback on lessons learned from the testing program.

#### Benefit

An accurate HPWH model will help to quantify the savings associated with installing a HPWH in the place of a standard electric water heater. In most locations, HPWHs are not yet a cost-effective alternative to natural gas water heaters. The detailed system performance maps that were developed by this testing program will be used to:

1. Target regions of the country that would benefit most from this technology.
2. Identify improvements in current systems to maximize homeowner cost savings
3. Explore opportunities for development of advanced hot water heating systems.

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