SHOWCASE PROJECT: DATA CENTER OPTIMIZATION AT NREL RESEARCH SUPPORT FACILITY

SOLUTION OVERVIEW
The National Renewable Energy Laboratory’s (NREL) Research Support Facility (RSF) uses 50% less energy than if it were built to current commercial building code standards and is certified LEED Platinum. The RSF also houses one of NREL’s greenest data centers. The RSF opened in 2010 with the intention of achieving net zero energy, however, as the load growth of the data center increased, net zero became more challenging to accomplish. The 1,900-square-foot data center alone accounted for 33% of the 222,000-square-foot facility’s annual electricity consumption, making it a key opportunity for ongoing energy efficiency improvements.

The RSF data center was formerly located in another building on NREL’s campus. The original “legacy” data center had an annual energy consumption as high as 2,394,000 kWh and the overall utilization rate was less than 5%. When migrating this data center into the RSF, NREL’s engineers prioritized energy efficiency, identifying opportunities to upgrade the data center and make it suitable for a net-zero energy building. In its former location, the data center’s overall power usage effectiveness (PUE) was 2.28, however, since the 2010 move, its PUE has continued to improve. In 2019, the RSF data center achieved a PUE of 1.2 – an 84% improvement in energy efficiency.

SECTOR TYPE
Data Center

LOCATION
Golden, Colorado

PROJECT SIZE
1,900 square feet

SOLUTIONS
After a decade of operation, NREL continues to identify opportunities to improve the RSF data center’s efficiency. From 2012 to 2014, the data center’s IT load grew steadily from 114 kW to 141 kW. To address this, NREL’s Platform Engineering staff phased out legacy IT equipment, consolidated blade centers, and decommissioned 10 blade chassis. These updates helped reduce the overall energy consumption of the facility and improve operational efficiency.

In 2018, NREL installed an improved environmental monitoring and metering system in the RSF.

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data center. This system provides advanced metering metrics to support NREL’s Intelligent Campus Program. This informatics platform helps align campus energy objectives to support innovative energy management and continuous building commissioning.

Other best practices at the RSF data center include:

- Upgraded spinning disk storage to flash storage
- Upgrading and optimizing the HVAC system operations
- Upgrading to highly efficient enterprise UPS
- Increasing operating temperatures
- Using energy-efficient cooling techniques, such as migrating fan and hot isle locations, maximizing free and evaporative cooling, and minimizing fan energy
- Continuing to consolidate and upgrade equipment when possible

This graph shows the energy use improvement between July 2014 and July 2019. The RSF data center has decreased site energy from above 400 kBtu to around 250 kBtu despite increased population and IT needs across the laboratory. NREL continues to explore opportunities to minimize the data center’s energy footprint and reduce costs.

You can learn more about the initial design elements incorporated into the RSF’s data center and some of the technologies used to help reduce both energy and cost in the following case studies: The Research Support Facility Data Center: An Example of Best Practices Implementation, Reducing Data Center Loads for a Large-scale, Low-energy Office Building: NREL’s Research Support Facility.
OTHER BENEFITS
By reducing the data center's energy footprint, the data center operators have been able to comply with the net zero energy goals of the RSF and abide by both NREL and Federal policies. In addition to the energy and cost savings, the improvements have reduced operation and maintenance requirements.

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<thead>
<tr>
<th>Annual Energy Use</th>
<th>Annual Energy Cost</th>
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<tr>
<td><strong>BaselineLegacy data</strong></td>
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<td>center's PUE(2014)</td>
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<td>2.28 PUE</td>
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<td><strong>ActualRSF data</strong></td>
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<td>center's PUE(2019)</td>
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<td>1.2 PUE</td>
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**Energy Savings**

84% reduction

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