

DOE Operator's Panel

ARPA-E COOLERCHIPS



Arman Shehabi
Staff Scientist
Energy Technologies Area
Oct 18, 2023

NERSC - Shyh Wang Hall - Building 59 - LBNL



 **ENERGY TECHNOLOGIES AREA**
BERKELEY LAB



U.S. DEPARTMENT OF
ENERGY

Office of
Science



Four-Story 150,000 GSF

- Two 20k sf office floors, 300 offices
- 28k sf HPC floor
- 21.5 MW Service Capacity

Energy Efficient

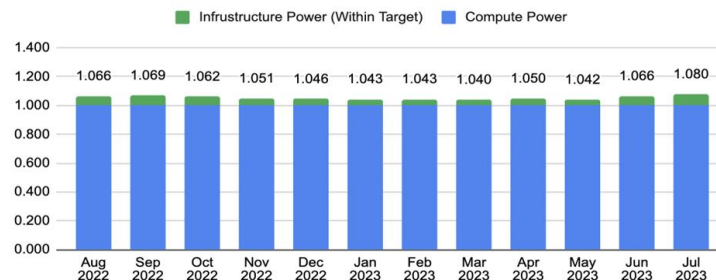
- Year-round compressor-free air and water cooling
- LEED Gold Rated Building
- High resolution monitoring
- TTM PUE 1.05**

Room Air & Cooling Water

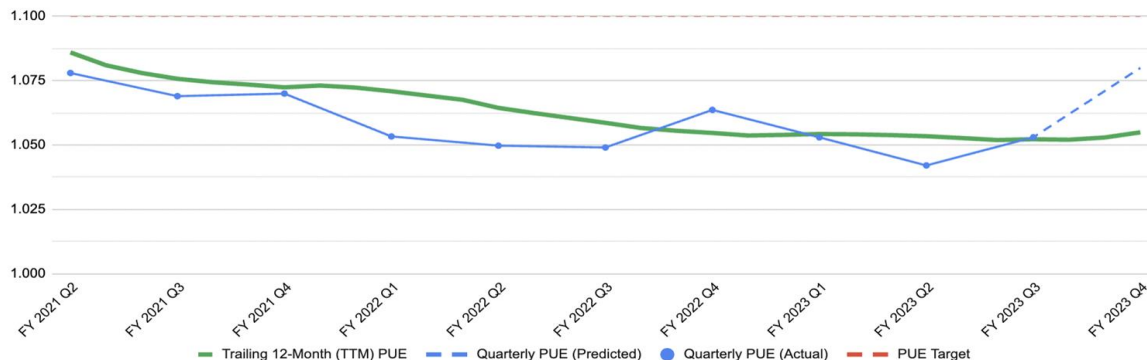
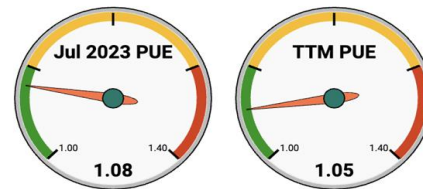
- Most hours, single pass air
- Cooling Towers can provide 75°F (24°C) or colder water all hours of year

NERSC PUE Dashboard (Jul 2023)

LBNL Energy Management Power Usage Effectiveness (PUE) Target < 1.10



$$PUE = \frac{\text{annual facility energy}}{\text{annual IT energy}}$$



Center of Expertise (CoE)

- DC Pro Software and Assessment Tool Suite
- Data Center Energy Practitioner (DCEP) certificate program
- Better Building Challenge
- Data Center Programming Guide
- Technology Case Study Bulletins
- Best Practices Guide
- Procurement Specifications
- Benchmarking Guide
- Report Templates
- Process Manuals
- Quick-Start Guide

Use CoE's Energy Efficiency Toolkit, including simulation tools.

Choose from live webinars, pre-recorded trainings, and in-person Data Center Energy Practitioner (DCEP) trainings.

Filter CoE's many resources by type and topic.

Search resources by topics of interest.

CENTER OF EXPERTISE
FOR ENERGY EFFICIENCY IN DATA CENTERS

About us

Tools Technologies Training Focus Areas Library

We offer tools, technologies and analysis to enhance energy performance in datacenters.

Featured Work

Electrical Power Chain Tool

NEW! Accessing Onboard Server Sensors for Energy Efficiency in Data Centers

NEW! Computer Server Selection Guidelines for Energy Efficiency and Decarbonization in Data Centers

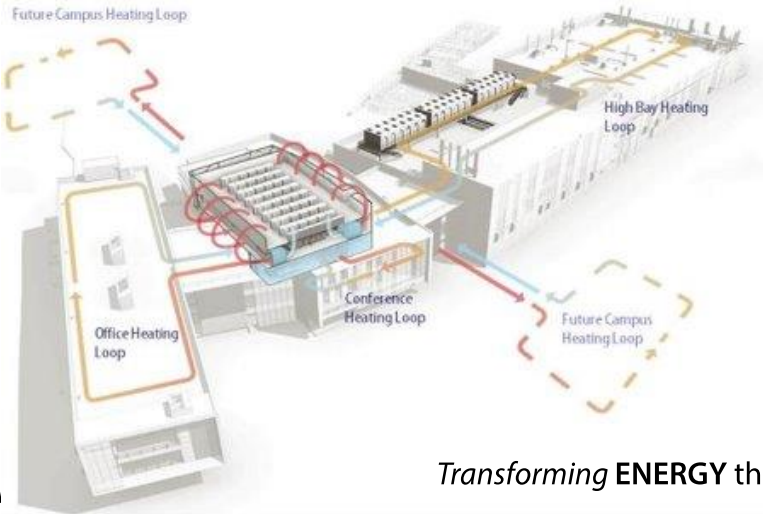
An aerial photograph of the NREL HPC Data Center and Energy Systems Integration Facility (ESIF) at sunset. The building is a large, modern structure with a flat roof and multiple wings. The roof is covered with various HVAC units and other mechanical equipment. The building is surrounded by a green, hilly landscape. In the background, there are power lines and a distant city skyline. The sun is low on the horizon, creating a warm, golden glow over the scene.

NREL HPC Data Center
Energy Systems Integration Facility (ESIF)

NREL HPC Data Center

- **Showcase Facility**

- ESIF 182,000 ft.² research facility
- 10,000 ft.² data center
- 10 MW at full buildout
- LEED Platinum facility, PUE ≤ 1.04
- No mechanical cooling (eliminates expensive and inefficient chillers)



- **Data Center Features**

- Direct, component-level liquid cooling, 24°C (75°F) cooling water supply
- 35°C–40°C (95°F–104°F) return water (waste heat), captured and used to heat offices and lab space
- Pumps more efficient than fans
- High voltage 480 VAC power distribution directly to high power density 60kW–80 kW compute racks

- **Compared to a Typical Data Center**

- Lower CapEx—costs less to build
- Lower OpEx—costs less to operate

- **Data Centers often largest load on campuses**

- NREL current and projected in the 30-50% range

Thank You

- National Renewable Energy Lab
 - <https://www.nrel.gov>
- NREL High Performance Computing
 - <https://www.nrel.gov/hpc>
- NREL HPC Data Center
 - <https://www.nrel.gov/computational-science/hpc-data-center.html>
- NREL Data Center Contacts

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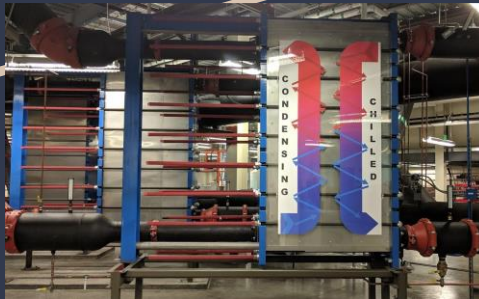
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NWSC Introduction

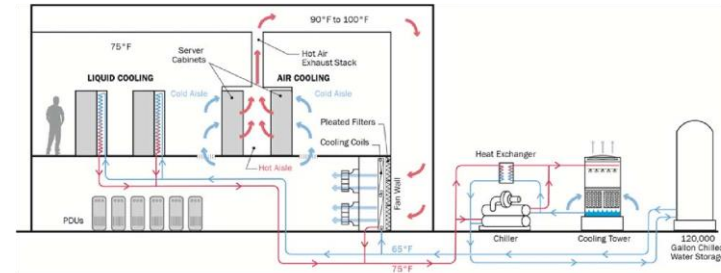
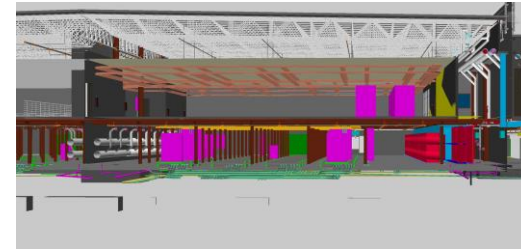


Michael Kercher - NWSC Operations Manager

NWSC Specifications



- NSF Funded FFRDC
- Constructed in 2011
 - Tier II Data Center
- Ten Foot Raised Floor
- Site Location: Cheyenne Wyoming
 - 6800 feet of elevation
 - Temps: -7°C to 28°C
 - Relative Humidity Range: 45% to 65%
- Mechanical System Config
 - HX Free Cooling with Chiller Back-up
 - Class W2 Chilled Water System: 18°C Setpoint
- 20,000 sq feet of white space
- 4.2 - 4.5 MW of Current Load
- PUE - 1.08



Project Advice

- Ease of serviceability for new designs and technologies is critical for adoption
 - PPE Requirements
 - Operational Requirements
- Understand the availability and expense of spare parts
 - Supply chains and part availability is being scrutinized more and more
- Software User Interfaces should be designed for entry level or beginning users
 - Operations rely on lower level technicians to monitor and interface with these products.

Contact info

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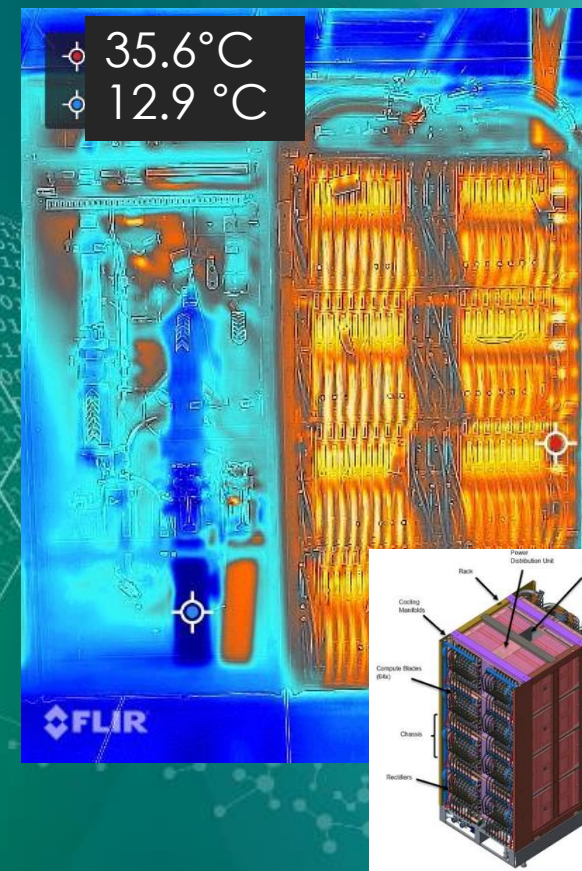
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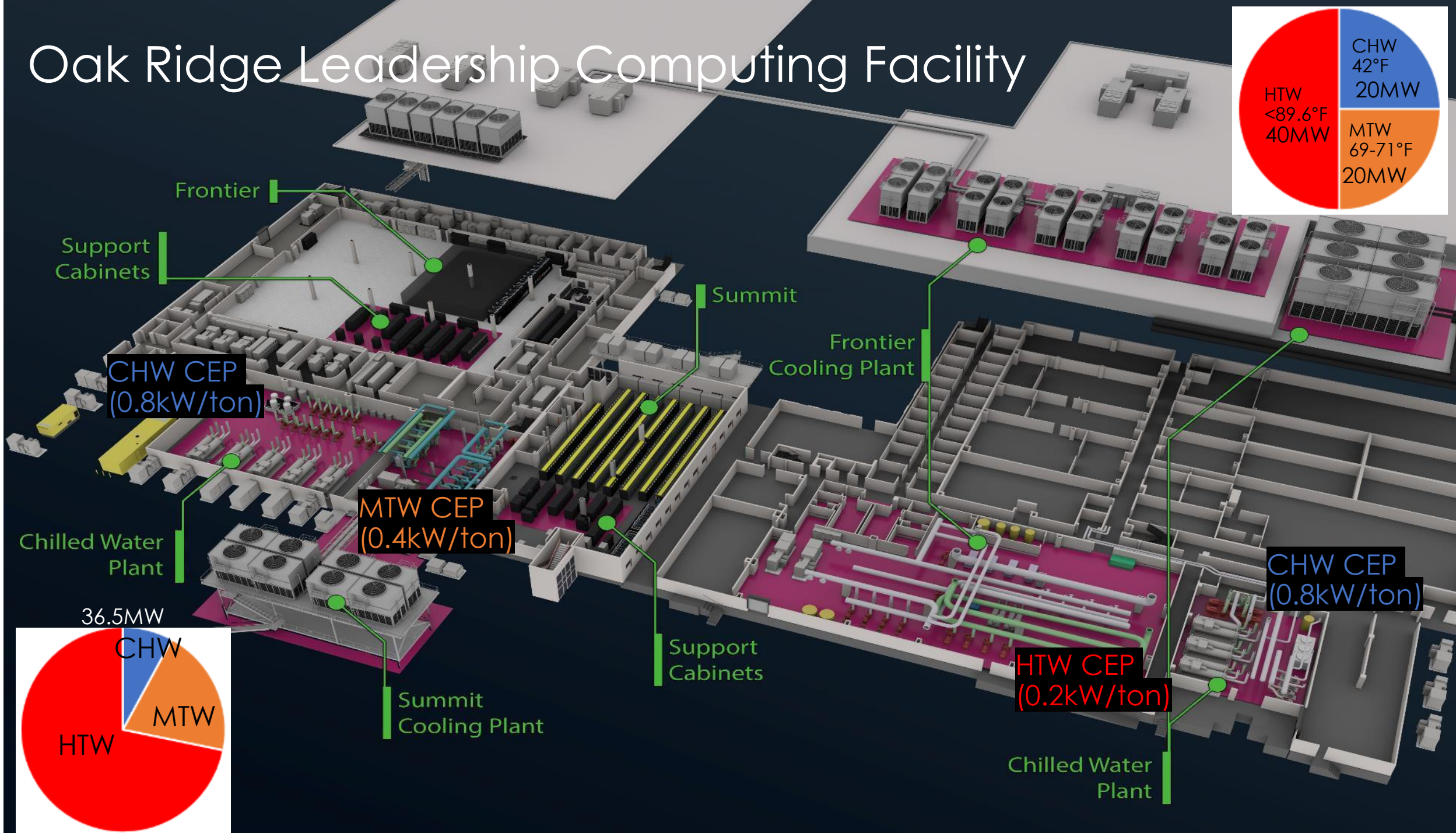
David Grant, PE, CEM, DCEP
HPC Mechanical Engineer
Oak Ridge National Laboratory

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U.S. DEPARTMENT OF
ENERGY

Oak Ridge Leadership Computing Facility



Project Advice

- Small decisions add up to big things at the facility level
- Working up against a ceiling thermally, but still try to minimize flow
- Simple fluids, savvy piping, series vs. parallel components
- Don't operate a razor's edge control envelope
- Maintainability

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