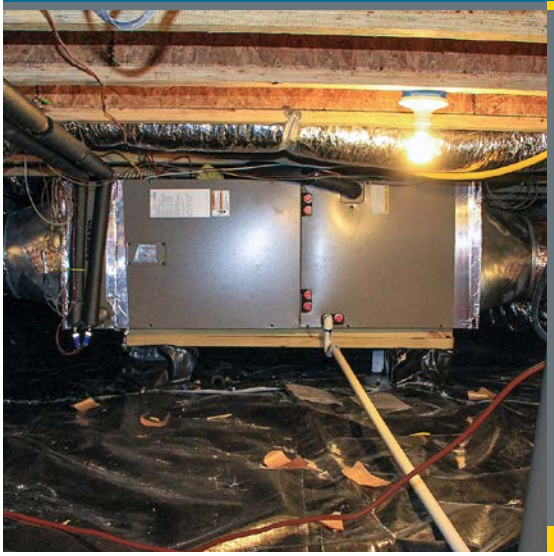


Building America Case Study
Whole-House Solutions for New Homes

Hydronic Heating Coil Versus Propane Furnace

Rehoboth Beach, Delaware

PROJECT INFORMATION

Construction: New Home

Type: Single-family, affordable

IBACOS, *www.ibacos.com*

Builder:
Insight Homes, Rehoboth Beach, DE
www.itsjustabetterhouse.com

Size: 1,715 ft^2

Price Range: About $230,000

Date Completed: 2012

Climate Zone: Mixed-humid

PERFORMANCE DATA

Builder standard practice = 56

Case study house = 1,715 ft^2

With renewables = Not applicable

Without renewables = 56

Projected annual energy cost savings: Not available

Incremental cost of energy-efficiency measures: Not available

Incremental annual mortgage: Not available

Annual cash flow: Not applicable

Billing data: Not applicable

Building America SM U.S. Department of Energy

In 2012, Insight Homes constructed two similar homes (identical floor plans and thermal envelopes) with different heating and domestic hot water (DHW) systems in Rehoboth Beach, Delaware. Each single-story, 1,715-ft^2 house has three bedrooms and two bathrooms. The heating, ventilation, and air conditioning (HVAC) systems and ductwork are located in conditioned crawlspaces. The standard house, which is the builder's standard production house, uses an air source heat pump (ASHP) with supplemental propane furnace heating. The Building America test house uses the same ASHP unit, but supplemental heat is provided by a combined DHW and hydronic space heating system. Both houses were occupied during the test period.

Standard house (left), and test house (right)

The U.S. Department of Energy Building America team IBACOS investigated the performance of the two space conditioning systems relative to thermal comfort (based on ASHRAE Standard 55) and operational energy efficiency (seasonal coefficient of performance [seasonal COP]). The team also explored the modeled efficiency of the two tankless DHW systems relative to actual occupant use.

In this investigation, the test system was more efficient than the standard system; the calculated COP values were 2.04 for the standard house and 2.67 for the test house. However, a backup system in the standard house may have needed servicing, and, combined with low resolution of the propane consumption monitoring,

Key Energy Efficiency Measures

HVAC

- SEER 16.3, HSPF 7.8 (COP 2.78) with hydronic coil connected to a tankless water heater
- Sealed R-6 flex ducts in conditioned crawlspace; duct leakage to the outside = 21 cfm @ 25 Pa
- Exhaust only ventilation

ENVELOPE

- Light-colored shingle roof
- R-38 blown ceiling insulation in vented attic
- R-23 grade-1 netted and blown insulation in 2 × 6 frame wall
- Double-pane, low-e vinyl windows.

U = 0.26, SHGC = 0.18

- Tightly sealed house, ACH50 = 0.47

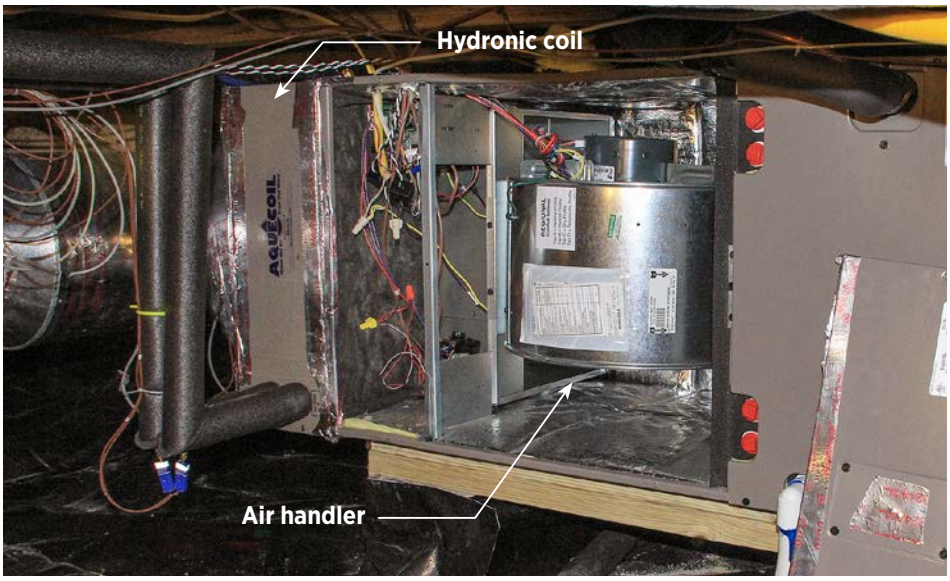
LIGHTING, APPLIANCES, AND WATER HEATING:

- 100% CFLs and light-emitting diodes
- ENERGY STAR® ceiling fans
- ENERGY STAR refrigerator, dishwater, and clothes washer
- Propane tankless condensing water heater

For more Information, please see the Building America report, *Dual-Fuel Air Source Heat Pump Field Performance Evaluation,* at *www.buildingamerica.gov*

Image credit: All images were created by the IBACOS team.

the team was unable to conclude which backup heating system is more efficient. Comfort conditions in both houses were consistently outside the ASHRAE Standard 55 thermal comfort range. The room temperatures compared to the central thermostat in each house did not deviate more than 2°C for the coldest days recorded during the analysis period, indicating that the heat was distributed evenly. Recorded DHW draw profiles from the tankless water heaters in both houses showed considerable variability; however, when monitored draw profiles from each house were modeled in EnergyPlus software, these efficiencies were approximately the same. The modeled results also indicated that the DHW draw profile per the Building America House Simulation Protocols yielded similar water consumption and fuel use results as the actual draw profile.



High efficiency air handler and test hydronic coil connected to condensing tankless water heater.

Lessons Learned

The following lessons were learned from this project:

- The heating equipment in the standard house was not functioning correctly; future analyses of this type of system could be improved with more detailed monitoring of either the propane flow rate (higher resolution) or better status indication of equipment activity (normal operation, supplemental operation, and defrost cycle).
- The hot water draw schedule had little impact on the modeling results of the efficiency of a tankless water heater.

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

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www.buildingamerica.gov

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