



Building America Case Study

Technology Solutions for New and Existing Homes

Replacing Resistance Heating with Mini-Split Heat Pumps

Sharon, Connecticut

PROJECT INFORMATION

Project Name: Sharon Ridge Apartments

Location: Sharon, CT

Partners:

Sharon Housing Authority,
www.sharonct.org/

Advanced Residential Integrated
Solutions Collaborative (ARIES),
<http://levypartnership.com/>

Building Component: HVAC

Application: Retrofit, single, or
multifamily

Year Tested: 2012–2013

Applicable Climate Zone(s):
Mixed-humid and cold

PERFORMANCE DATA

Cost of energy efficiency measure
(including labor): \$3,000–\$4,000 per
apartment

Projected energy savings: 25%–50%
heating savings

Projected energy cost savings:
\$500–\$1,000/year per apartment

Residential buildings consume more than 20% of the electricity in the United States; 40% of that is used for space conditioning. Many homes use electric resistance heating, which is generally more expensive than the alternatives. A mini-split heat pump (MSHP) uses electricity far more efficiently than resistance heaters, even in cold climates, where many other types of heat pumps run inefficiently. MSHPs are beginning to establish market share and have the potential to cost effectively replace resistance heat. They may also be competitive with some types of fossil-fuel systems such as older oil furnaces and boilers.

The U.S. Department of Energy Building America team Advanced Residential Integrated Solutions Collaborative (ARIES) studied the suitability of MSHPs for multifamily retrofit applications. As part of a program sponsored by the Connecticut Energy Efficiency Fund and with funds from the American Recovery and Reinvestment Act, the Sharon Housing Authority installed MSHPs in the Sharon Ridge Apartments—affordable housing units with electric resistance heating and room air conditioners. These apartments include one-bedroom units and studios, and each received a single wall-mounted heat pump. The new MSHPs offered a variety of advantages, including:

- Heating and cooling in a single device
- Inverter-driven compressors and variable-speed fan technology, resulting in very high efficiencies of up to 27 seasonal energy efficiency ratio and 12.5 heating season performance factor
- Compact size allowing for use in a wide variety of applications where space is at a premium
- Small capacities suitable for low-load buildings, small apartments, and individual rooms.

Another advantage of MSHPs is that, unlike window air conditioners and window heat pumps, they do not obstruct or interfere with windows. A single outside compressor can be connected to numerous independently controlled air-handling units so spaces can be flexibly zoned without being over- or under-conditioned.

Description



A basic system consists of an indoor evaporator unit and an outdoor compressor/condenser unit; however, multiple indoor units or varying types can also be connected to a single outdoor unit. Indoor units, such as the wall-mounted unit pictured above, must have their filters periodically cleaned.

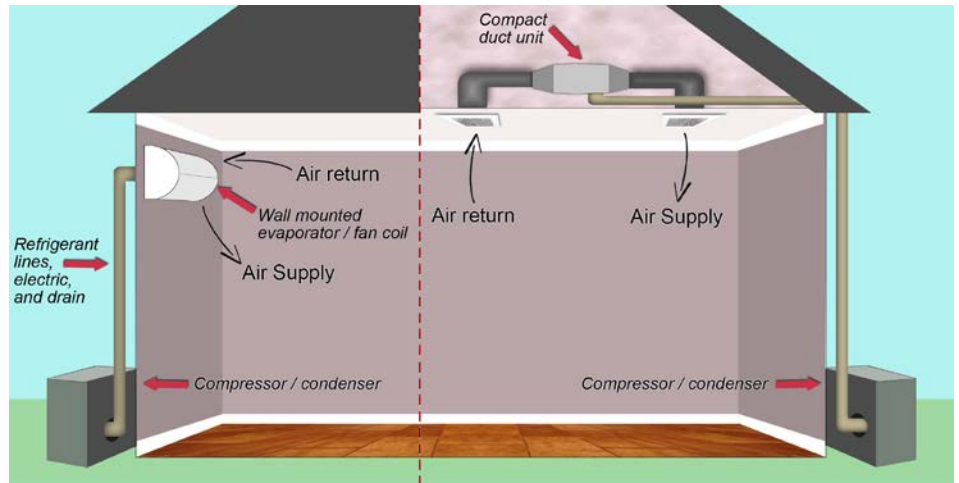


Typically outdoor units may be as far as 60 ft from indoor units without an efficiency penalty.

Refrigerant, electric, and drain lines can fit through 3-in. diameter opening; however, for some retrofits, residents may object on aesthetic grounds to running them up the façade to upper floors.

For more information, see the Building America report, *Mini-Split Heat Pumps Multifamily Retrofit Feasibility Study*, at www.buildingamerica.gov

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



The Sharon Ridge project used wall-mounted units, but MSHPs can also be mounted on the floor or ceiling or concealed and have short duct runs, as shown in the right side of the figure.

Lessons Learned

- MSHPs can be cost-effective replacements for electric resistance heating in cold climates.
- MSHPs can provide adequate heating capacity, even at the low outdoor air temperatures characteristic of New England winters.
- MSHPs eliminate the need to seasonally install and remove window air conditioners. However, MSHPs require more maintenance (associated with filter cleaning and replacement) than do resistance heaters.
- Precautions include protecting the outdoor unit from ice accumulation caused by roof run off and freezing rain (installing an aluminum cover helps). The unit must also be mounted high enough so snow will not interfere with airflow.
- Some residents find the more complex controls difficult to operate compared to electric resistance systems. The Connecticut program switched from the standard MSHP remote control to a simpler, wall-mounted thermostat provided by the manufacturer. Educational sessions were conducted where residents were shown how to use the new systems.

Looking Ahead

Future evaluation is needed, and planned, to quantify the actual energy savings from this retrofit project. Research is also needed to develop solutions for larger homes that have more complex air distribution challenges. ARIES is conducting side-by-side testing of three, three-bedroom homes in the South to compare an MSHP approach with traditional ducted split systems, as well as monitoring the performance of three low-energy homes with MSHPs in the Northeast.