Network Advisory: Using Cooling Efficiency Ratio (CER)

Part 2 of a 2-part Network Member Case Study on Data Center Cooling Efficiency Optimization

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Smarter Together

The Uptime Network is a community of data center owners and operators under mutual NDA. No member organizations or individuals are named in this report.

This is part two of a two-part case study showcasing data center cooling optimization from a member company.

Network advisory documents do not necessarily represent the opinions of Uptime's technical leadership or members but instead provide members resources to track our community's ongoing discussions. These readouts are intended for Uptime Network internal use.

Email suggestions for future topics to Matt Stansberry: mstansberry@uptimeinstitute.com.

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About this case study

- An Uptime Network Member implemented a project to raise IT equipment inlet temperature to 75°F. (Top of ASHRAE recommended temperature range).
- Managing the inlet temperature at the maximum range was expected to reduce energy use and carbon emissions – a commonly held expectation.
- The facilities and IT organizations collaborated to incrementally increase the inlet temperatures to monitor for and address adverse outcomes. Energy savings were expected.
- The organization monitored cooling system performance to calculate the *cooling efficiency ratio* (CER) – the quantity of cooling delivered for each unit of energy consumed to run the cooling system.
- Monitoring showed that raising the inlet temperature **increased energy use** and **reduced cooling efficiency,** demonstrating the importance of validating expected savings.

Calculating CER

Cooling Efficiency Ratio (CER) as defined by the EN50600 standard measures the efficiency of the cooling system from the heat capture in the IT space to the heat rejection into the ambient environment.

Calculating CER requires:

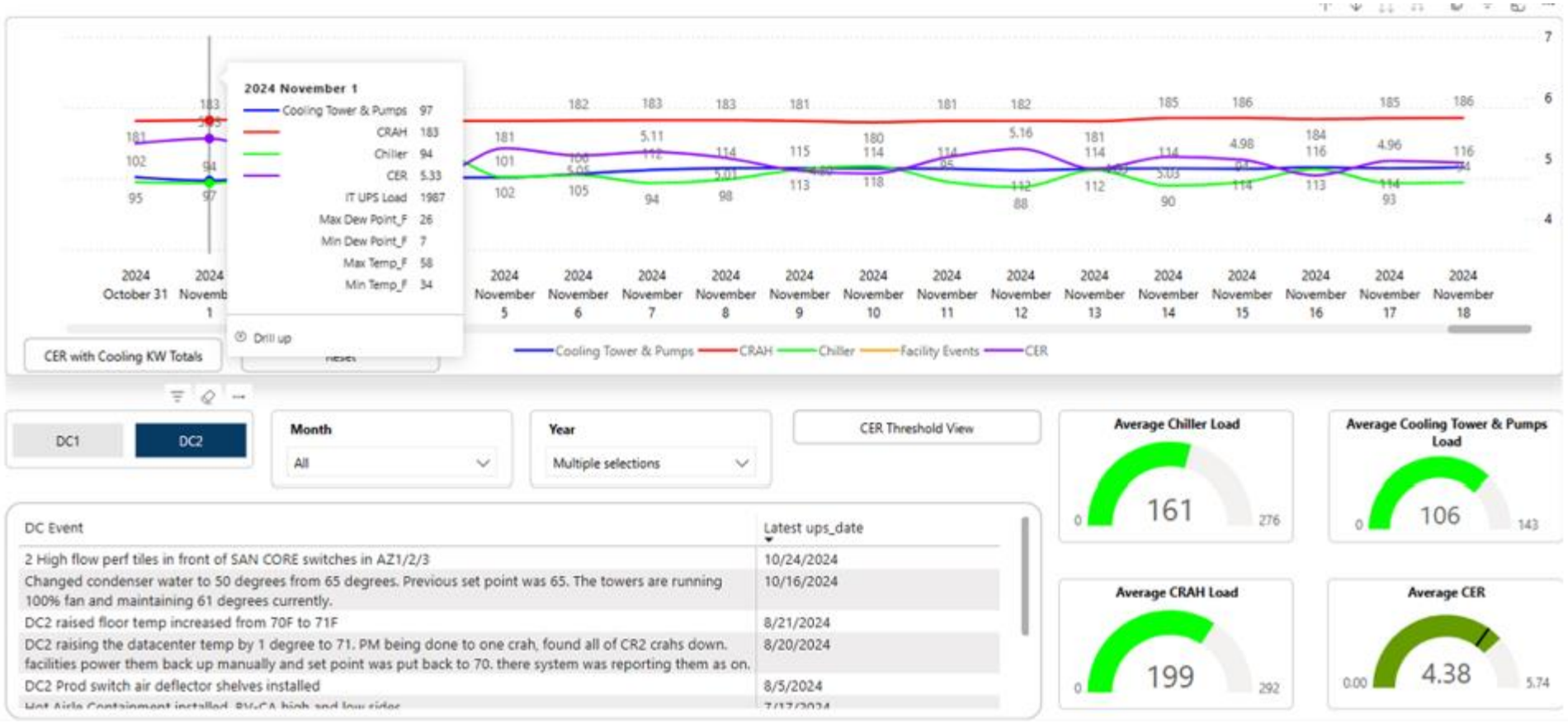
Measuring the energy consumption of mechanical systems to calculate energy used to deliver cooling,

Measuring the temperature deltas across the heat exchange systems, and air and cooling water flow rates to calculate the quantity of cooling delivered to the IT equipment.

It is also important to track the changes in IT equipment energy due to fan speed changes as the IT space temperature is raised.

See Part 1 of this Case Study for more information on the comprehensive dashboards.

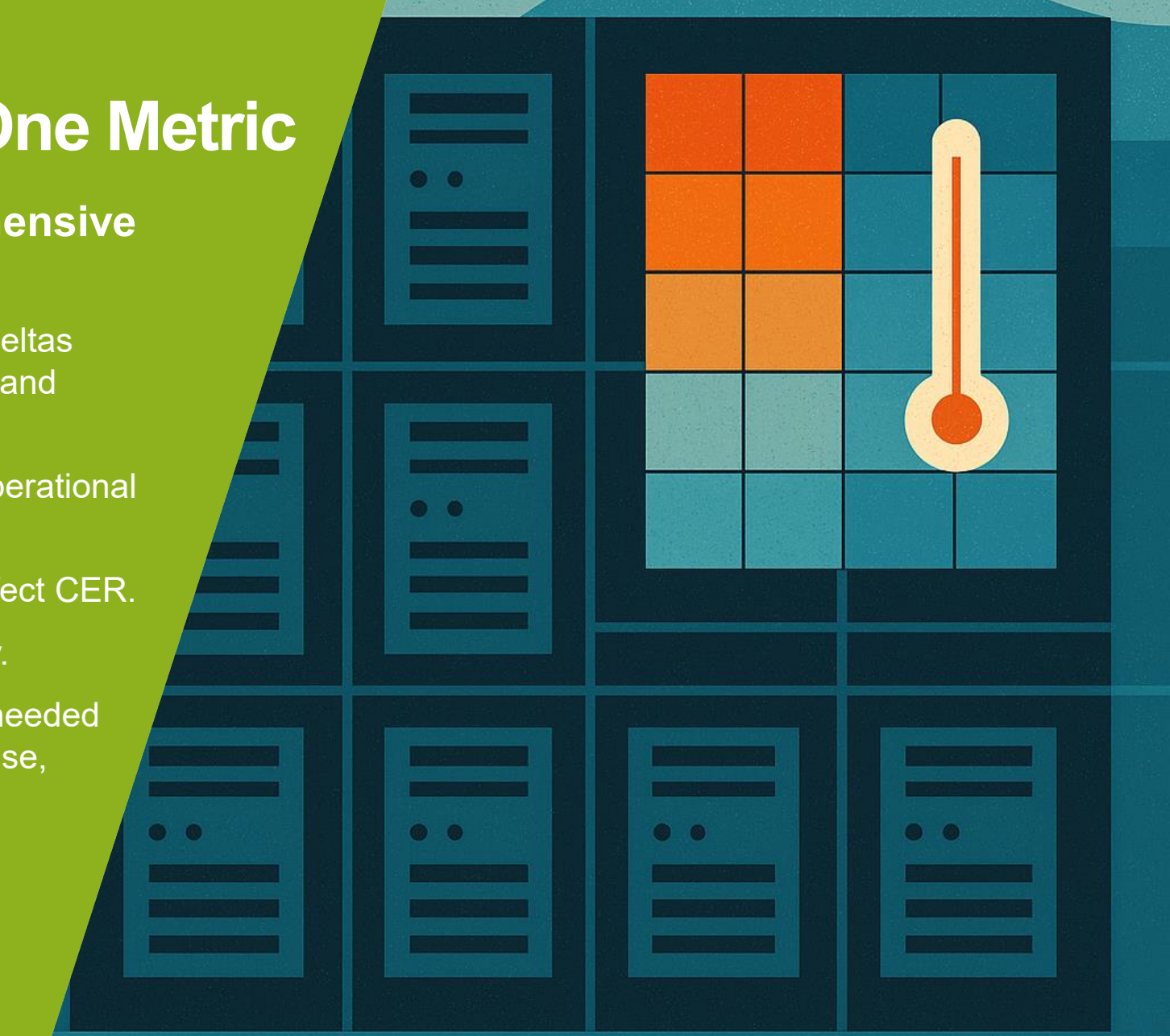
Cooling Efficiency Ratio (CER) dashboard



Multiple Data Sources – One Metric

CER measurements enable a comprehensive view of cooling system performance:

- Tracks energy use, fluid flow, and temperature deltas across chillers, CRAHs, pumps, cooling towers, and related equipment.
- Granular tracking allows quick assessment of operational changes.
- A facility events panel logs changes that may affect CER.
- The CER value reflects overall cooling efficiency.
- CER provides the detailed system-level insight needed to optimize cooling, reduce data center energy use, and improve PUE.



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CER supports fact-based decisions about cooling

- CER has a major impact on the case organization's ability to set cooling objectives and quantify cooling performance.
- CER acts as a primary measure used to ensure the team is focused on the business goal of optimizing cooling efficiency, rather than on tactics that might improve performance in one area without necessarily delivering facility-wide benefit.
- And with a dashboard that spans facility and IT systems and measurements, the organization can see connections between systems that are not natively connected or typically analyzed as factors in a single equation.

Set-Point Change that Didn’t Deliver

The case organization used CER to assess the impact of raising IT space temperatures in 2° increments from 68°F to 75°F.

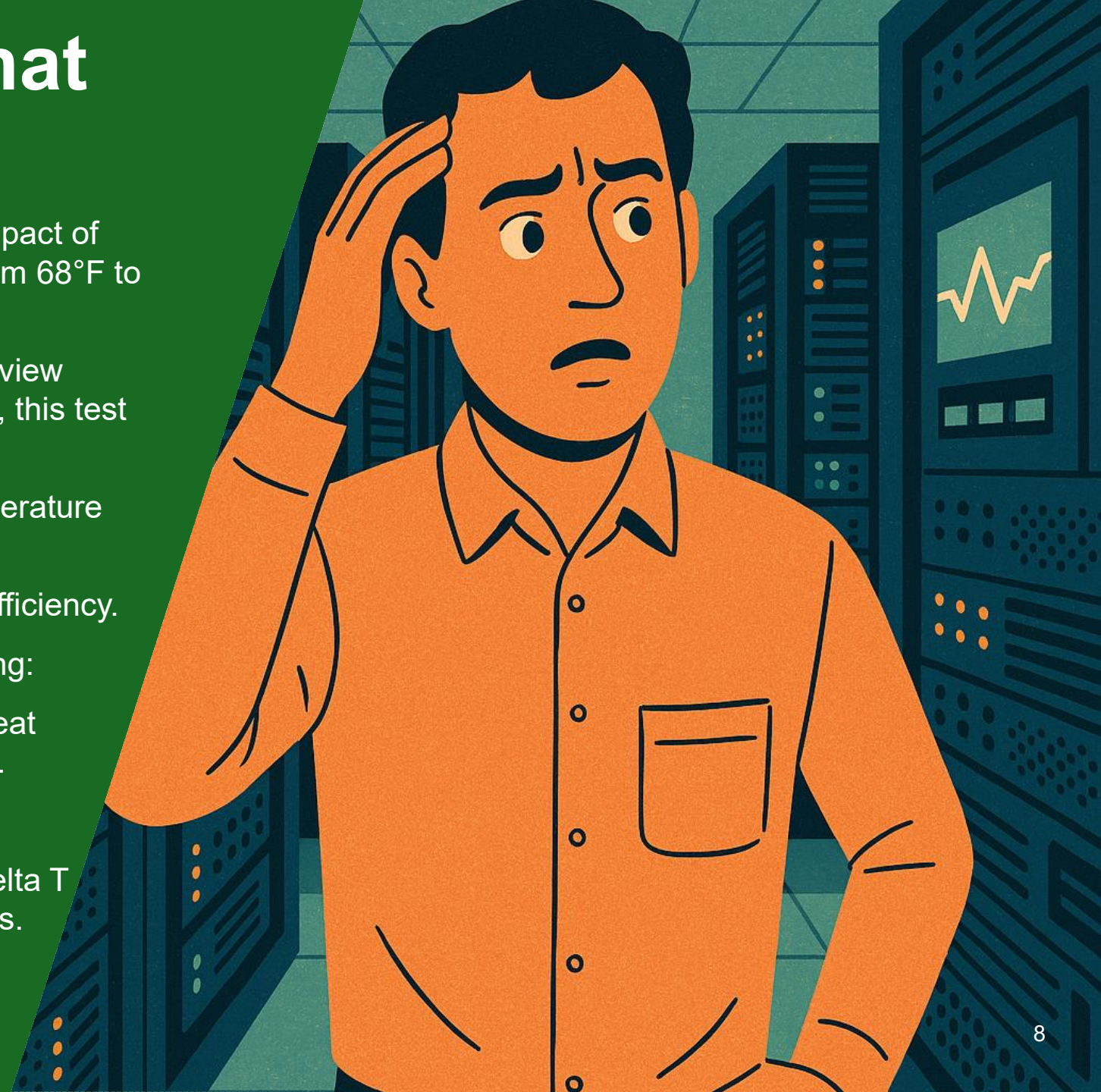
While some regulators, advocates, and operators view higher IT temperatures as a simple efficiency gain, this test revealed two negative outcomes:

•**Increased equipment failures** as IT space temperature rose.

•**Lower CER values**, indicating reduced cooling efficiency.

At 75°F, the CRAH unit fans hit full power, triggering:

- Faster airflow, which reduced dwell time and heat removal—especially for servers low in the rack.
- Increased CRAH energy use.
- Higher chiller energy use, likely due to lower delta T from accelerated airflow and shorter dwell times.



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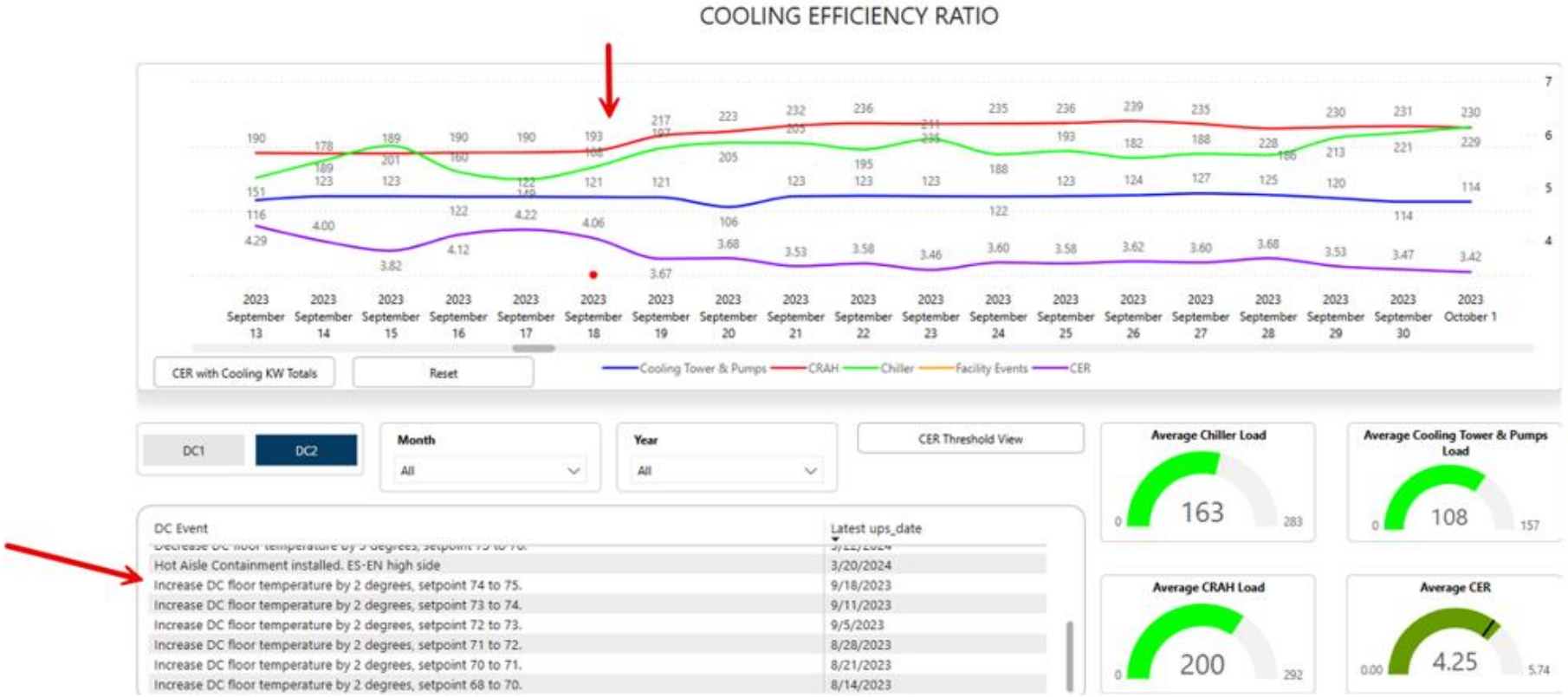
Impact of Set-Point Increase



On September 18th, the IT space temperature was increased from 74°F to 75°F. CER decreased from 4.08 to 3.67. CRAH energy consumption increased from 193 to 217 kw. Chiller energy consumption increased from 168 to 199 kw

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Up-Ending Assumptions

The higher set point was run for a sufficient time to validate the increased system energy use and reduced CER. The team then lowered the set point from 75° to 70°:

- Power drawn by CRAH dropped by approximately 100 kW.
- Chiller power increased by roughly half that amount.
- The net result: CER improved from 4.28 to 4.80.

This case study demonstrates that the effect of raising IT equipment inlet temperatures depends on:

- The type of external heat exchange system.
- The use of variable versus fix speed fans.
- The presence of fixed or programmable set points on individual cooling system equipment.
- The temperature set points on the IT equipment fan speeds.

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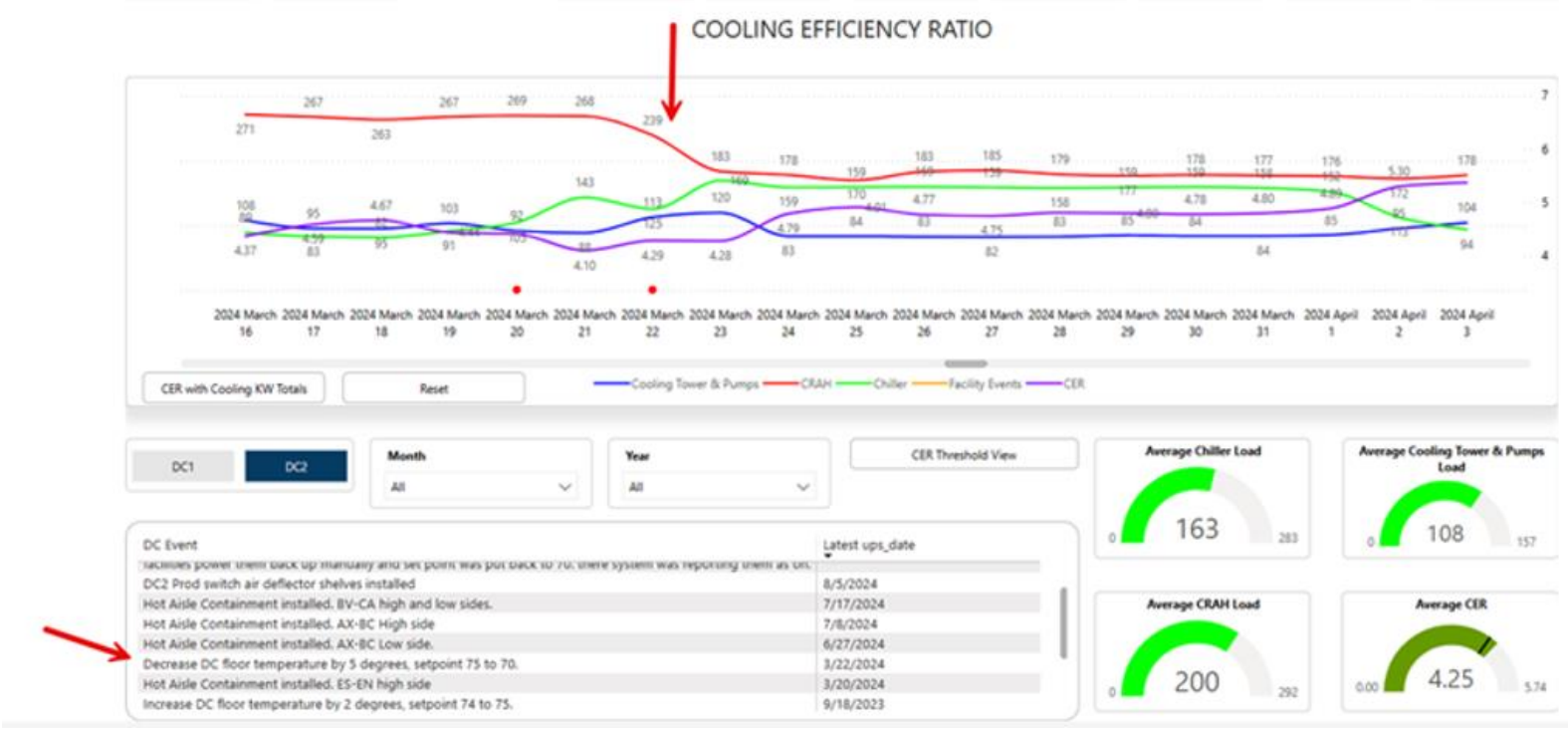
Impact of Set-Point Decrease



Key lesson: Measure and validate all energy efficiency efforts; increasing IT equipment inlet temperatures does not guarantee efficiency improvement – it is dependent on the overall system characteristics

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Demonstrating the Value of CER

Applying CER will support future decisions on cooling optimization, including:

- Testing energy-efficient cooling technologies
- Improving airflow management
- Maximizing free cooling
- Finding the IT temperature that minimizes both failures and energy use

Real-time dashboard metrics allowed the organization to experiment with CER to track system performance continuously, enabling:

- Immediate feedback and quick issue detection
- Identification of normal vs. anomalous behavior
- Faster recovery from problems

Data Strategy Driven by Sustainability Goals

The case organization invested in real-time dashboard capabilities to:

- Optimize energy use
- Enable proactive maintenance
- Monitor operational carbon emissions
- Report progress to leadership
- Support ISO 50001 certification

Internal Dashboards Built for Deep Insight

The Case Organization chose to build custom dashboards in-house
Investment was primarily time:

- Time needed to learn how the different systems worked, and to explore the data that they produce as well as additional, useful data monitoring points.
- Time required for the IT and facilities teams to jointly prepare a design scope;
- Time used to build the system itself: to assemble the data sources and build dashboard screens that facilitate deep insight into the influence of operational variables on overall system performance.

Lessons Learned

Real-time tracking of operational metrics such as CER enables data center operators to gain valuable insights into the operating characteristics and performance of their critical systems.

- Identify opportunities to reduce energy use and costs and improve environmental performance.
- Track system performance to identify and correct anomalous operations events.
- Meet and exceed resiliency, reliability, cost, and sustainability objectives.

Cross-functional collaboration on the construction of the dashboard provides a global view of system operations and identification of otherwise invisible interdependencies between facilities and IT systems. Using the cooling system and the CER metric as an example:

- A comprehensive dashboard accounts for variations in IT equipment utilization, temperature, due point, IT space temperature and other factors, helping to take holistic actions to optimize CER.
- Real-time monitoring enables the organization to incrementally modify system and operational setpoints to find the operating points that minimize energy use and maximize system performance.
- In this case study, the monitoring of responses to the IT space temperature changes showed that 70°F was the most efficient operating point for the installed cooling system.

About this document: This Case Study report was prompted by an interaction with an Uptime Network member in the second half of 2024. Contributing Uptime experts included Jay Dietrich.

Please contact Scott Killian at skillian@uptimeinstitute.com or Matt Stansberry at mstansberry@uptimeinstitute.com if you would like to schedule a discussion with an Uptime expert on building a cooling efficiency dashboard system or related topics.

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