



Building America Case Study Technology Solutions for New and Existing Homes

Supplemental Ductless Mini-Split Heat Pump in the Hot-Humid Climate

Brevard & Volusia Counties, Florida

PROJECT INFORMATION

Project Name: Phased Deep Retrofit:
Phase II

Location: Central Florida

Partners: Florida Power & Light,
<https://www.fpl.com/>

Building America Partnership for
Improved Residential Construction,
www.ba-pirc.org/

Building Component: HVAC

Application: Retrofit, single-family

Year Tested: 2014-2015

Applicable Climate Zone: Hot-humid

PERFORMANCE DATA

Average Home Living Area: 1,872

Central HVAC Heating: Heat pump (2);
resistance heat (4)

Median HVAC SEER: 13.0

Median Duct Leakage: $Q_{n,out} = 0.06$

Cost of Energy-Efficiency Measure
(including labor): \$3,465

Projected Energy Savings: 37%
cooling; 59% heating

Projected Energy Cost Savings:
\$280/year

Simple Payback: 12 years

Central HVAC systems, commonplace in Florida, have leaky and heat gain-prone duct systems. Ductless Mini-Split Heat Pumps (MSHP) inherently have at least a 15% efficiency advantage over these standard systems.

High-efficiency 25.5 SEER, 1-ton MSHPs were installed in the main living area of six central Florida homes. It was hoped that the ductless supplemental mini-split systems might reduce space cooling and heating energy by shortening the runtime of less efficient, existing central systems subject to duct losses. However, how this would work out practically was highly speculative because the result is two different systems with potentially competing thermostats serving a single zone.

In most cases, the indoor unit was located as close as possible to the central return grille of the existing system to help with room-to-room distribution of MSHP air when both systems were functioning. In each house, the cooling set point of the MSHP was initially set 2°F or 4°F lower than that of the central system. There was no way to know in advance of the experiments how the systems would interact with two independent thermostats. To maximize comfort and efficiency in each home, BA-PIRC researchers worked with homeowners in the days and weeks following the MSHP installation to find the optimal thermostat set points for both systems.

Figure 1 graphically illustrates the energy savings achieved at one site after the MSHP was installed. Among the six test sites, median cooling energy use was reduced by 10.9 kilowatt-hours per day (kWh/day) (37%) and heating energy use by 13.2 kWh/day (59%). The economics of this measure, assuming a current installation price of about \$3,500, are potentially attractive, with a suggested payback of 12 years and an 8.1% annual rate of return.

Supplemental Ductless Mini-Split Heat Pump Installation



The indoor unit is located as close as possible to the central return grille of the existing system

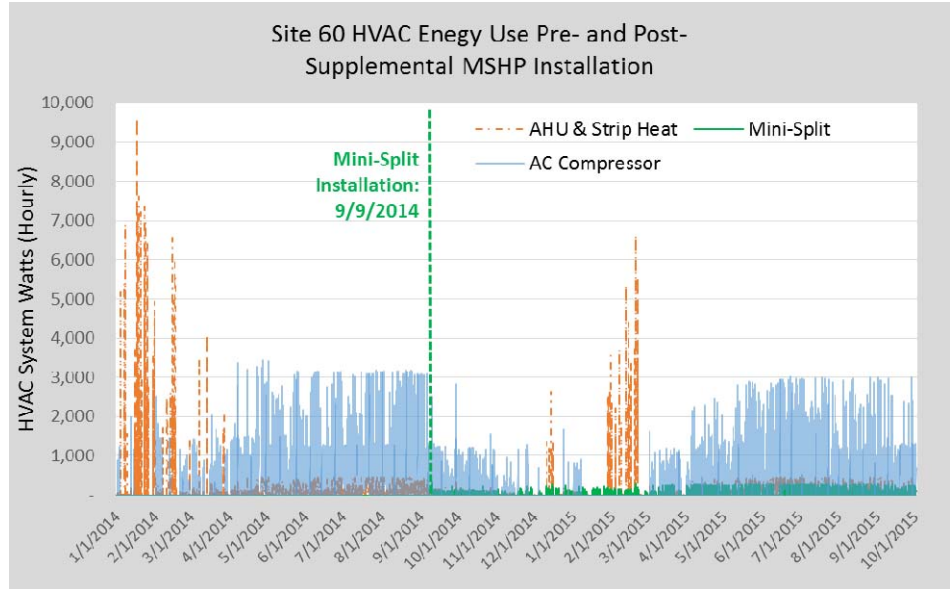


Figure 1. Times series data in which electric resistance strip heat is highly visible, as is the reduction in summer space cooling and the very low power consumption of the mini-split system

Lessons Learned

- Heating energy savings, in terms of percent, were much larger than cooling savings in the four homes with electric resistance central heating.
- If the MSHP takes on too much of the space-conditioning load, there is potential for comfort issues in bedrooms; if the MSHP has too little runtime, there are lost energy savings opportunities.
- Without proper guidance, an occupant might run the central HVAC in constant fan mode to help circulate air. This may lead to elevated relative humidity and added energy costs.
- A large additional benefit to the consumer is a redundant heating and cooling system—highly desirable given the failure rate of central air-conditioning systems.
- Occupants may be concerned their energy costs will increase with the addition of a space-conditioning system.
- The retail cost for the 2014 installations was \$4,676. However, equipment costs have fallen sharply in 2015 to \$3,465.

Looking Ahead

The equipment and installation costs are expected to decrease as the MSHP market matures, thus improving economics.