

NERSC - Efficiency in High Performance Computing

Focused effort on efficiency in high performance computing to save as the equivalent electricity of three football fields of solar photovoltaics

Project Overview

The National Energy Research Scientific Computing Center ([NERSC](#)), the [Energy Technologies Area](#), and [Sustainable Berkeley Lab](#) are working together to optimize the cooling systems and save electricity at the Lab's high performance computing center in Shyh Wang Hall (Building 59). The project has saved over two million kWh and over a half million gallons of water per year. The electricity savings corresponds to 42% of the baseline "non-compute" electricity use at the facility. The project has also established ongoing monitoring to provide NERSC with tools to protect these savings over time.

Background

Shyh Wang Hall was designed to be very energy efficient, with a power utilization effectiveness (or PUE) of less than 1.1. PUE measures the ratio of total data center electricity use to the electricity used directly for computing. A PUE of 1.1 means that the support and cooling of the computing equipment is just 10% of the direct computing energy use. A PUE below 1.1 puts the high performance computing center in line with the most efficient facilities in the world.



Cooling towers at Shyh Wang Hall reject heat from the high-performance computing center.

But after its first year of operation, NERSC operators were certain that the design efficiency of the center could be improved. The project team reviewed operating data and found several opportunities for optimization. The primary savings have come from choosing how much cooling is provided by different parts of the cooling plant under different weather conditions. Other energy-savings strategies have also been found. For example, a software upgrade applied to the uninterruptible power supplies to the computers improved their efficiency by about 12%. For a large computing center like NERSC, the savings add up.

Summary

The project savings is summarized below.

		Energy Savings	Water Savings	Cost Savings
	Measure Title	kWh/yr	gallons/yr	\$
1	Install Firmware to Enable ESS Mode for UPSs	350,000	140,000	\$26,690
2	Implement Tower Water Supply Temperature Reset and Reduced Tower Water Pump Speed	270,000 ¹	0	\$20,970
3	Reset Cooling Water Temperature Setpoint and Enable Cray Dynamic Fan Control	275,000	110,000	\$20,970
4	Install New Heat Exchanger	760,000	300,000	\$57,900
5	Install Bypass Valves	35,000	10,000	\$2,620
6	Reset Cray Air Temperature Setpoint	82,000	30,000	\$6,220
7	Balancing Adjustment to Alleviate Pump Check Valve Issues	150,052	0	\$10,650
8	Adjusting AHU Balancing Dampers	140,000	0	\$9,940

Total	2,062,052	590,000	202,460
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Total Non-IT Energy 4,866,000 kWh
Savings as a % of Non-IT Energy 42%

As of fall 2024, after many changes to the configurations of equipment at NERSC, the Lab is maintaining annual savings of 1.75 million kWh at NERSC - approximately 43% of a previous baseline “non-compute” electricity consumption - and 460,000 gallons/year of water.

¹ 310,000 kWh/yr from May 2017 and 70,000 kWh/yr from April 2018, then 270,000 since July 2021.