Building America Case Study

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

Brevard and Volusia Counties, Florida

PROJECT INFORMATION

Project Name: Phased Deep Retrofit: Phase II

Location: Central Florida

Partners:

Florida Power & Light, *fpl.com*

Building America Partnership for Improved Residential Construction, *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 ft^2

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

Median HVAC SEER: 13.0

Median duct leakage: Qn,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

Building America SM U.S. Department of Energy

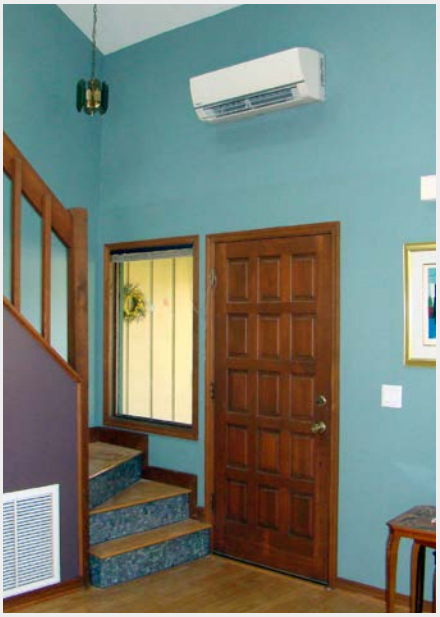
Central heating, ventilating, and air-conditioning (HVAC) systems are commonplace in Florida but have leaky and heat gain-prone duct systems. Ductless mini-split heat pumps (MSHP) inherently have at least a 15% efficiency advantage over these standard systems.

The Building America Partnership for Improved Residential Construction BA-PIRC is a U.S. Department of Energy Building America team that studied the effects of MSHPs in six central Florida homes. Team members installed 1-ton MSHPs that were high-efficiency—25.5 Seasonal Energy Efficiency Ratio (SEER)—in the homes' main living areas. It was hoped that the ductless supplemental MSHPs might reduce space cooling and heating energy by shortening the runtime of less-efficient existing central systems that are subject to duct losses. However, how this would work out practically was highly speculative because this configuration required 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 was reduced by 13.2 kWh/day (59%). Assuming a current installation price of about $3,500, the economics of this measure are potentially attractive; they include 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

For more information see the Building America report *Phased Retrofits in Existing Homes in Florida Phase II: Shallow Plus Retrofits* at *buildingamerica.gov*.

Image credit: All images were created by the BA-PIRC team.

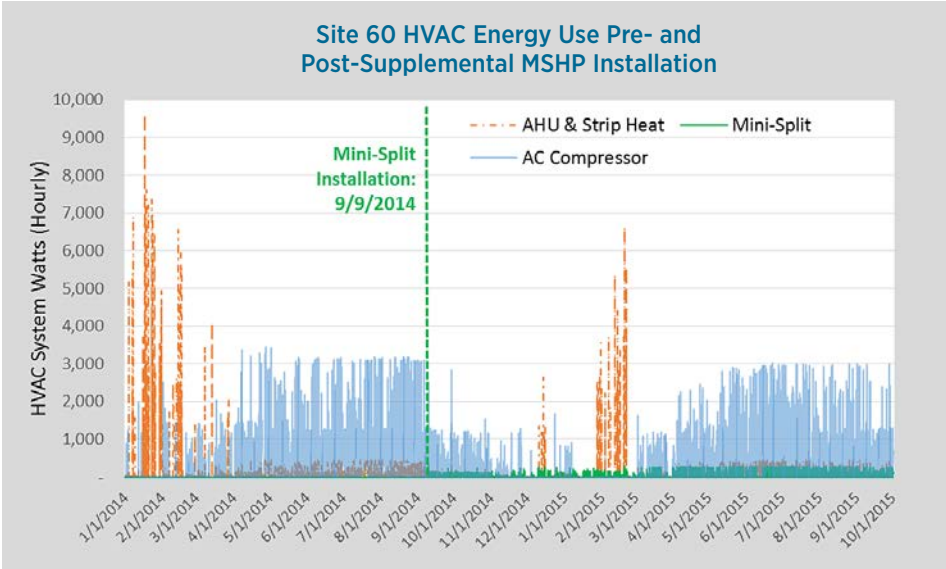


Figure 1. Times series data in which electric resistance strip heat is highly visible—as is the reduction in summer space cooling and the very low power consumption of the MSHP system

Lessons Learned

- Heating energy savings were 59%—much larger than cooling savings of 37% 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 situation 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 that 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.

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

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

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