Direct Liquid Cooling Demonstration

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Presentation

- Acknowledgments
- What is this technology?
- Demonstration Goals
- Setup
- Turning Data into Information
- Conclusions

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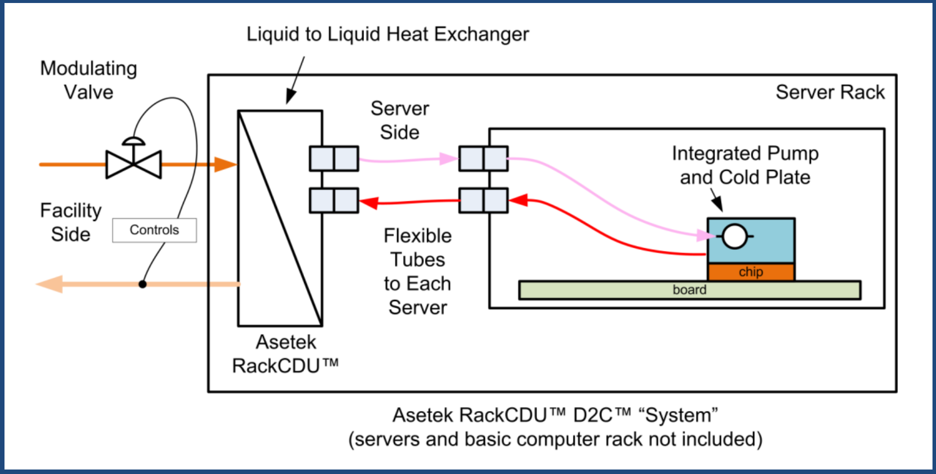
What is it?

Direct Liquid Cooling

Asetek RackCDU D2C ™ Liquid Cooling

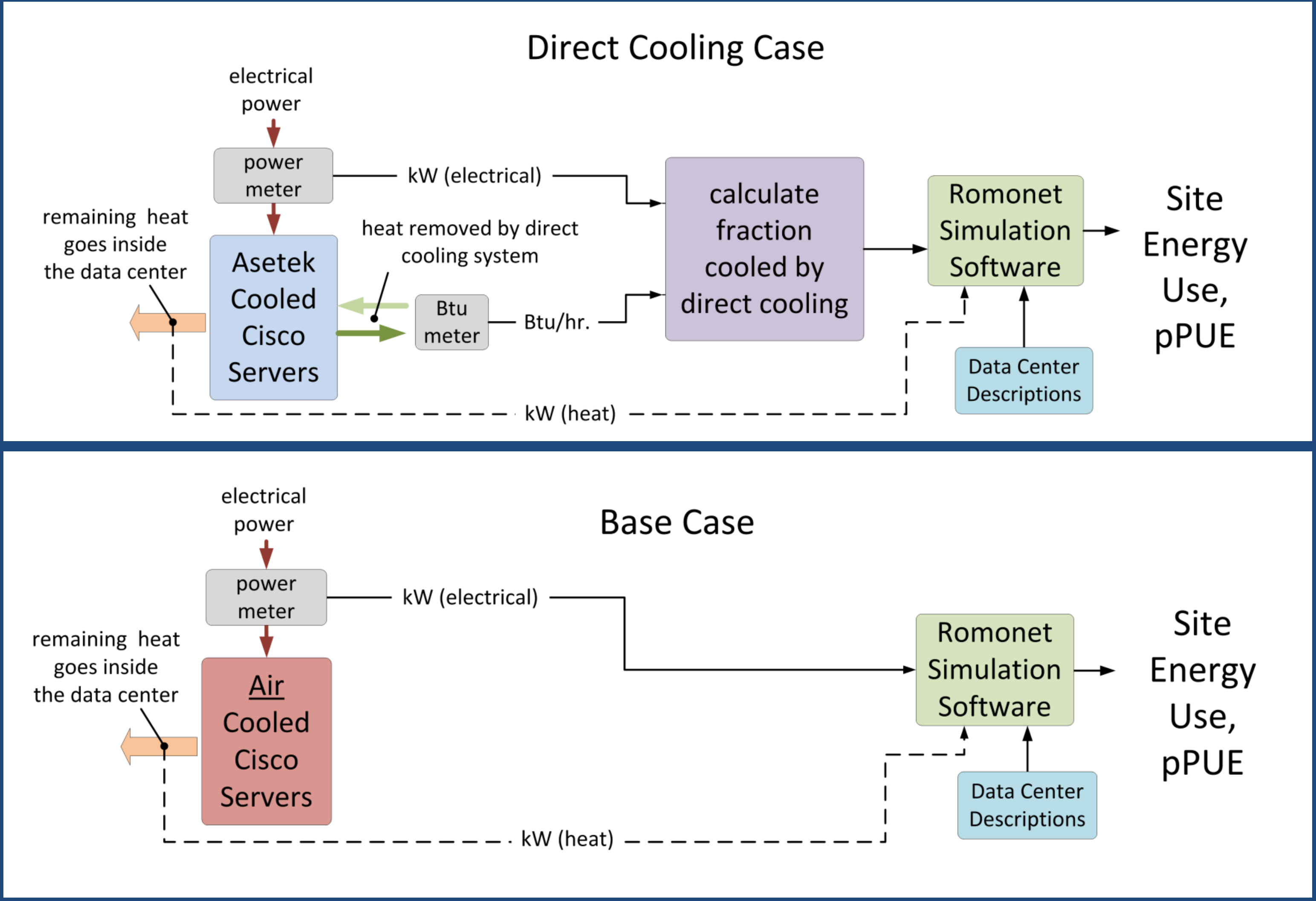
Direct Cooling of CPU and Memory

CPU Cooling Concept



Demonstration Goals

Estimate Energy Savings of This Technology Compared to A Base Case



Goal: Key Variables

Goal: Determine Fraction of Server Heat Captured for a Broad Range of Conditions

- Supplied Water Temperature

  15C - 45C (59F - 113F)

- Water Flow Rate (Return Water Temperature)

  ~0.5->4.9gpm = ~17C-~50C (62F – 122F)

- IT Heat Level

  ~100 w/server (idle) –> ~440 w/server (max. power)

Setup

38 Asetek Cooled Cisco Servers

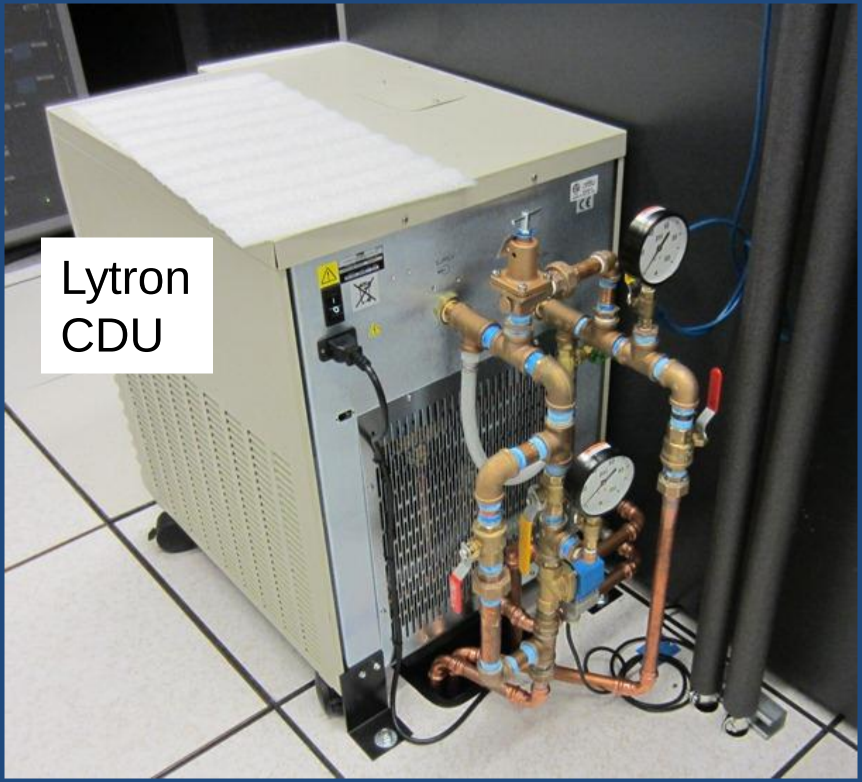
Lytron CDU Not Part of Asetek Product

Asetek CDU

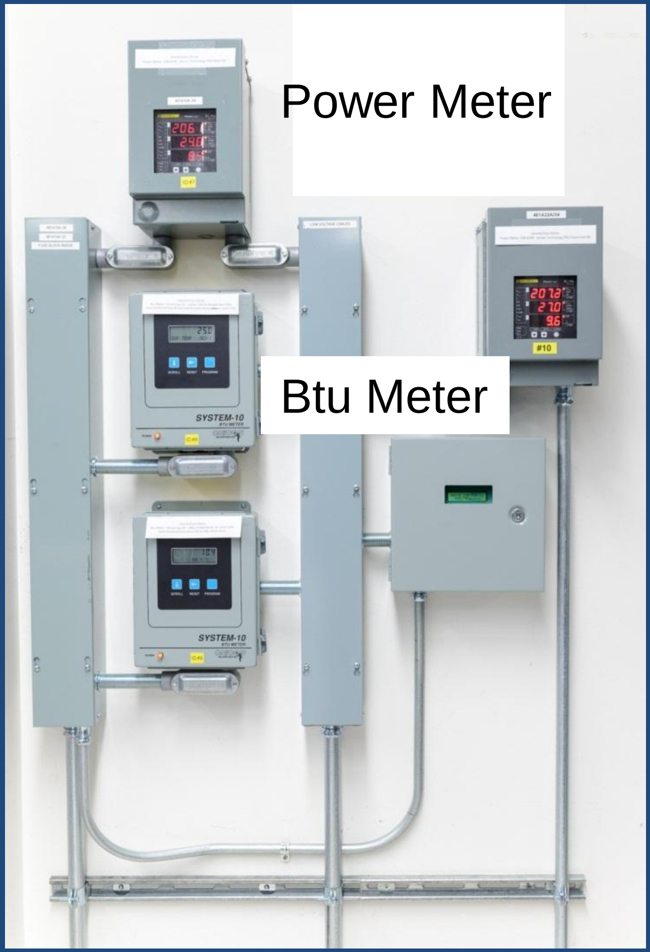
Back of Rack with 38 Cisco Servers

Setup (cont.)

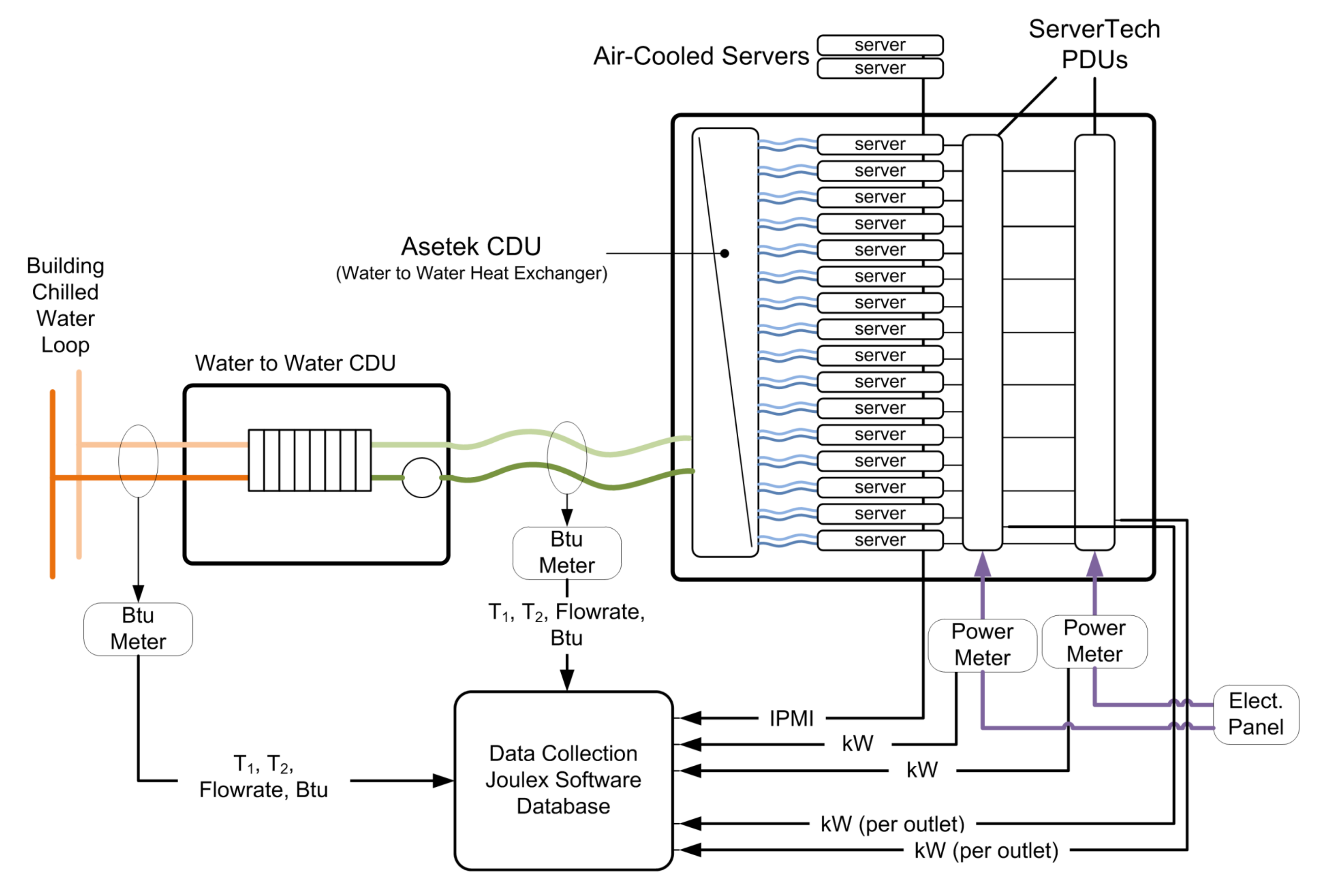
Supply Water Temp. Control



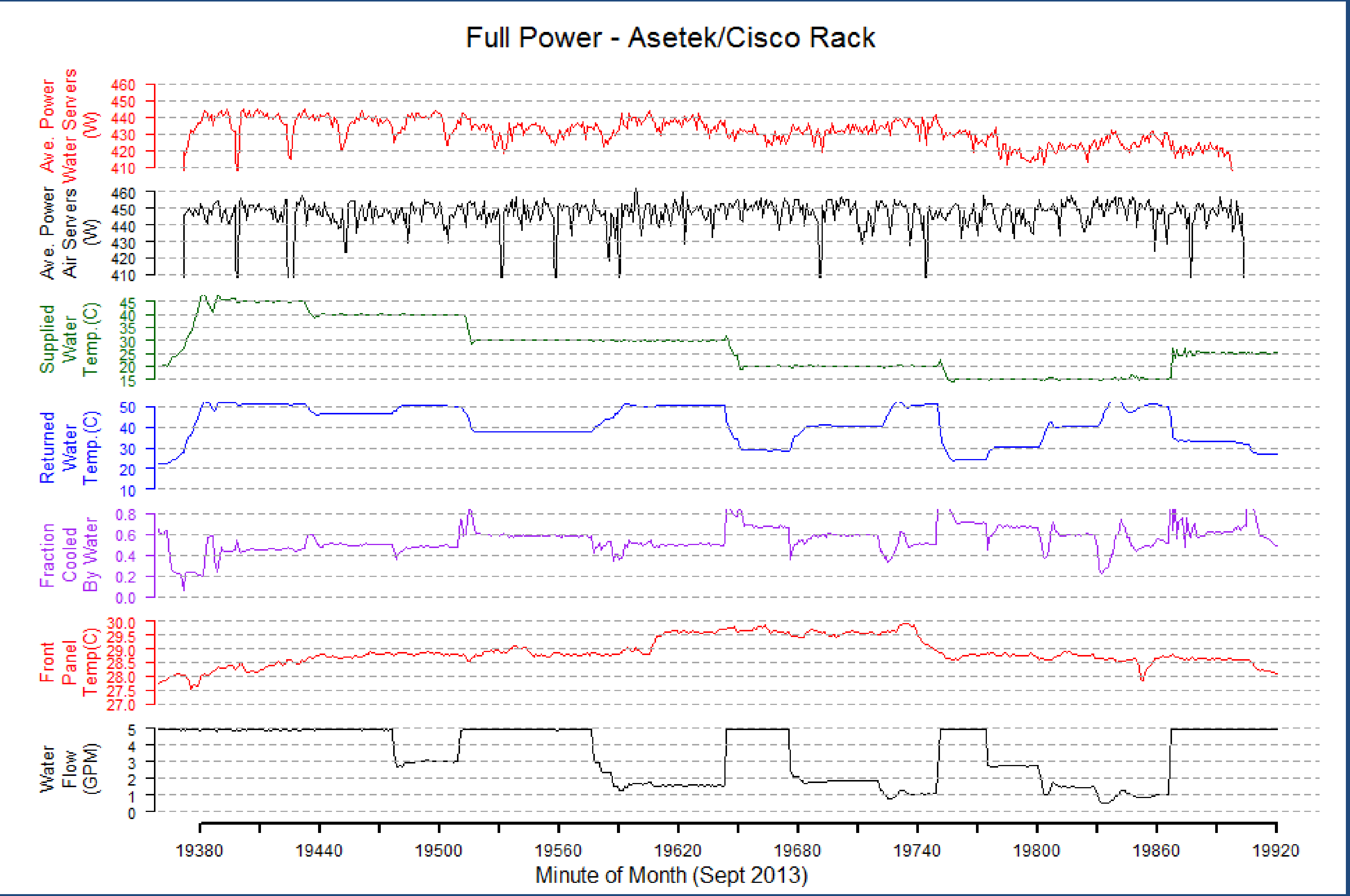
Metering: Btu, Electrical Power



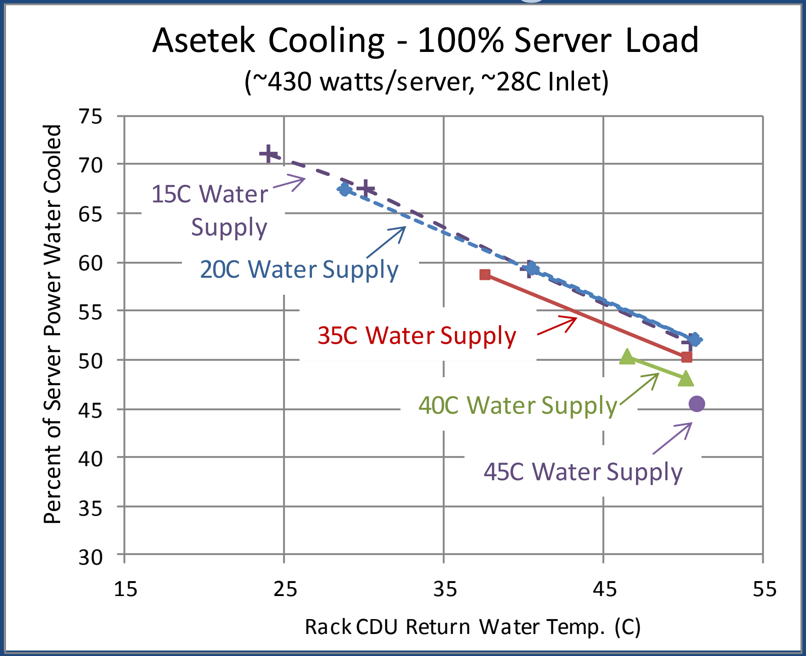
Setup (data collection)

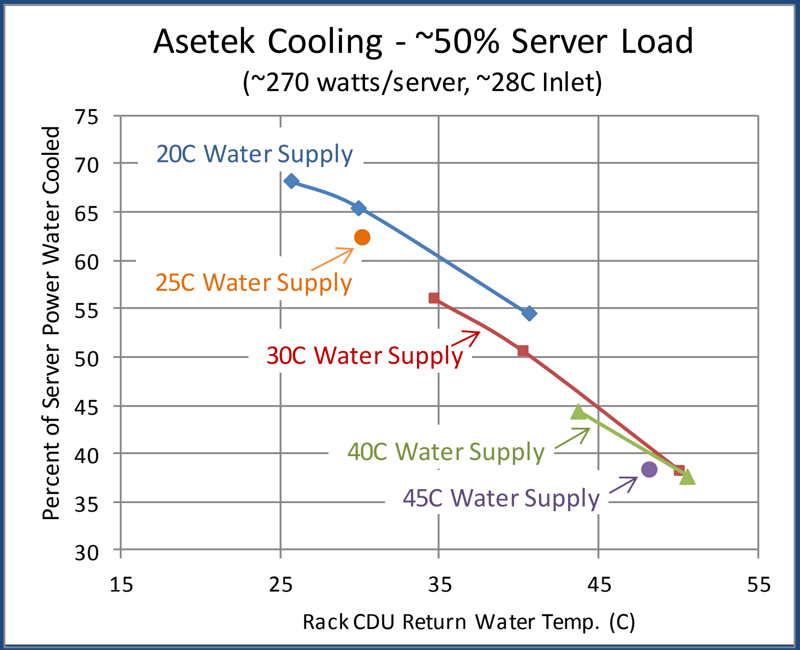


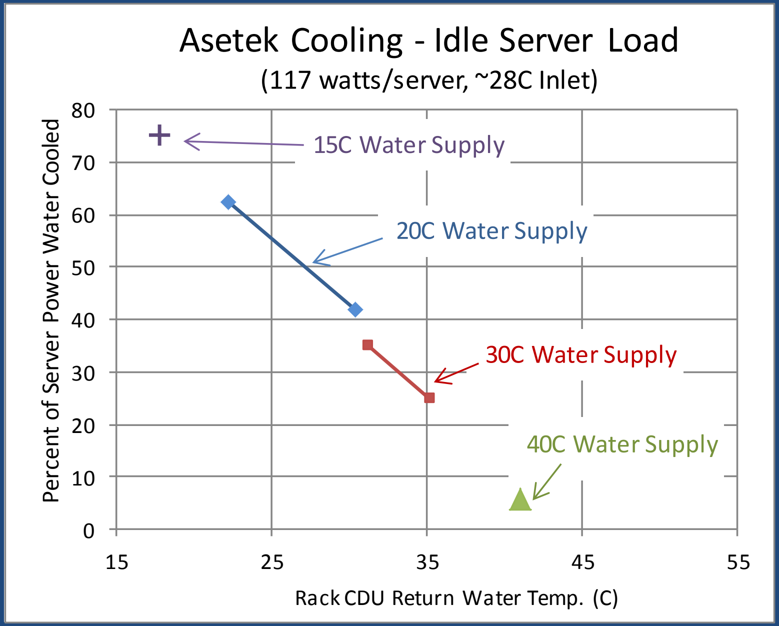
Collected Data (sample)



Turning Data into Useful Information

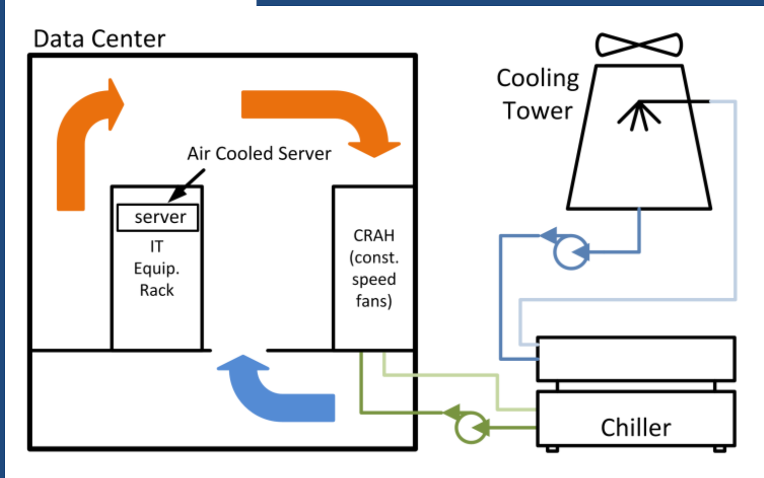




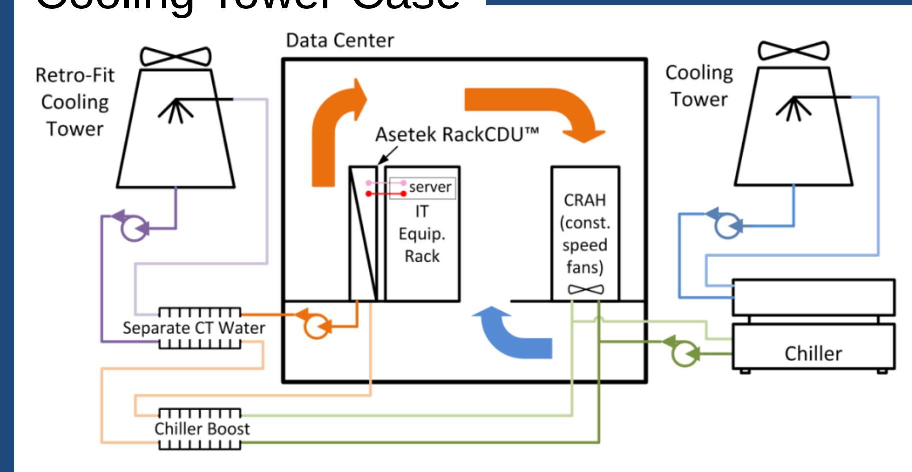


Data Center Models

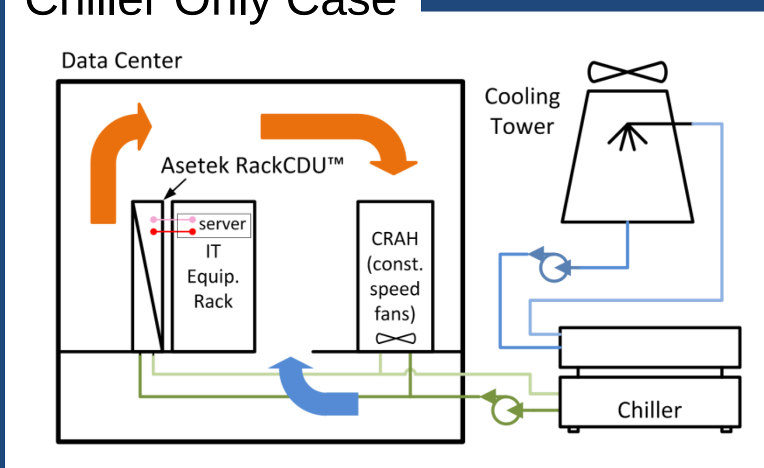
Base Case



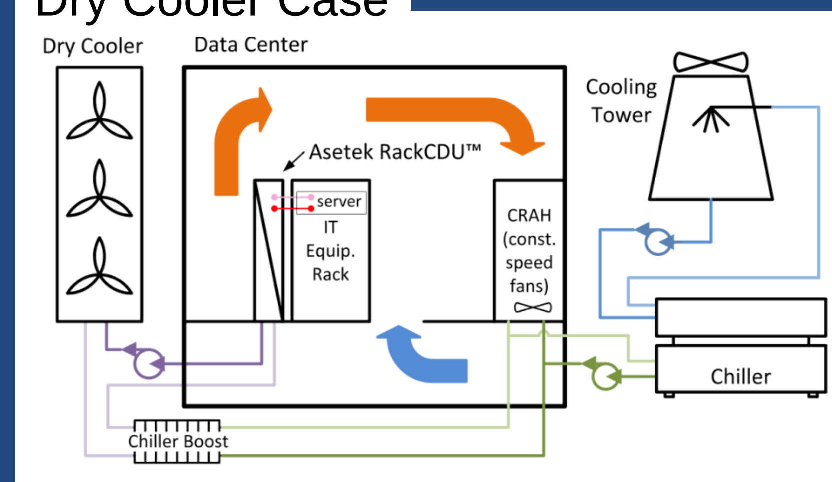
Cooling Tower Case



Chiller Only Case



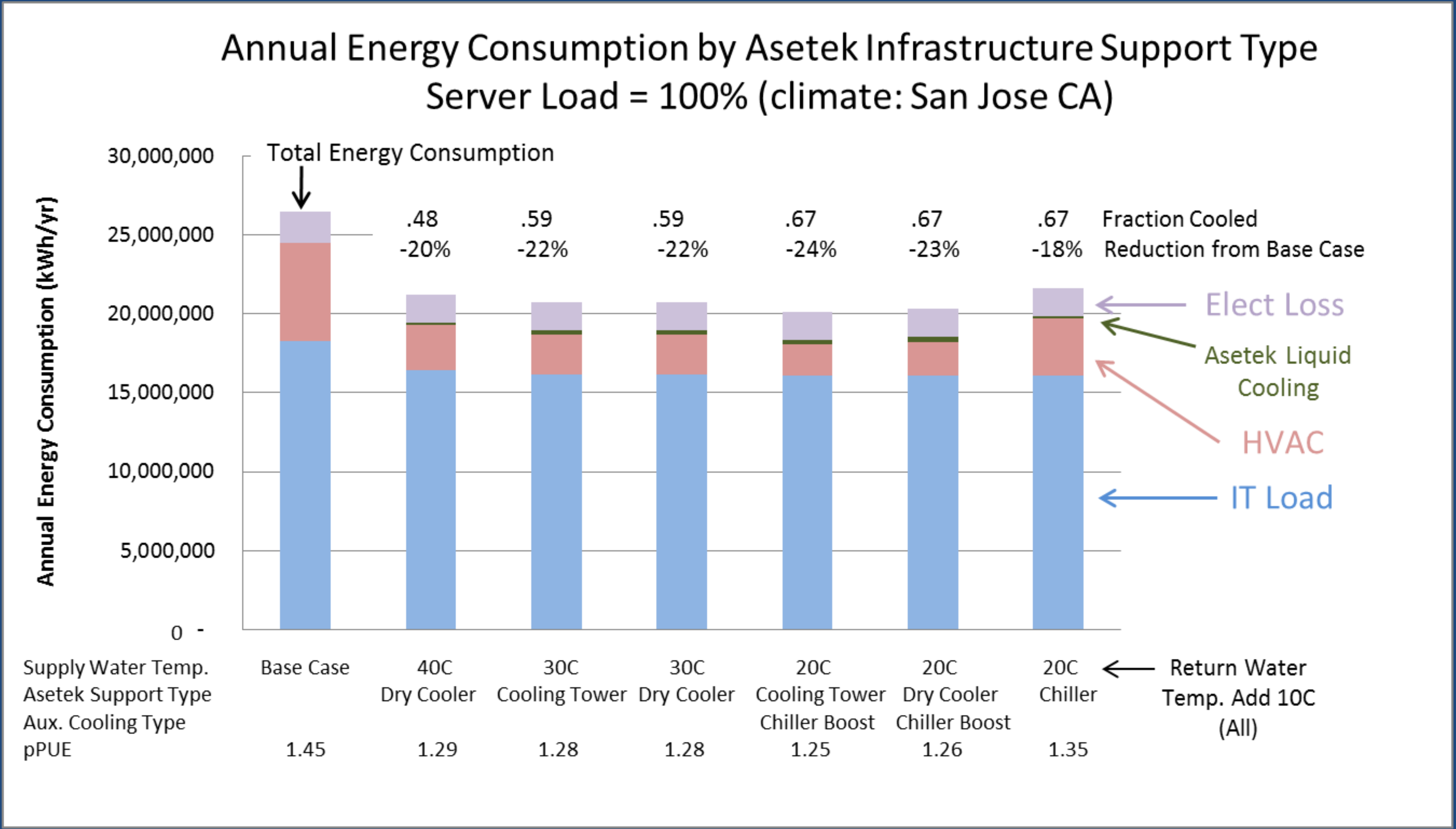
Dry Cooler Case



2MW IT Load, N+20% Fixed Speed CRAHs (id. sel.), N+1 Water Cooled Chillers,
N+1 Counter-Flow Cooling Towers, N+1 UPS, 2N Step-Down PDUs

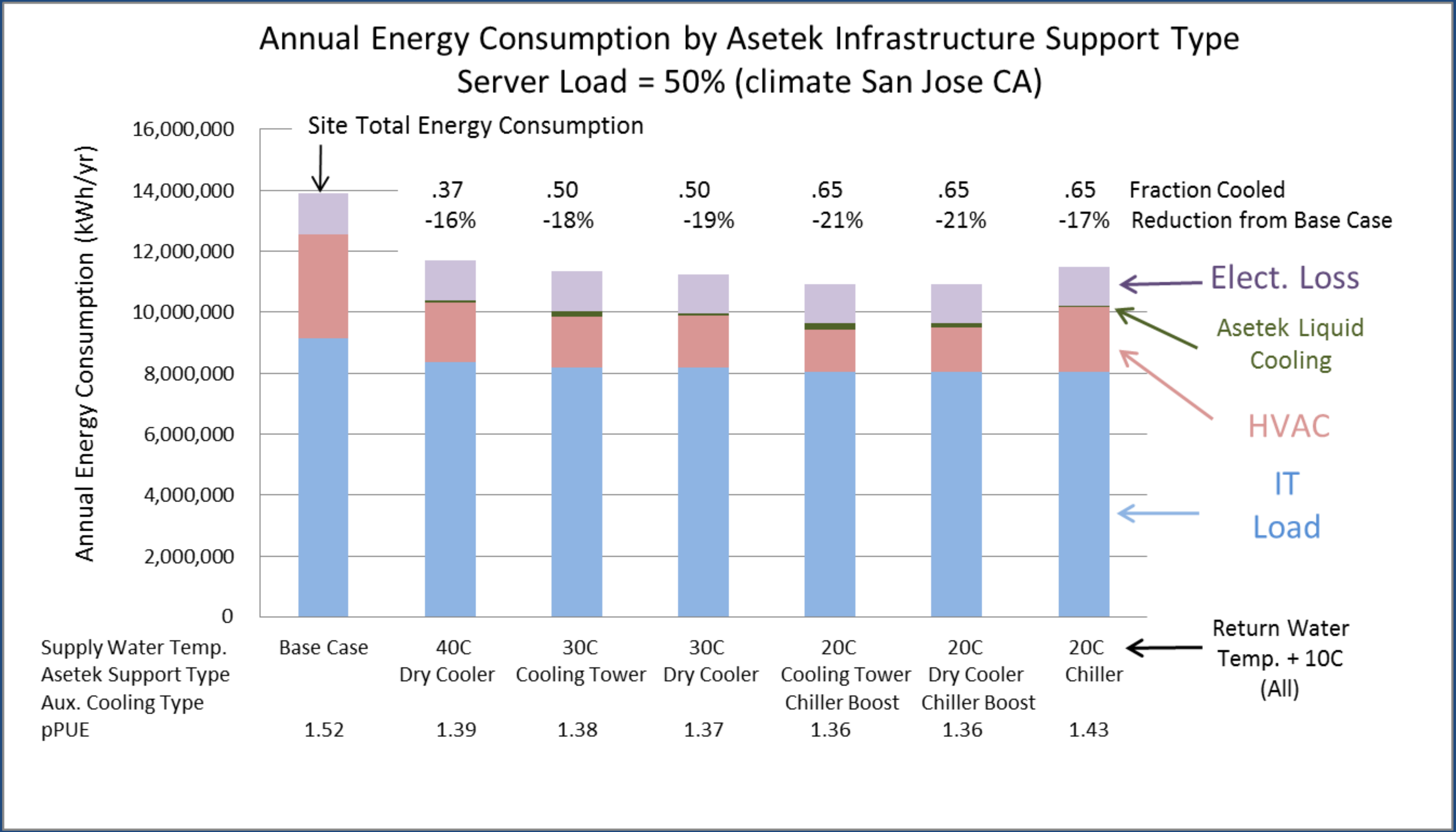
Modeling Results: pPUE for Full IT Load

preliminary results



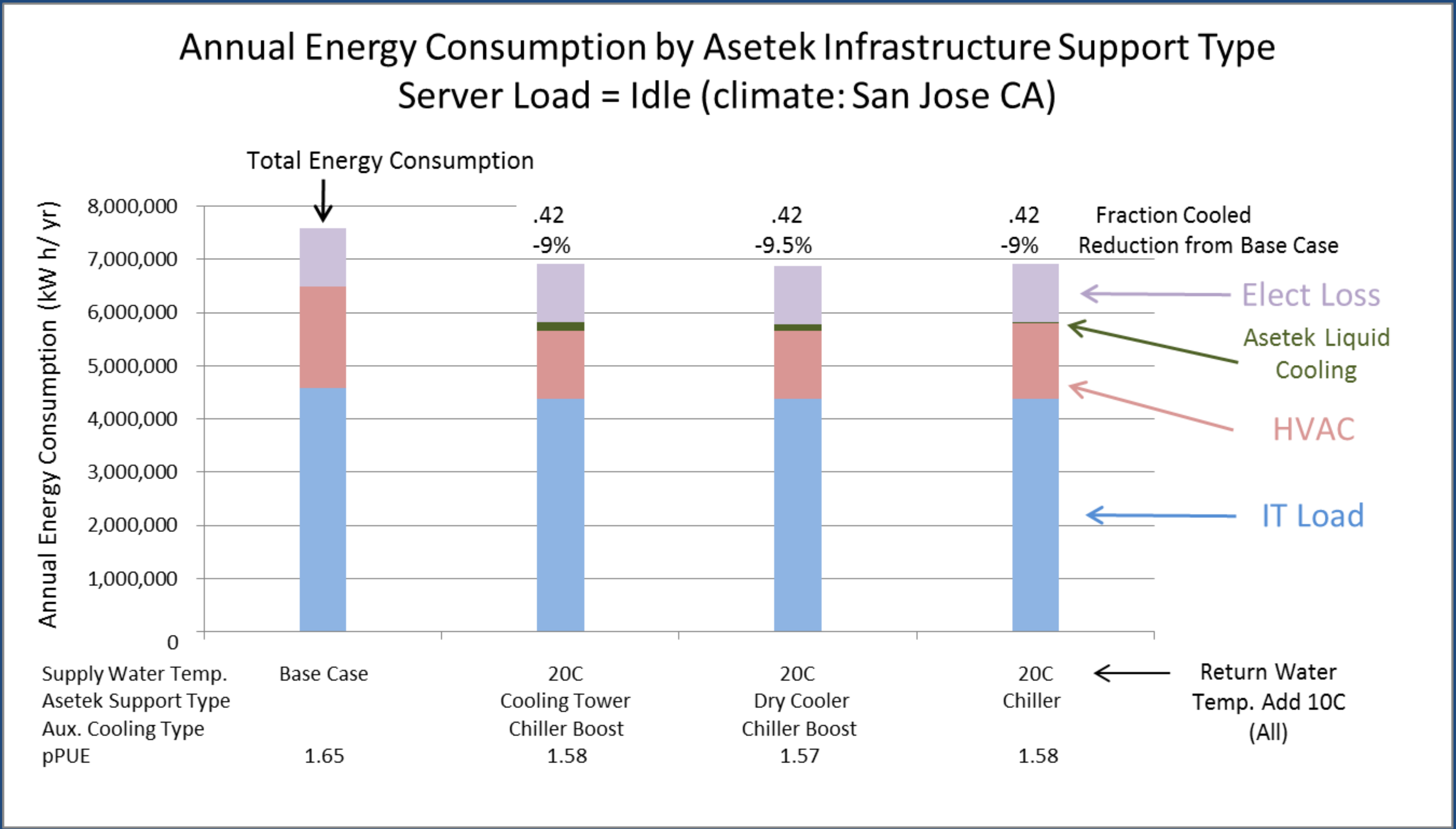
Modeling Results: pPUE Estimates for 50% IT Load

preliminary results



Modeling Results: pPUE Estimates for Idle IT Load

preliminary results



Conclusions

- This direct cooling technology should provide a significant reduction (~16-21%) in total data center energy consumed if implemented as modeled for an IT load of 50%.
- Using colder water when economically available reduces the total energy consumed for the climate modeled (San Jose CA) in our study. Other climates will provide different results.
- Significant site-level energy savings should be possible using this technology even though it does not capture 100% of the server waste heat.

Questions

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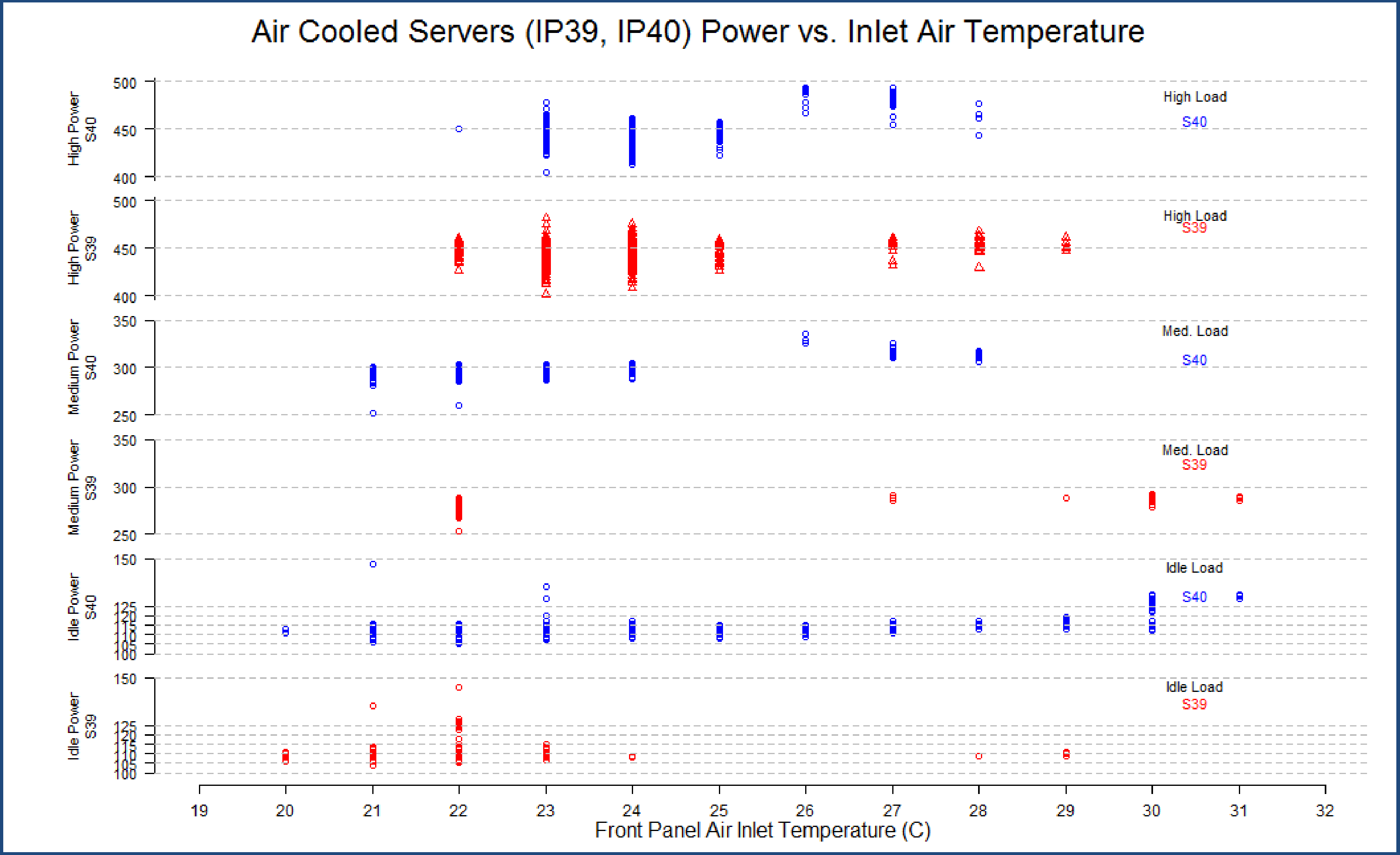
Backup Slide

Measured Air Cooled Server Power vs. Air Inlet Temperature



Backup Slide

Air Cooled Server Power Adjustment vs. Front Panel Air Inlet Temperature