NREL Highlights RESEARCH & DEVELOPMENT

NREL Documents Efficiency of Mini-Split Heat Pumps

A new report delivers MSHP performance data for use in whole-building simulation tools.

Mini-split heat pumps (MSHPs) are highly efficient refrigerant-based air conditioning and heating systems that permit room-by-room conditioning and control in homes. Because of their size, efficiency, and price, MSHPs are very popular overseas and are gaining market share in energy-efficient home upgrades in the United States. They are a good option for retrofitting older homes that lack ductwork. To evaluate MSHP cost effectiveness and performance in U.S. homes, National Renewable Energy Laboratory (NREL) researchers are studying these systems in the laboratory, simulated buildings, and field test settings. A new NREL report describes an innovative laboratory approach to testing MSHPs and includes experimental performance maps for use in whole-building simulation tools.

Most public information on MSHP performance is provided by equipment manufacturers, and is typically limited to performance at a single operating speed for heating and cooling. Mini-split heat pumps use variable speed components that spin up and down to continuously meet the heating or cooling need, significantly improving a system's operating efficiency. Measuring that efficiency in a laboratory is challenging and required new approaches to performance testing. NREL researchers worked with colleagues at Purdue University's Herrick Labs and Ecotope, Inc. to refine and apply this new approach to a suite of MSHP products.

Researchers measured the performance of two MSHPs across a variety of operating conditions, which allowed, for the first time, development of accurate building simulation MSHP models. In the laboratory tests, researchers found that both MSHPs achieved manufacturer-reported performance at rating conditions. However, at other temperature and humidity conditions, the heat pumps' capacity ranged from 40% above to 54% below the manufacturer-reported values. Knowing how performance varies is critical in order to reasonably estimate annual energy consumption of a MSHP, and to compare MSHPs to other heating and cooling options. Mini-split heat pump efficiency (COP) was seen to significantly exceed rated efficiency at low compressor speeds—a very important effect.

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Reference: Winkler, J. (2011). *Laboratory Test Report for Fujitsu 12RLS and Mitsubishi FE12NA Mini-Split Heat Pumps*. NREL Report No. TP-5500-52175; DOE/GO-102011-3380. *http://www.nrel.gov/docs/fy11osti/52175.pdf*.

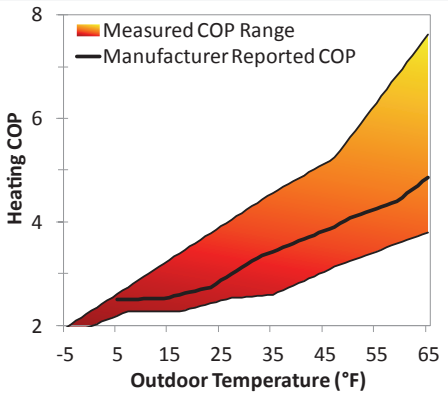

Chart of MSHP heating efficiency (COP) at various outdoor temperatures. The wide colored band represents efficiency variation due to different heating loads. The manufacturer's reported efficiency is indicated by the thick blue line.

Key Research Results

Achievement

Two MSHPs were tested in a laboratory so that performance across a range of temperature, humidity, and equipment speed could be evaluated.

Key Result

Measured performance results are now available to enable simulation of MSHPs for any building and climate. Some conclusions comparing the tested units to high-SEER (Seasonal Energy Efficiency Ratio) staged systems are also provided.

Potential Impact

Annual energy savings and better indoor comfort can be improved through accurate modeling of HVAC system effectiveness. Emerging technologies can be evaluated against the current "best practices" to maximize the impact of innovations.

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