

## Cocoa Florida, United States

Ducted heat pump water heater on Space Conditioning monitored in a single family house, tested side by side at the Flexible Residential Test facility laboratories

### Key facts

#### Building

Location	Cocoa, Florida (USA)
Construction	2014
Heat distribution in building	
Heated area	142.6 m <sup>2</sup> living
Level of insulation	....

#### Heat pump and source

Number of heat pumps	2
Installed capacity kW + kW	
Operation mode	monoenergetic
Heat source	indoor and outdoor air
Brand and type	A.O. Smith 60-gal <a href="#">Voltex</a>
Refrigerant	
Sound level	dB

#### Heating system

Heat demand	n.a.
Heating temperature	n.a. °C

#### Domestic hot water

Type of system	see overview
Max. Temperature	52 °C
Circulation system	
Legionella measures	
Storage size	230 litres
Number of storage tanks	2
Storage losses	
Temperature control	

#### Other information

Electric energy	
Consumption year	kWh
Investments costs	unknown
PV installation	none
Solar thermal	none

#### Lessons learned

[Effect of Ducted HPWH on Space-Conditioning and Water Heating Energy Use](#)—Central Florida Lab Home

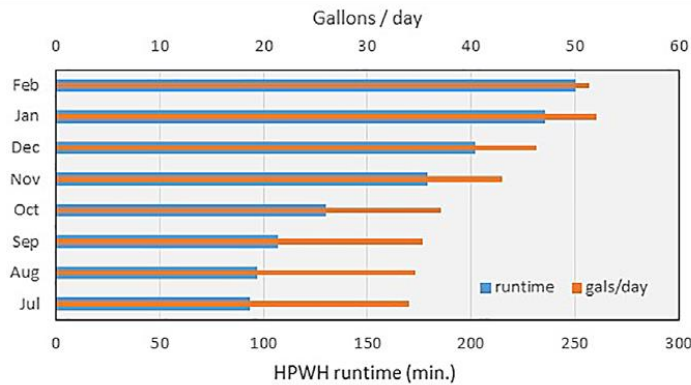
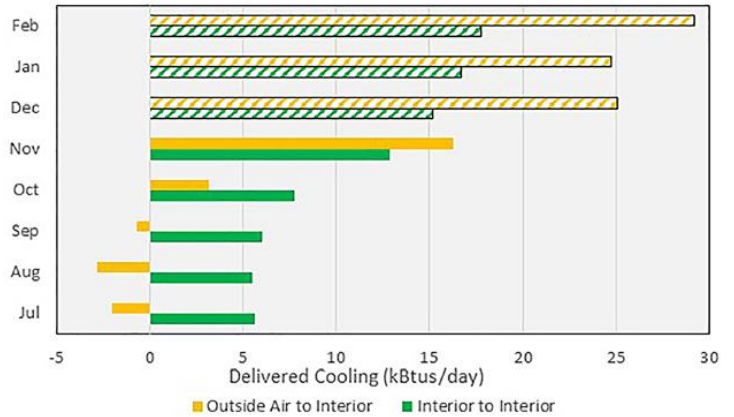
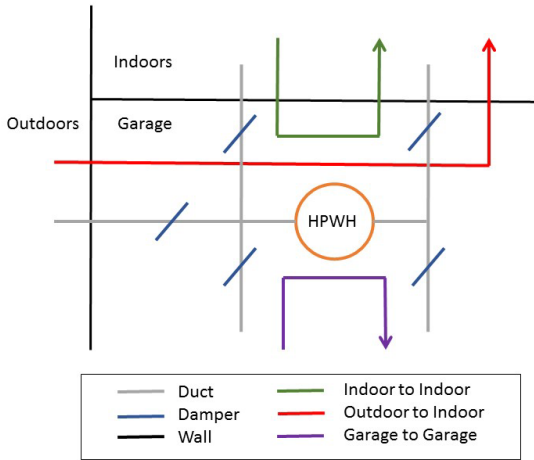
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The Building America Partnership for Improved Residential Construction (BAPIRC) investigated the impact of ducted heat pump water heaters (HPWHs) on space conditioning and water heating energy use in residential applications. Two identical HPWHs, each of 60-gallon capacity, were tested side by side at the Flexible Residential Test facility (FRTF) laboratories at the Florida Solar Energy Center (FSEC) campus in Cocoa, Florida. The FRTF's residential buildings feature the same square footage (142.6 m<sup>2</sup>), orientation, and envelope characteristics, with the only current difference being the floor material. The same water heating experiment was run in each test house from July 2014 to February 2015. During testing, air was either drawn from the conditioned space (indoor to indoor or closed loop), or outdoors (outdoor to indoor, or open loop), sent across the HPWH evaporator coil, and then directed into the conditioned space. The impact on the building's indoor air enthalpy (h) change was investigated during the cooling season. An average monthly auxiliary net cooling effect ( $\Delta h$ ) provided by the HPWH increased from about 1.64 kWh/day in July 2014 to 3.78 kWh/day in November 2014 when utilizing the indoor-to-indoor airflow configuration. This resulted in an approximate savings of 0.86 kWh/day, or 3.8%. When using the outdoor-to-indoor airflow pathway, the HPWH was unable to completely mitigate the load imposed by the outdoor air, and a small net cooling load was added to the building during peak summer months. This resulted in a small (1%) cooling energy penalty, which is very minor considering the outdoor air could constitute approximately 30% of the mechanical ventilation requirements of ASHRAE 62.2.

During winter months, the closed-loop configuration imparted approximately 4.83 kWh/day of heating load on average, resulting in a heating energy penalty of about 6%. The open-loop airflow configuration added approximately 7.71 kWh/day of heating load on average, resulting in a heating energy penalty of approximately 17.5%. This result points to the potential to optimize whole house annual energy savings by being able to direct HPWH exhaust away from the conditioned living space during winter.

Cocoa Florida, United States, Technical details



Summary plot comparing airflow pathways and their monthly net effect on indoor building enthalpy change

Variation in imposed hot water draw and HPWH runtime response throughout the testing period

Description of the technical concept



Lessons learned:

- Cooling and mechanical ventilation provided by the exhaust of a HPWH is a function of runtime, which is influenced primarily by the seasonal hot water gallons used (incoming water temperature) and HPWH thermostat setpoint.
- Cooling efficiency demonstrated by the HPWH was measured and averaged across all airflow configurations resulting in a Coefficient of performance (COP) of 1.5 (1.12 to 1.9).
- Seasonal hot water heating efficiency of the HPWHs showed little variation for the seasonal hot water load imposed (129–200 litres per day), averaging a COP of 2.0 and 2.1 for the east and west FRTF buildings.

Heat pump water heaters were retrofitted with duct kits (shown without insulation) and manual directional dampers to study the impact of different airflow pathways.