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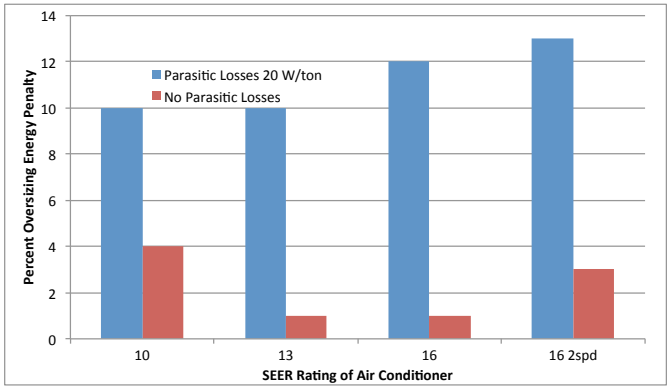
NATIONAL RENEWABLE ENERGY LABORATORY

Understanding Energy Impacts of Oversized Air Conditioners

Highlights in Research and Development

NREL research reveals the effects of parasitic power losses on the energy consumption of oversized residential air conditioners.



This graph shows the percentage penalty in energy use due to oversizing with and without off-cycle parasitic power for a range of air conditioner SEER ratings. If there are no parasitic power losses, the oversizing energy penalty is minimal; if there are parasitic power losses, oversizing of an air conditioner can result in substantial additional energy use. Image by Chuck Booten, NREL

Retrofits of existing homes can be substantial investments that reduce home energy use for years; therefore, knowledge about the energy impacts of building systems is critical. In the case of air conditioners, conventional wisdom suggests that oversized cooling equipment leads to higher energy use because equipment cycling is inefficient. It also implies that there are energy benefits from proper sizing and negative consequences to out-of-sequence retrofits that lead to oversizing (such as installing the air conditioner first and then making building improvements that reduce the cooling load). Quantitative analysis is necessary to determine if conventional wisdom is accurate and, if so, to verify the relative magnitudes of the various effects.

In this study, researchers from the National Renewable Energy Laboratory (NREL) evaluated the replacement of an air conditioner in a typical 1960s vintage home in Houston, Texas. To analyze choices that homeowners or their contractors might consider, the scientists simulated retrofits that also included duct and envelope improvements. These upgrades reduce the cooling load on the house. If they coincide with or predate the air conditioner replacement, the upgrades also provide an opportunity to reduce the size—and potentially the energy use—of the new air conditioner.

Simulation results for different scenarios demonstrated that the additional energy use caused by an oversized air conditioner can be significant. However, researchers found that the penalty is not due to unit cycling efficiency but rather to off-cycle parasitic power consumption from components such as controls and crankcase heaters. The significant additional energy use results from oversized units that are off more of the time, meaning the parasitic power accounts for a larger percentage of the total energy used. Under these circumstances, the results from this study support the conventional wisdom that having an oversized air conditioner leads to increased energy use. On the other hand, when off-cycle parasitic power consumption is minimal, oversizing has a negligible effect on energy use.

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References: Booten, C.; Christensen, C.; Winkler, J. (2014). *Energy Impacts of Oversized Residential Air Conditioners—Simulation Study of Retrofit Sequence Impacts.* Golden, CO: National Renewable Energy Laboratory, NREL/TP-5500-60801. *http://www.nrel.gov/docs/fy15osti/60801.pdf*

Key Research Results

Achievement

A simulation-based case study that analyzes the energy impacts of oversized residential air conditioners.

Key Result

If parasitic power losses are minimal, there is very little increase in energy use for oversizing an air conditioner.

Potential Impact

This research demonstrates that new residential air conditioners can be sized primarily based on comfort considerations, because capacity typically has minimal impact on energy efficiency. The results of this research can be useful for contractors and homeowners when choosing a new air conditioner or heat pump during retrofits of existing homes. If the selected unit has a crankcase heater, performing proper load calculations to be sure the new unit is not oversized will help avoid excessive energy use.

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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