Building America Case Study Technology Solutions for New & Existing Homes

Measure: Heat Pump Water Heater Retrofit

West Palm Beach, Florida

PROJECT INFORMATION

Project Name: Habitat for Humanity of Palm Beach County, Inc.

Location: West Palm Beach, FL

Partners: Palm Beach County Habitat for Humanity; Florida Solar Energy Center

Building America Partner: Pacific Northwest National Laboratory

Building Component: Water Heating

Application: Single-Family Retrofit

Year Tested: 2011

Climate Zone(s): Hot Humid

PERFORMANCE DATA

Cost of Energy-Efficiency Measure (including labor):

Whole House Retrofit: $5,875

Heat Pump Water Heater: $1,350

Projected Energy Savings:

Whole House Retrofit: 40%

Heat Pump Water Heater: 11%

Projected Energy Cost Savings:

$56 per month or $676 per year

Building AMERICA U.S. Department of Energy

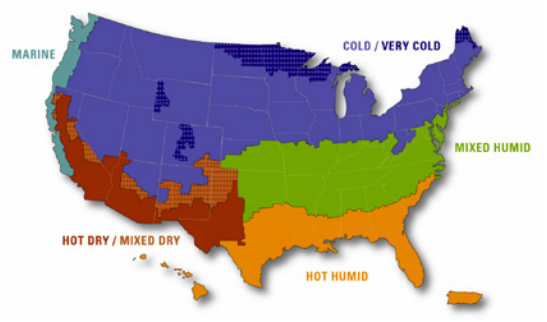
The U.S. Department of Energy reports that water heaters consume 14 to 25% of the energy used in homes across the U.S. on average (www.energysavers.gov). Heat pump water heaters are an efficient, cost-effective alternative to traditional electric resistance water heaters, improving energy efficiency by up to 62%[1]. Heat pump water heaters work on a reverse refrigeration cycle, absorbing and using heat from the surrounding air to heat the water in the tank, and exhausting cool, dry air. In warmer climates, this cycle can offer additional energy benefits by cooling and dehumidifying the interior space and reducing the load on the cooling equipment.

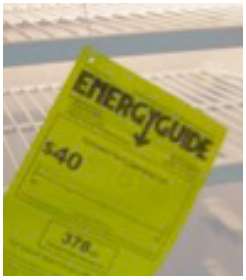
In an unoccupied, foreclosed home being retrofit by Habitat for Humanity of Palm Beach County, a heat pump water heater was included as one of the primary retrofit measures to achieve a combined 40% whole house energy savings. Habitat worked with the Florida Solar Energy Center, as part of the Pacific Northwest National Laboratory Building America team, to identify cost-effective measures to achieve significant energy savings, including the recommended heat pump water heater. The heat pump water heater had a coefficient of performance (COP) of 2.35 compared to 0.9 for a typical electric water heater, and reduced the home's overall energy usage by more than 11%.

Ideally, heat pump water heaters should be located in conditioned space to fully realize the associated space cooling benefits in Florida's hot humid climate. However, the heat pump water heater could not be located in the conditioned space in this small (1,176 square foot) home. Instead, it was installed in an attached shed that shared airspace with the home's attic. Locating the water heater in this shed allowed it to simultaneously heat water and cool the attic, reducing the cooling load on the rest of the home while lowering the humidity in the attic. Also, the high outdoor temperatures in this climate will increase the efficiency of the heat pump water heater.

CLIMATE CONSIDERATIONS

Heat pump water heaters are excellent for cooling-dominated climates. In heating-dominated climates, savings resulting from the increased efficiency of the heat pump water heater can be realized. However, there will be a space conditioning penalty due to the cool air exhausted into conditioned space. If the heat pump water heater is located outside conditioned space in cold climates, the efficiency of the heat pump will be reduced. Optimal heat pump water heater placement will depend on specific climate and building characteristics.





OTHER MEASURES

In addition, the Habitat partner installed efficient lighting and appliances; a central, forced air conditioner (SEER 15) with heat pump; and additional insulation to increase the attic ceiling insulation level to R-38. Additional duct sealing and air sealing tightened the house from 11 air changes per hour at 50 pascals depressurization (ACH50) to 7 ACH50 and reduced duct leakage by 60% (153 cubic feet per minute at 25 pascals depressurization [cfm25] to 61 cfm25).

For more Information, see the Building America report at www.buildingamerica.gov

Lessons Learned

- Heat pump water heaters offer a great opportunity for energy savings compared with electric resistance water heaters, including synergistic efficiency savings from a decreased space conditioning load in cooling-dominated climates.
- Even when not installed directly in conditioned space, installing a heat pump water heater in the attic or a connected space by reducing attic temperatures and relative humidities, to decrease the cooling load in the interior conditioned space.
- Installing a heat pump water heater in this home in will decrease energy use by 11%. The additional incremental cost of the more efficient unit is expected to pay back in 8 years. Similar savings would be expected in other cooling-dominated climates.

Installing a heat pump water heater in conditioned space can increase energy savings by reducing the load on space conditioning equipment. When there is insufficient room indoors for a heat pump water heater, which requires more clearance than a traditional electric resistance water heater, locating it in the attic or a connected space can also decrease cooling loads by cooling and dehumidifying the attic, the hottest part of the home in summer.

Looking Ahead

Heat pump water heaters are becoming increasingly available, with a relatively minor price premium over typical electric resistance water heaters. As their prices continue to fall and they become more common, heat pump water heaters will become more cost competitive with electric resistance water heaters and increase in market share. Builders in hot, humid climates can create energy-saving synergies by locating heat pump water heaters in conditioned space, which decreases the load on cooling equipment. Heat pumps appropriate for all climate zones are being developed. Heat pump technologies and installation best practices that are appropriate for all climate zones are being developed. These may include the practice of locating heat pumps in unconditioned space or ducting kits that exhaust cool air outside the building envelope.

[1] Based on the DOE test procedure and comparison of an electric tank water heater (EF=0.90) versus a heat pump hot water heater (EF=2.35).

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Energy Efficiency & Renewable Energy

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The U.S. Department of Energy's Building America program is engineering the American home for energy performance, durability, quality, affordability, and comfort.