

# DOE rooftop challenge winners offer energy, cost savings

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New super-efficient rooftop units that heat and cool commercial buildings offer significant energy and dollar savings, say scientists at the Department of Energy's Pacific Northwest National Laboratory. They found that the devices reduce energy costs an average of about 41 percent compared to units in operation today.

The newly published report analyzes the operation of the commercial rooftop HVAC unit known as the Daikin Rebel, which was one of two units to meet DOE's Rooftop Challenge, a competition for manufacturers to create a rooftop unit that significantly exceeds existing DOE manufacturing standards. Daikin Applied was the first to produce such a unit, which was studied in depth by PNNL researchers; Carrier Corp. also met the challenge. The work is part of a broader DOE program known as the DOE Rooftop Campaign, which promotes the adoption of efficient rooftop units.

The PNNL study, done by scientists Srinivas Katipamula and Weimin Wang, is an in-depth look at the performance of the Rebel compared to other rooftop units in use today. The devices are usually nestled on building roofs, far from view but crucial to our comfort. The devices demand a significant proportion of the 18 quadrillion BTUs of [energy](#) that the nation's [commercial buildings](#) swallow every year.

The PNNL team estimates that if current rooftop units were replaced with devices similar to the Rebel over a 10-year period, the benefits in terms of energy saved and reduced pollution would be about equal to

taking 700,000 cars off the road each year. Put another way, the reduced energy draw could idle about eight average-size coal-fired power plants in each of those 10 years.

If all rooftop units with a cooling capacity of 10 to 20 tons were replaced immediately, DOE officials estimate the cost savings at around \$1 billion annually.

"There are great gains waiting to be made in energy savings, using technologies that exist today," said Katipamula, whose study was supported by DOE's Office of Energy Efficiency and Renewable Energy.

Katipamula and Wang ran extensive simulations analyzing the Rebel's performance compared to other rooftop units. The pair used DOE's Energy Plus building energy simulation software and worked with detailed performance data supplied by Intertek of Cortland, N.Y., which tested the units in the laboratory. Katipamula and Wang also created several new computer models – a necessary step because they were testing technology that has never existed before. The Rebel includes variable-speed fans and a variable-speed compressor, which allow it to respond more precisely to conditions inside a building than conventional technology.

The team ran simulations for a typical 75,000-square-foot big-box store in three cities: Chicago, Houston, and Los Angeles. They compared performance of the Rebel to three types of units: those in use today, those that meet current federal regulations for new units, and those that meet more stringent requirements, known as ASHRAE 90.1-2010 standards. DOE designed the Rooftop Challenge to exceed the ASHRAE standards.

The team found that the Rebel reduced energy costs and use as follows:

- Compared to units in operation today that are ready for replacement, energy costs were 33 percent less in Chicago, 44 percent less in Houston, and 45 percent less in Los Angeles. The Rebel slashed energy demand by 15 percent, 37 percent, and 36 percent, respectively.
- Compared to new units that meet current federal regulations, costs were cut 29 percent, 37 percent, and 40 percent, in Chicago, Houston, and Los Angeles, respectively. Likewise, energy demand was reduced 12 percent, 30 percent, and 32 percent in those three cities.
- As expected, savings were a bit less when compared with new units that meet today's strictest ASHRAE standards. Costs to run the Rebel™ system were 15 percent lower in Chicago, 27 percent lower in Houston, and 18 percent lower in Los Angeles. Energy demand was 8 percent, 23 percent, and 15 percent lower, respectively.

While the cost of the unit was not part of the team's analysis, Katipamula estimates it would take at least a few years for the latest technology to pay back the increased investment in the newer units. The team's analysis did not include a look at some of the unit's additional features, such as its potential to save energy used for heating.

"The savings depend very much on the particular conditions – the climate, the size of the store, the materials used in the construction, and so on," said Katipamula. "We've developed Energy Plus software models that allow building designers or owners to calculate for themselves the cost-effectiveness of installing a newer unit that meets the DOE [rooftop](#) challenge."

While "cost-effectiveness" might seem to break down into simple dollars and cents, that is often not the case for commercial buildings. Payback differs dramatically depending on whose investment is at stake;

oftentimes, tenants pay the [energy costs](#), and they often have no choice in what equipment a building owner or builder chooses to use. Katipamula says that offering incentives to builders is one way to increase their stake in using cost-efficient equipment.

Provided by Pacific Northwest National Laboratory

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