

In The Field

A Heating and Cooling Game Changer?

EPRI Tests 'Next-Gen' Heat Pump with a Potential Application in up to 90% of American Homes

By Sarah Stankorb

Insights from EPRI lab and field tests on advanced heat pumps are helping to speed adoption of this promising technology, with potential for significant energy savings for consumers and grid flexibility for utilities.

Using electricity to move heat from one area to another, heat pumps can heat cold rooms or cool hot rooms. They are far more efficient than heating systems that burn fossil fuels. Yet they have historically had limited heating ability and lower efficiency in regions with very cold winters, and the majority are deployed in the Southeast. According to the U.S. Energy Information Administration, in 2015 they were used in just 10% of American homes.

To help encourage mass adoption, EPRI has outlined technically achievable performance attributes for a next-generation heat pump that include better efficiency, higher heating capacity in cold climates, variable operation for demand response, remote control, and grid connectivity. A key component is the variable-speed compressor, which operates more efficiently and can provide up to 50% more heating capacity than a similarly sized traditional system with a single-speed compressor. This makes the “next-gen” version potentially applicable to 90% of the U.S. population.

“That’s the fundamental change,” said EPRI Program Manager Ron Domitrovic. “Systems now are able to provide enough heat for heating in cold climates.”

“In northern geographies and especially in rural communities, variable-speed heat pump technology is becoming very much a part of the conversation,” said Jeff Tyminski, portfolio leader for heat pumps at Ingersoll Rand (which owns Trane, a company that manufactures heating, ventilation, and air conditioning systems).

Based on insights from prototype development and testing, EPRI has offered guidance to heat pump manufacturers such as Trane, Carrier, Daikin, and Mitsubishi. “We’ve built prototypes to show manufacturers what’s possible with a next-gen heat pump,” said Domitrovic.

Insights from Lab and Field Tests

In recent years, some manufacturers have commercialized systems that meet EPRI’s next-gen attributes and that include other new features. Many are equipped with internal diagnostics, which can be used for system maintenance. Trane’s next-gen heat pump is integrated into a home automation system with zoned heating and air conditioning.

Because these systems are relatively new, EPRI is evaluating their operations and performance to better inform consumers, manufacturers, and installers about the potential benefits of heat pumps. One area of investigation is their ability to enhance efficiency by eliminating the use of backup electric resistance heat. On cold days when single-speed heat pumps cannot meet building heating demand, they engage these backup systems, which can increase a utility’s peak load. EPRI field tests in Ocala, Florida demonstrated that next-gen heat pumps can eliminate this peak by providing sufficient heat capacity without engaging backup systems.

In the laboratory, researchers compared the performance of several next-gen and single-speed heat pumps during demand response events. The single-speed devices turn off for part of the events, while the next-gen devices throttle power draw primarily by reducing the compressor's speed. EPRI found that this throttling strategy was 10–30% more efficient than the on-off cycling, potentially making the next-gen version more cost-effective for consumers and utilities. In 2017, EPRI plans to conduct similar tests in the field. Strong performance could inform utilities and other stakeholders in their decisions to encourage deployment of next-gen units through energy efficiency programs.

Over the next few years, EPRI will continue to test next-gen heat pump technology from multiple manufacturers, examining topics such as:

- Ability to provide comfort to consumers across geographical regions
- Carbon emissions reductions enabled by displacing fossil-fuel-powered heating systems
- Remote feedback on system status to support maintenance

Key EPRI Technical Experts

Ron Domitrovic