

**Building America Case Study:
Technology Solutions for Existing Homes****A Homeowner's Guide to
Window Air Conditioner Installation
for Efficiency and Comfort****PROJECT INFORMATION**

Building Component: HVAC

Application: Retrofit; single and/or multi-family

Year Tested: 2012

Applicable Climate Zone(s): All

PERFORMANCE DATA

Cost of Window A/C unit: \$150–\$600

Cost of Materials for Improved Installation: \$10–\$15

Energy Savings: up to 7% cooling savings, or up to 280 kWh/year

Electricity Bill Savings: up to \$31/year; enough to pay for the cost of the unit over its lifetime

FOR MORE INFORMATION

Read the full report, Laboratory Performance Testing of Residential Window Air Conditioners, NREL/TP-5500-57617, February 2013. www.nrel.gov/docs/fy13osti/57617.pdf

Homeowners in the United States spend one out of every eight dollars of utility costs on cooling their living space. Window air conditioners (A/Cs) are an inexpensive alternative to central systems, and are sold in greater numbers each year than all other residential cooling systems. They are purchased to cool a specific room and are easy for anyone to install. In contrast to these benefits, window A/Cs come at a cost—they operate less efficiently (using more energy to do the same cooling) than most other residential A/C systems.

Researchers at the National Renewable Energy Laboratory (NREL) studied window A/Cs on behalf of the U.S. Department of Energy's Building America program, to understand how they perform and how they could be improved.

The study showed that window A/C installation resulted in significant air leakage—equivalent to having a 5-in² hole in the outside wall. All summer long, hot outdoor air flows into the home, as shown in the figure to the right, making the A/C run longer and use more energy. This outdoor air reduces comfort for occupants through increased heat and often carries humidity into the home.

A portion of the cool air leaving the A/C is recirculated back into the unit because the outlet and inlet are so close together. Thus, that cool air does not help cool off the home and is a secondary waste of energy. Also, the researchers verified the importance of appliance maintenance and cleaning.

“Air sealing around the window and the air conditioner is critical for best performance”

—Chuck Booten, Ph.D.,
Senior Engineer, NREL

Finally, NREL's team identified simple measures to improve both efficiency and comfort. Accessories provided by manufacturers can be replaced with inexpensive hardware store materials to improve a window A/C installation, increase efficiency, improve comfort, and lower utility bills with a payback of less than one year.



Typical air leakage pathways increase electricity use and decrease comfort. *Illustration by Marjorie Schott, NREL*



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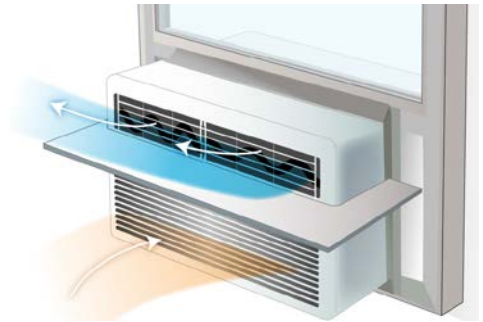
Five Easy Steps to Limit Window A/C Infiltration

1. Remove accordion panels. Typically, a sliding keeper can be removed. Pull the frame out, then remove another keeper from the side of the A/C. *(Do not remove top and bottom braces; they hold the unit in the window. Use manufacturer-supplied hardware to secure the window in place after replacing the unit.)*
2. Cut and install rigid foam panels to fill the spaces beside the A/C. Measure the thickness of the window sash to determine foam thickness; ¾–1½ in. thick will fit most window frame channels. Some foams have a skin to help protect the foam from weather. Exterior grade tape can be used to cover outside surface of foam for increased durability. If this is done, work from bottom to top and overlap tape so water will drain appropriately. (Cost of foam: \$3–\$10 for multiple windows.)
3. Foam strips provided by the manufacturer for sealing between sashes are prone to air leaks. Instead, use backer rod (closed cell cylindrical foam) between sashes. Measure gap thicknesses to select appropriate size. (Cost of backer rod: ~\$4, enough for multiple windows.)
4. No matter what foam is used, it is important to also plug the top of the side channels.
5. Use tape to secure the foam panels and prevent air leaks around joints. Tape the foam panels to the window, window frame, and A/C; tape the top and bottom of the A/C. Different colors of tape are available. If window frames are painted, consider using tape with a less aggressive bond to prevent peeling. (Cost of one roll of duct tape: ~\$6, enough for multiple windows.)

Go Further: Address Cool Air Recirculation

To further enhance performance, install a diverter between the cool air supply and room air return of the air conditioner. This reduces short-circuiting of air from the supply to the return and maximizes the amount of cool air that goes into the room, saving energy and money.

Diverter can be made from ¼-in. medium density fiberboard or similar material. (Cost for one sheet of fiberboard: ~\$5.)



Installing a diverter (bottom) helps to maximize cool air flow from the A/C unit. *Illustration by Marjorie Schott, NREL*

The Bottom Line

- Air leakage wastes energy and costs money, but homeowners can reduce this leakage easily.
- Recirculation of air near the unit lowers efficiency and can be easily reduced.
- Periodic cleaning of intake and exhaust grills on both the indoor and outdoor portion of the unit can help maintain efficient performance.
- Remove unit from window or seal it up completely on the inside after cooling season is over; otherwise, air will leak through the unit itself.

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The U.S. Department of Energy's Building America program is engineering the American home for energy performance, durability, quality, affordability, and comfort.