



BUILDING AMERICA TOP INNOVATIONS 2013 PROFILE

INNOVATIONS CATEGORY:

1. Advanced Technologies and Practices
- 1.2 Energy-Efficient Components

TOP INNOVATOR:

NREL

High-Efficiency Window Air Conditioners

NREL estimates these recommendations 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.

Comprehensive performance tests lead to affordable methods for increasing the energy efficiency of window air conditioners.

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 in 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. NREL also published a homeowner's guide for providing tips for better window air conditioner installation.



BUILDING AMERICA TOP INNOVATIONS

Recognizing Top Innovations in Building Science – The U.S. Department of Energy's Building America program was started in 1995 to provide research and development to the residential new construction and remodeling industry. As a national center for world-class research, Building America funds integrated research in market-ready technology solutions through collaborative partnerships between building and remodeling industry leaders, nationally recognized building scientists, and the national laboratories. Building America Top Innovation Awards recognize those projects that have had a profound or transforming impact on the new and retrofit housing industries on the road to high-performance homes.



(Top left) NREL tested new and older model window air conditioners under real-world conditions for several climate zones and found actual efficiencies did not match rated efficiencies in older models.

In it's *Homeowner's Guide to Window Air Conditioner Installation for Efficiency and Comfort*, NREL provided home owners with several low-cost practical tips for improving the energy efficiency of their window-unit air conditioners.

- Remove the accordion panels that come with the unit and replace with pieces of rigid foam insulation cut to fit. Use duct tape to secure the foam panels and prevent air leaks.
- Install foam backer rod between the sashes.
- Periodically clean the intake and exhaust grills on the inside and outside of the unit.
- Remove the unit from the window when the cooling season is over.



One problem with window air conditioners is that a significant portion of the conditioned air gets recirculated back into the air conditioner.

Lessons Learned

- The installed performance of window air conditioners does not match ratings.
- There is significant potential for degradation of the window units with time, because proper maintenance is difficult.
- A poorly installed window air conditioner can increase whole house air leakage by 10%.
- Air recirculation can reduce the overall efficiency of the air conditioner by 10%.
- Air sealing around the air conditioner is critical for best performance.
- 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.



Installing a diverter helps to maximize cool air flow from the air conditioner.

REFERENCES

NREL. 2013. *A Homeowner's Guide to Window Air Conditioner Installation for Efficiency and Comfort*. NREL-FS-5500-58187. Prepared by the National Renewable Energy Laboratory for the U.S. Department of Energy Building America Program, www.nrel.gov/docs/fy13osti/58187.pdf

Winkler, J., C. Booten, D. Christensen, and J. Tomerlin. 2013. *Laboratory Performance Testing of Residential Window Air Conditioners*. NREL/TP-5500-57617. www.nrel.gov/docs/fy13osti/57617.pdf