



## Retrofitting Inefficient Rooftop Air-Conditioning Units Reduces U.S. Navy Energy Use

As part of the U.S. Navy's overall energy strategy, the National Renewable Energy Laboratory (NREL) partnered with the Naval Facilities Engineering Command (NAVFAC)

### When Considering an Advanced Rooftop Control System:

- Implement on rooftop units with a minimal capacity of 7 tons, not older than 10 years of age, and that operate at least 50 hours per week
- Choose a system with features that include a variable-speed supply fan, demand-controlled ventilation, and web-based building management services
- Include testing, adjusting, and balancing services to balance the supply and outdoor air rates during installation.

to demonstrate market-ready energy efficiency measures, renewable energy generation, and energy systems integration. One such technology—retrofitting rooftop air-conditioning units with an advanced rooftop control system—was identified as a

promising source for reducing energy use and costs, and can contribute to increasing energy security.

The demonstration was one of eight technologies studied at bases in Hawaii and Guam, and evaluated the benefits and compatibility of the technology

### The Technology Demonstration

#### Overview

NREL implemented advanced control systems on existing rooftop air-conditioning units, increasing the efficiency of the equipment.

#### Key Results

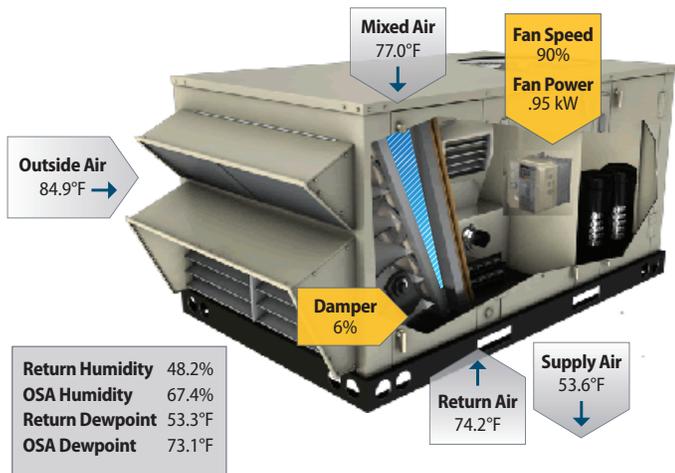
During the demonstration, the retrofits reduced overall energy use by 100 megawatt-hours across the 11 rooftop air-conditioning units.

with the Navy's mission and practices. The overall project focused on identifying new or underutilized commercial technologies that could help meet the Navy's ambitious energy goals of producing at least 50% of shore-based energy from alternative sources and ensuring that 50% of Navy and Marine Corps installations will be net-zero energy.

A collaborative effort by the NREL-NAVFAC integrated project team was a key success factor to the project, resulting in technology demonstrations that met stringent Navy requirements while providing credible performance data to help guide energy-related decisions.

### Rooftop Air-Conditioning Unit Retrofits

Rooftop air-conditioning units (RTUs) contain all the components of heating, ventilation, and air conditioning in one package, and are used in a variety of Navy buildings. To combat the RTU's historically low efficiency, advanced rooftop control (ARC) systems are being implemented to boost the performance of the RTU equipment by controlling its components with greater



An advanced rooftop control system. Illustration from Transformative Wave Technologies

dexterity. ARC systems convert the supply fan from constant speed to variable speed and provide demand-controlled ventilation. Packaged with a web-based building management system, they maintain savings through remote thermostat control and monitoring, and enable automated fault detection and diagnostics.

On Joint Base Pearl Harbor-Hickham in Hawaii, NREL and NAVFAC implemented an ARC on the nine RTUs that serve the Naval Exchange store, as well as on two that

serve small office buildings. The selected ARC product for this demonstration had been successfully tested in other federal agency field demonstrations within the continental United States and included all the advanced control options requested. During the demonstration, NREL used the remote monitoring feature to evaluate the energy savings at the building level.

The 11 RTU retrofits showed a combined annual savings of 100 megawatt-hours (MWh) total, with the system paying for itself in the fifth year. For future deployments on buildings with more operating hours, the projected net energy savings increased to 120 MWh, with a simple payback of three years. In addition to energy and cost savings, the ARC system lowered the relative humidity levels inside the buildings and improved occupant thermal comfort.

To learn more about the demonstration projects, download the NAVFAC Hawaii and Guam Energy Improvement Technology Demonstration Project reports at [nrel.gov](http://nrel.gov), visit NREL's Department of Defense website at [www.nrel.gov/defense/](http://www.nrel.gov/defense/), or contact Jeffrey Dominick at [jeffrey.dominick@nrel.gov](mailto:jeffrey.dominick@nrel.gov).

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