

NREL Solves Residential Window Air Conditioner Performance Limitations

Highlights in
Research & Development

Comprehensive performance tests lead to enhanced modeling capability and affordable methods to increase energy efficiency.

Window air conditioners are inexpensive, portable, and can be installed by home occupants, making them a good solution for supplemental cooling, for installing air conditioning into homes that lack ductwork, and for renters. As a result, 7.5 million window air conditioners are purchased each year in the United States—more than all other home cooling equipment combined. However, a window air conditioner is required to meet only modest minimum efficiency standards, and its typical installation in a window causes air leakage, which significantly reduces the equipment’s performance.

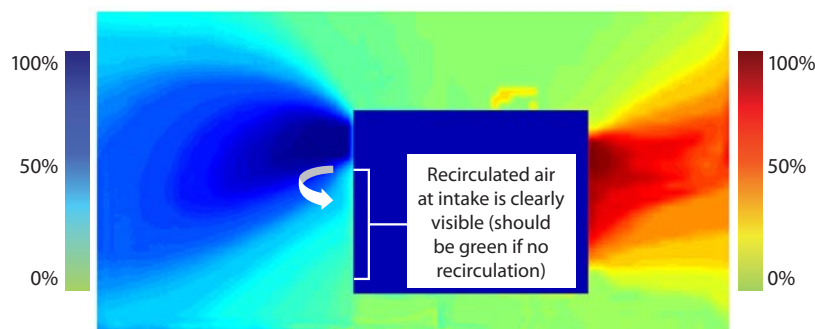
To measure the impact these products have on home energy use, researchers at the National Renewable Energy Laboratory (NREL) studied the performance of one 10-year-old and three new window air conditioners in a range of climates and conditions at NREL’s Advanced Heating, Ventilation, and Air-Conditioning (HVAC) Systems Laboratory. The testing provided unique performance data that allowed separate evaluation of the performance impacts of cooling operation, internal air leakage, and leakage resulting from installation in a window. NREL showed the new air conditioners’ measured performance was consistent with their ratings, while the 10-year-old unit was no longer operating as efficiently as it could. NREL’s methods also permitted calculation of real-world impacts (energy use and comfort) of window air conditioners in different climates, which showed that rated performance does not accurately correlate to real-world performance.

In addition to the performance testing, NREL developed recommendations for window air conditioner manufacturers on how to improve this real-world performance at very modest cost, and has published a homeowner’s guide for a better window installation. It is estimated that adoption of these methods will result in 5% to 10% cooling energy savings—enough to pay for the air conditioner over its lifetime. If all window air conditioners were improved in this way, the nation’s energy use could be reduced by 6 trillion Btu per year, saving consumers \$190 million each year.

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References: Winkler, J.; Booten, C.; Christensen, D.; Tomerlin, J. (2013). *Laboratory Performance Testing of Residential Window Air Conditioners*. NREL/TP-5500-57617. <http://www.nrel.gov/docs/fy13osti/57617.pdf>.

A Homeowner’s Guide to Window Air Conditioner Installation for Efficiency and Comfort (2013). Produced by NREL on behalf of the U.S. Department of Energy Building America Program. NREL-FS-5500-58187.



Concentration of air from the air conditioner inside the house (blue) and outside (red). The arrow shows how some of the air is recirculated back into the air conditioner, which reduces efficiency and cooling capacity.

Key Research Results

Achievement

Researchers characterized the performance of residential window air conditioners over a range of conditions. They measured installed air leakage as well as recirculation of conditioned air and estimated degradation of performance with time.

Key Result

Researchers found that:

- Installed performance of window air conditioners does not match ratings.
- There is significant potential for degradation with time, because proper maintenance is difficult.
- Window installation can increase whole house air leakage by 10%.
- Air recirculation on the evaporator can reduce efficiency by 10%.
- There are affordable techniques for reducing air leakage and recirculation that users can easily install; other low-cost product modifications are recommended to manufacturers.

Potential Impact

Homeowners can follow NREL-recommended installation procedures to increase unit efficiency up to 10%, which can save up to \$30 a year in utility bills. This can be done with a one-time cost of around \$15 using materials from home improvement stores. This saves enough energy to pay for most air conditioners over their lifetime.

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

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