PUTTING DATA IN CONTEXT

HOW COOLING COIL PERFORMANCE DATA CAN INFLUENCE DESIGN & OPERATION

IDEA CampusEnergy | March 2018

FlowEnergy Surge

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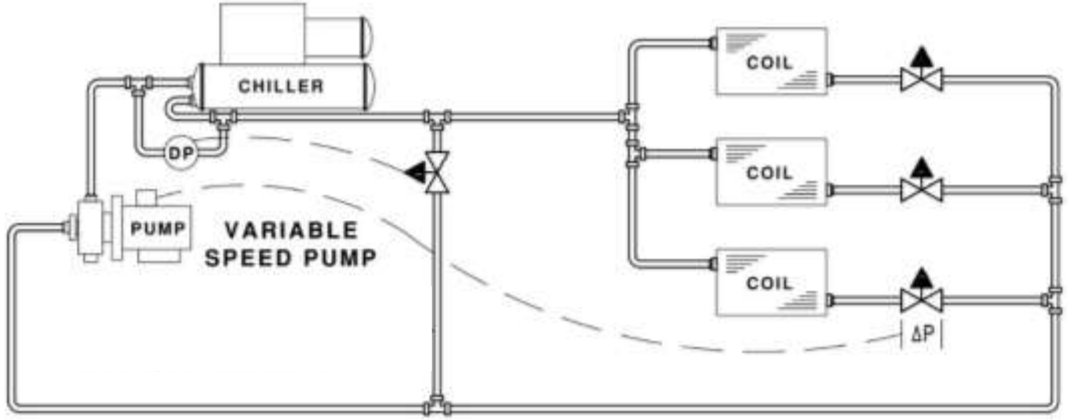
Where Do We Start?

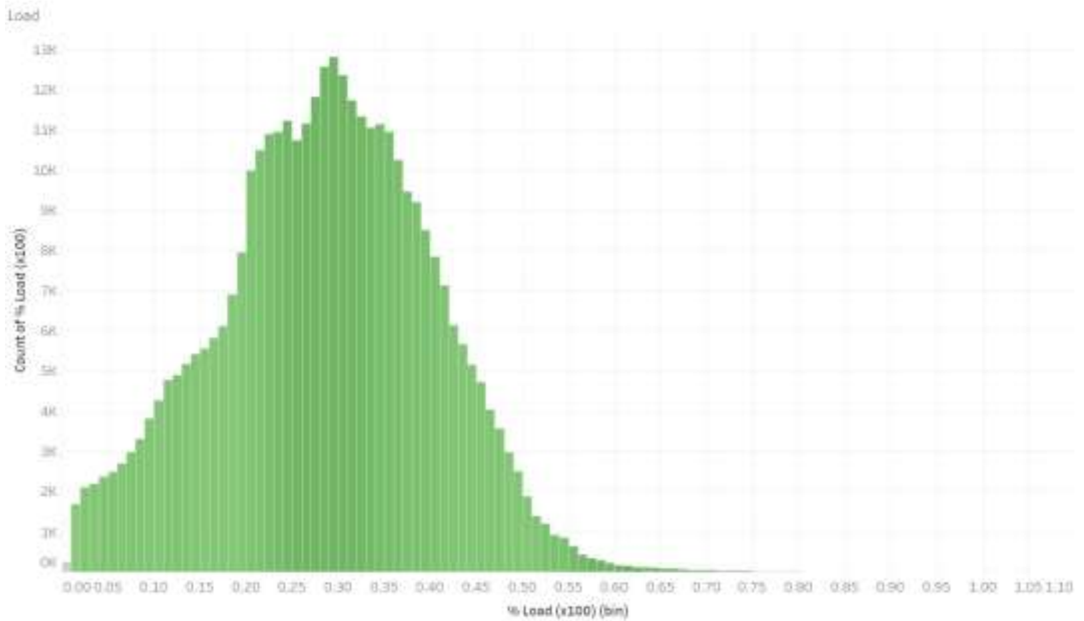
The system has one purpose: moving heat



- Every component serves a unique purpose
- Optimization opportunities: configuration, operation, equipment…

What Data Can We Use?

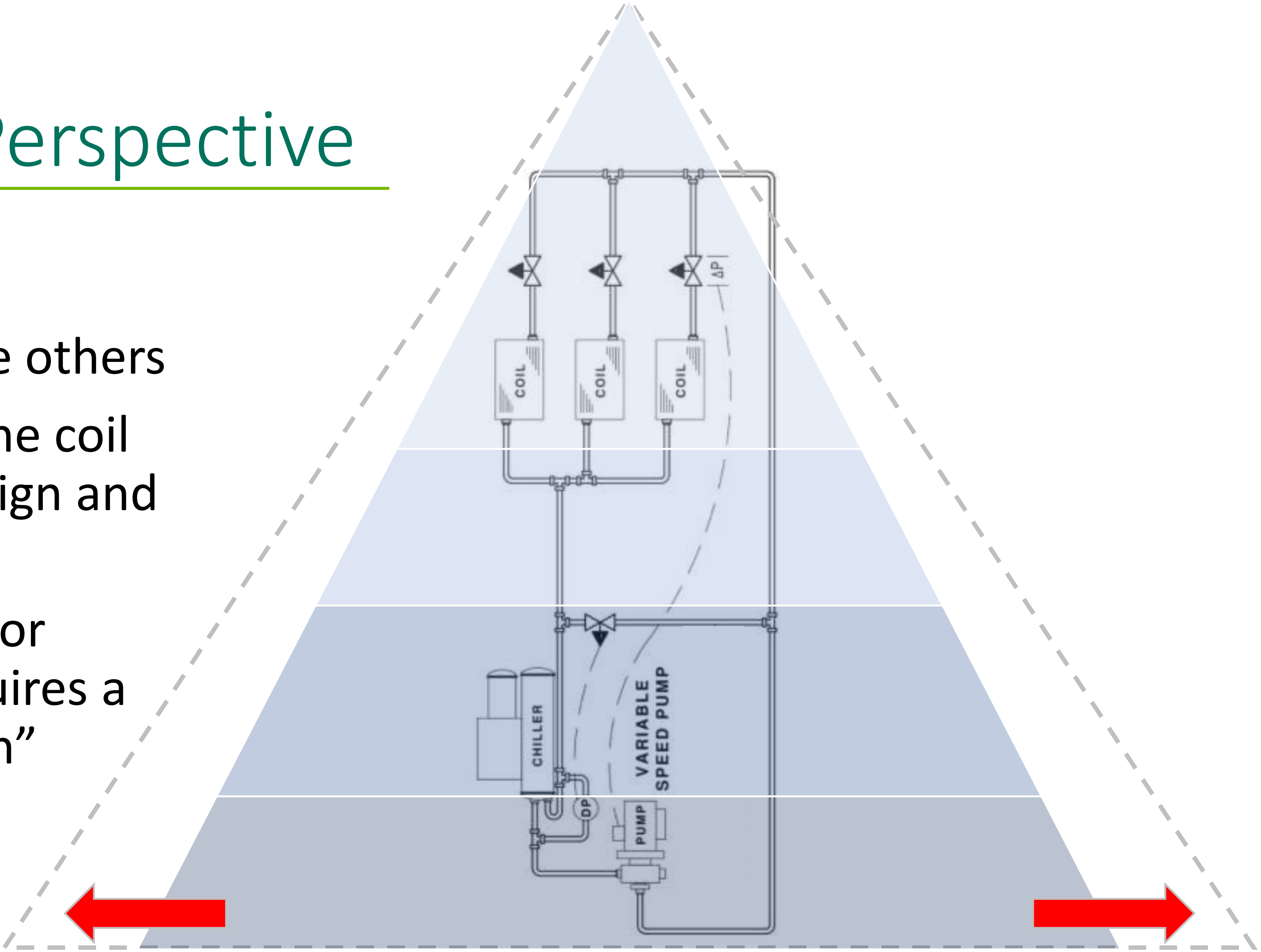
- Anecdotes & equipment logs
- BAS trend data & metering
  - Plant, building, coil, space
- Plant efficiency
- Load profile



These metrics are good for telling us what the performance *was*, but what *should* it be?

A Different Perspective

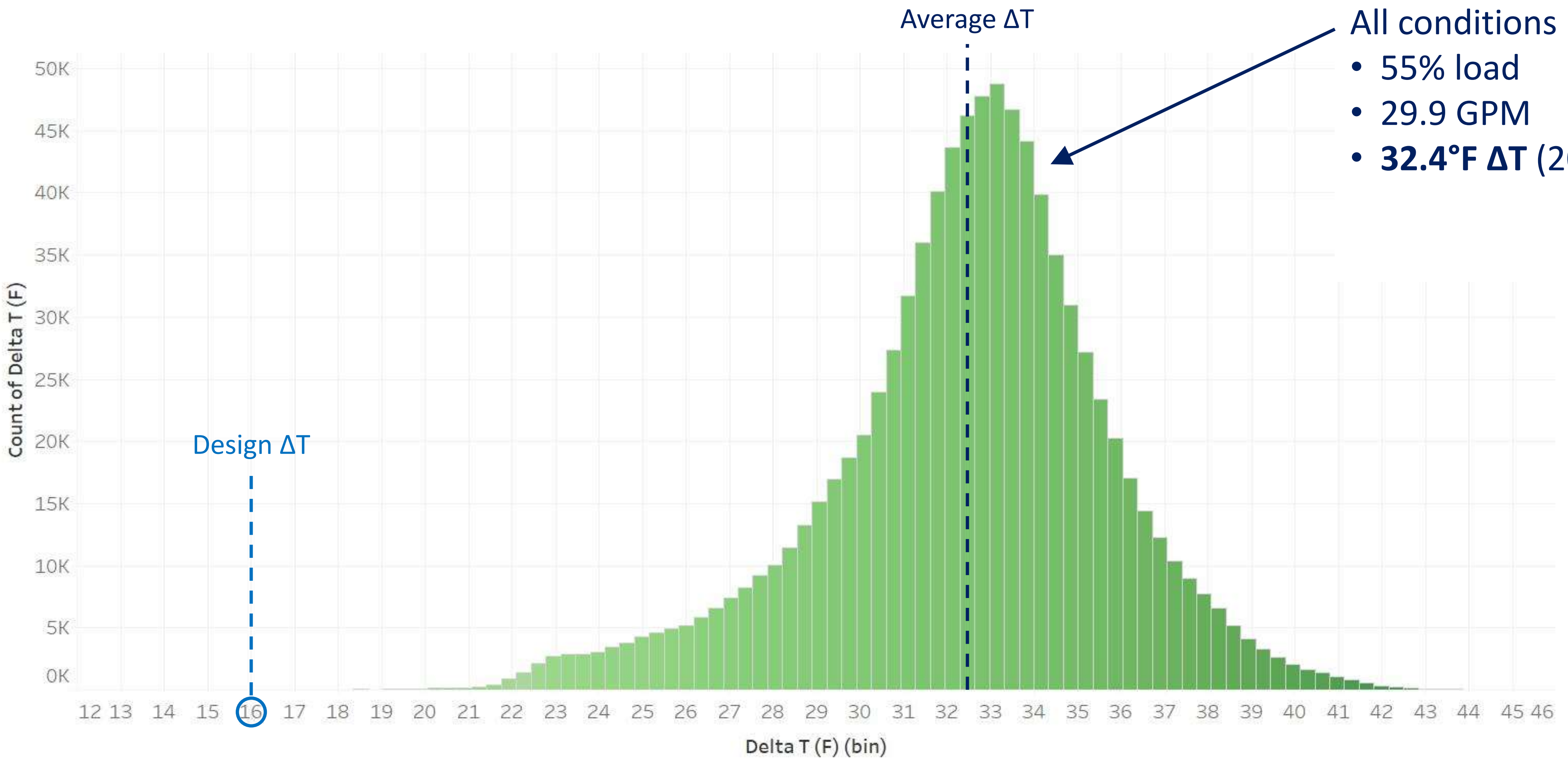
- Each component depends upon the others
- Heat transfer at the coil drives system design and performance
- Uncertainty or poor performance requires a larger “foundation”



Using Data as a Guide

- Three projects evaluated: different facility types and climates
  - Clinical research center and hospital in Duarte, CA
  - College campus in Yuma, AZ
  - University dental school in Kansas City, MO
- Projects implemented between 2014-2015
- 2 years of operational data, 2016-2018
- 1 minute interval data from individual SmartValves at AHU cooling coils: air & water temps., flow, pressures

Coil ΔT Profile – CA Hospital



<u>Avg. Performance</u>

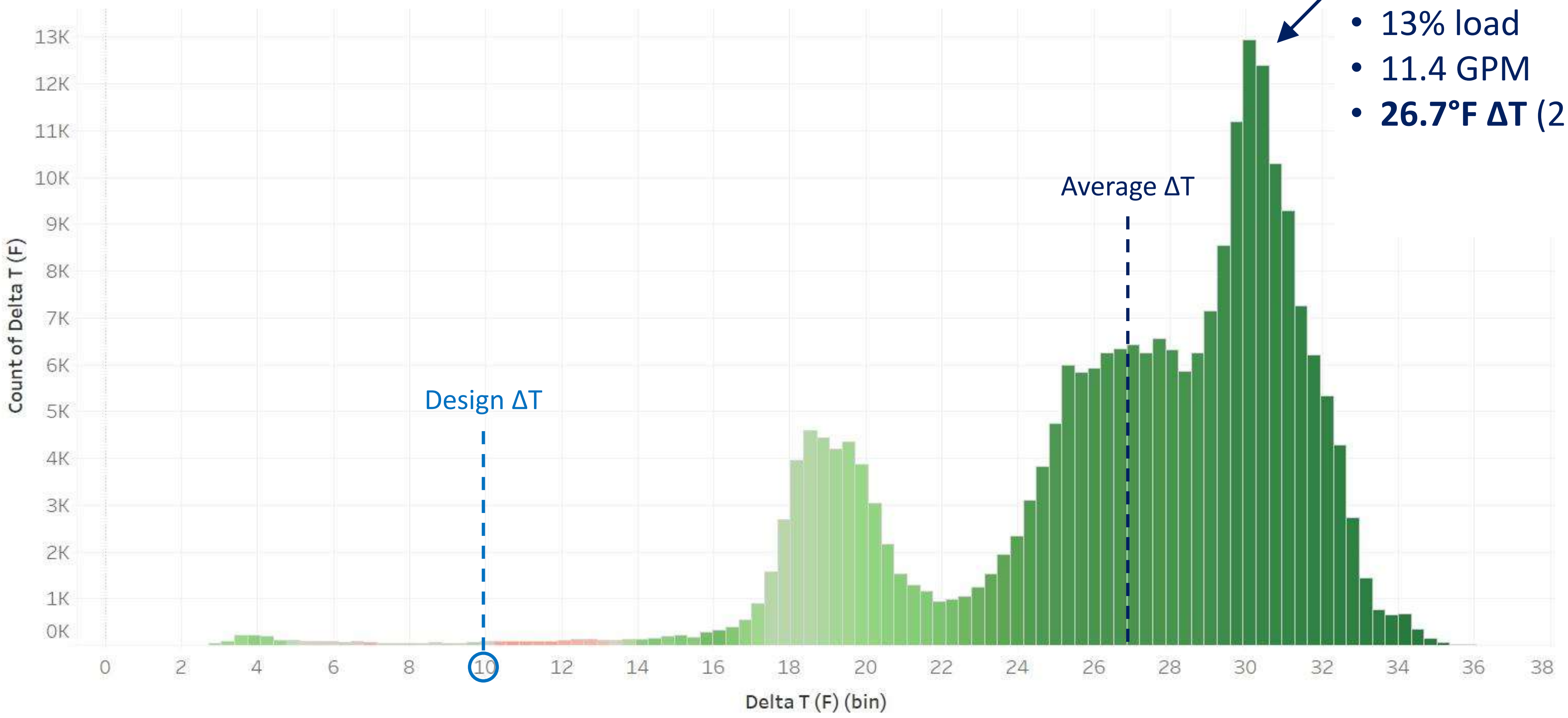
All conditions

- 55% load
- 29.9 GPM
- **32.4°F ΔT** (202%)

<u>Coil Design Details</u>

- Duarte, CA
- Research Lab
- 15,000 CFM
- 47% O.A. Min.
- 73 Tons
- 109 GPM
- 40/56°F CHW
- 16°F ΔT
- 48°F Coil LAT

Coil ΔT Profile – AZ College



Avg. Performance

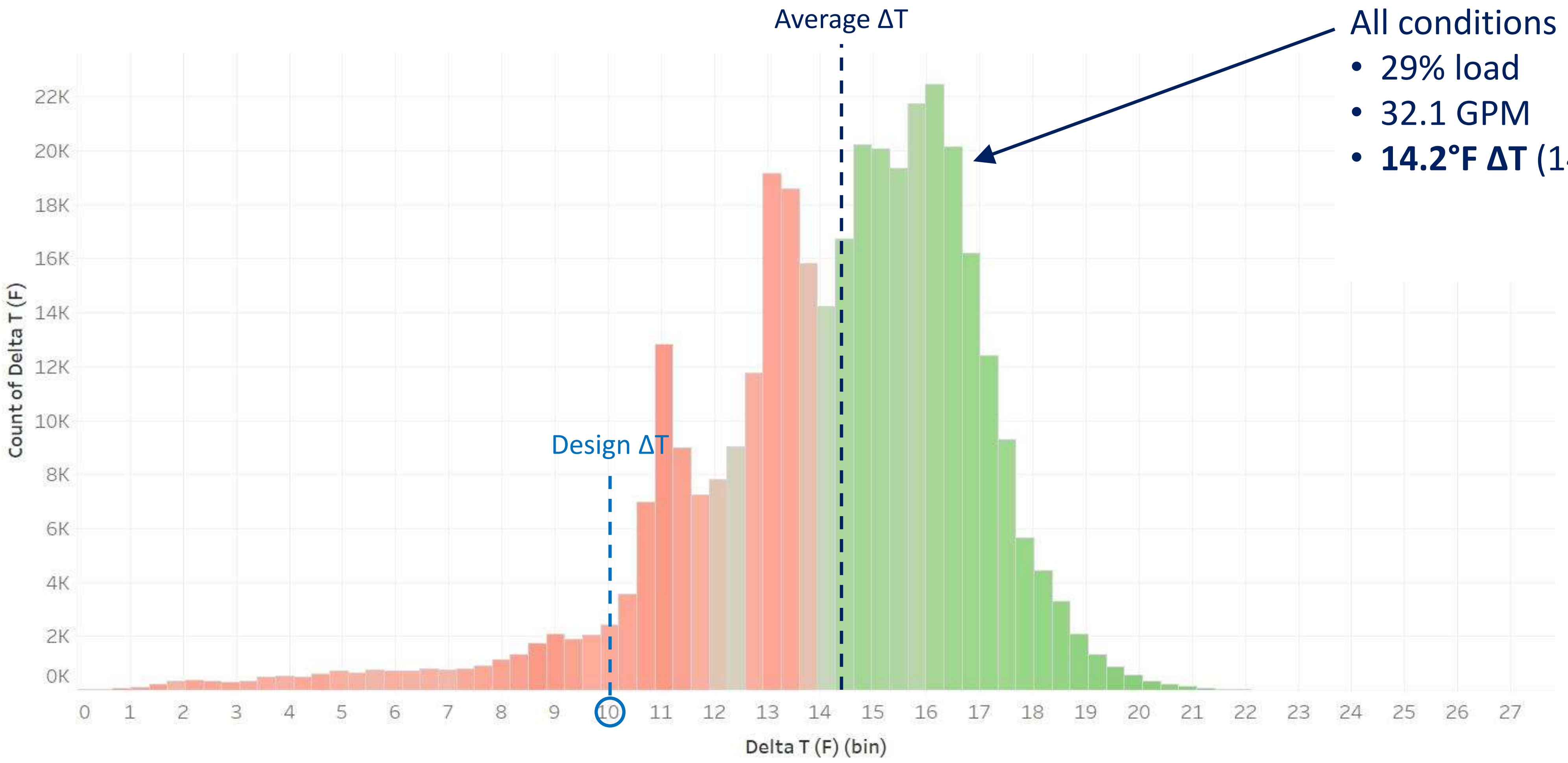
All conditions

- 13% load
- 11.4 GPM
- **26.7°F ΔT** (267%)

Coil Design Details

- Yuma, AZ
- Classroom
- 19,000 CFM
- 27% O.A. Min.
- 85.8 Tons
- 206 GPM
- 45/55°F CHW
- 10°F ΔT
- 51.1°F Coil LAT

Coil ΔT Profile – MO Dental School



Avg. Performance

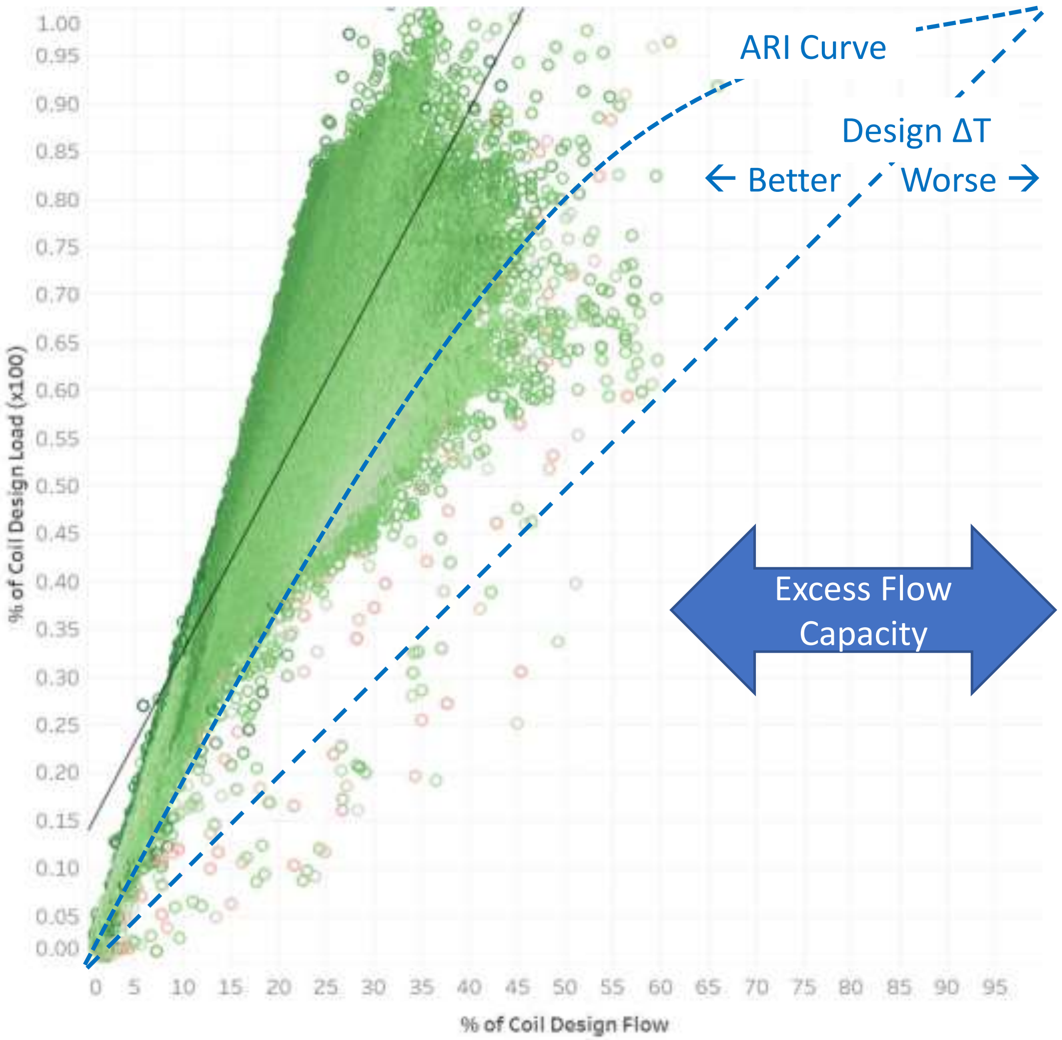
All conditions

- 29% load
- 32.1 GPM
- **14.2°F ΔT** (142%)

Coil Design Details

- Kansas City, MO
- Medical Office
- 15,510 CFM
- 33% O.A. Min.
- 62.1 Tons
- 149.1 GPM
- 45/55°F CHW
- 10°F ΔT
- 53.7°F Coil LAT

Coil Performance – Load vs. Flow

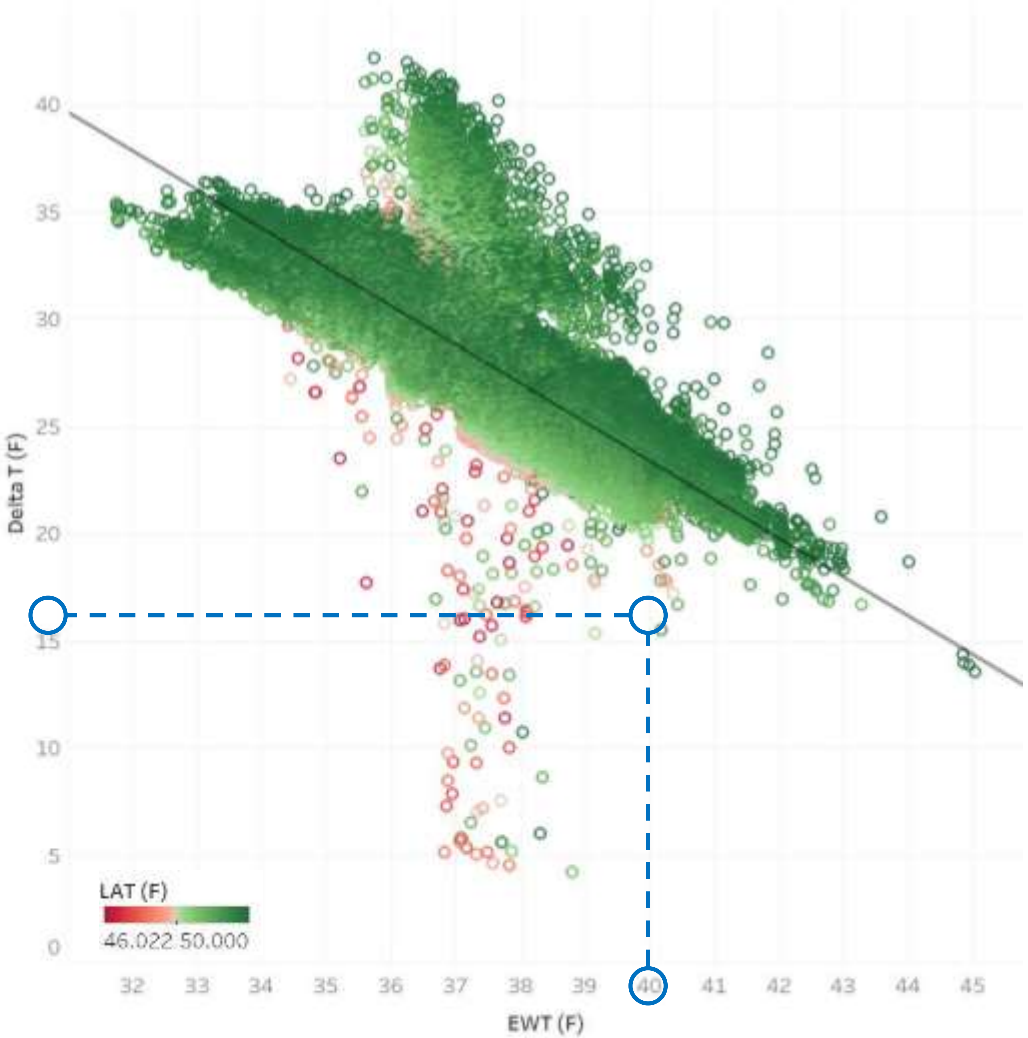


- % of coil max load & flow
- Coil effectiveness under the current operating conditions

- Is it oversized?
- How is it performing better than the coil characteristic?

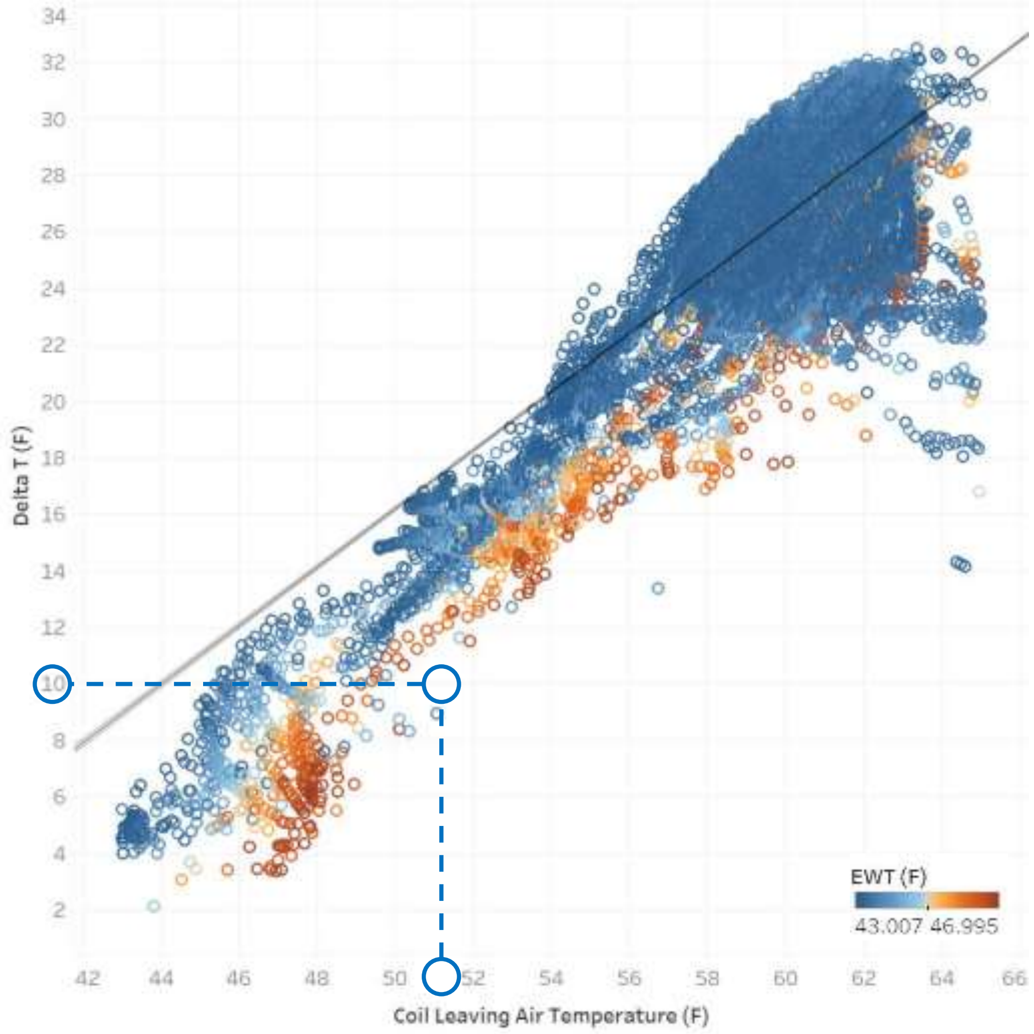
Coil Performance Influencers - Water

- Entering water temperature
  - 1°F EWT drop, ~0.33°F LWT increase
- Flow stability
  - Heat transfer improves when flow rate is consistent
  - Higher delta T coil designs are more sensitive to changes

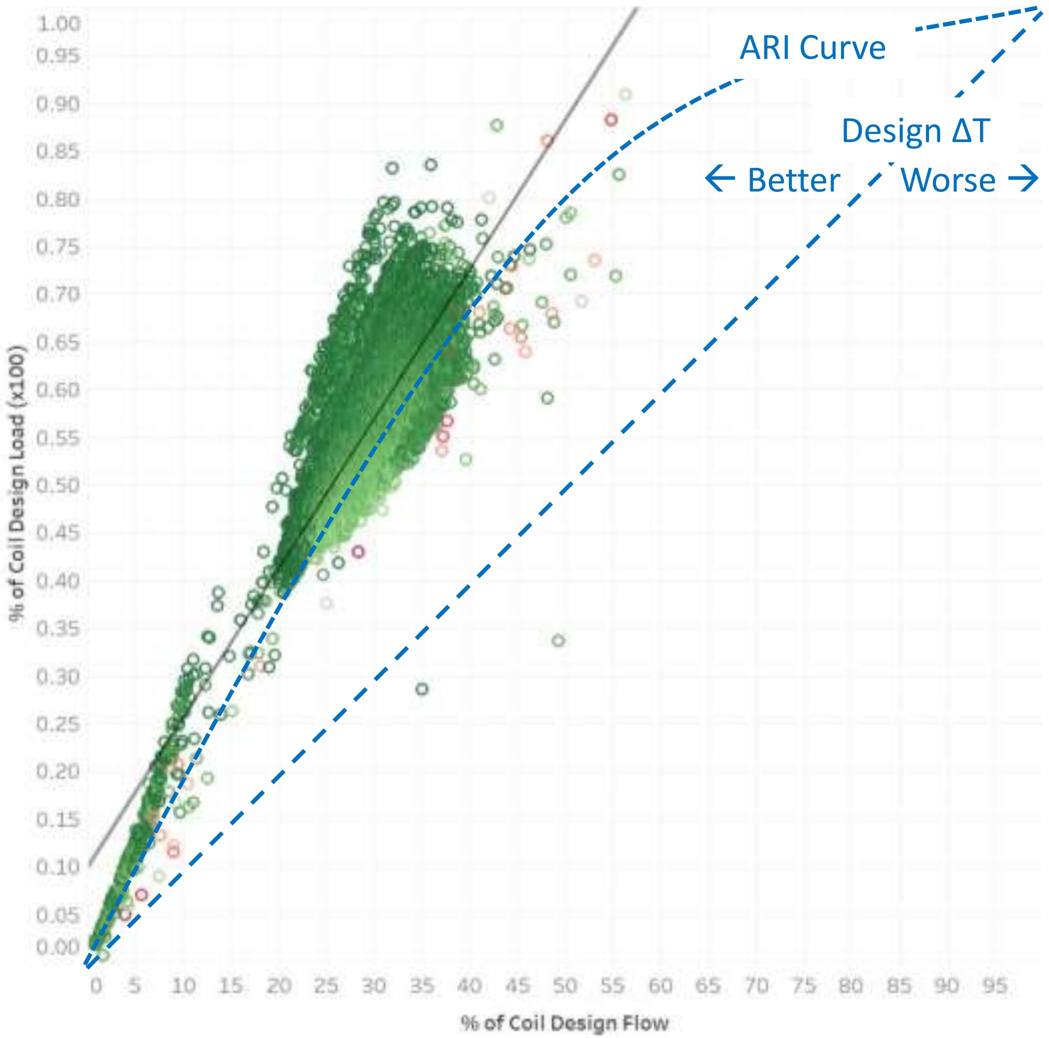


Coil Performance Influencers - Air

- Leaving Air Temperature
  - 1°F LAT increase, ~1°F LWT increase
  - Higher delta T coil designs are more sensitive to changes
- Airflow volume & velocity
- Blow-thru vs. draw thru
- Outside air %



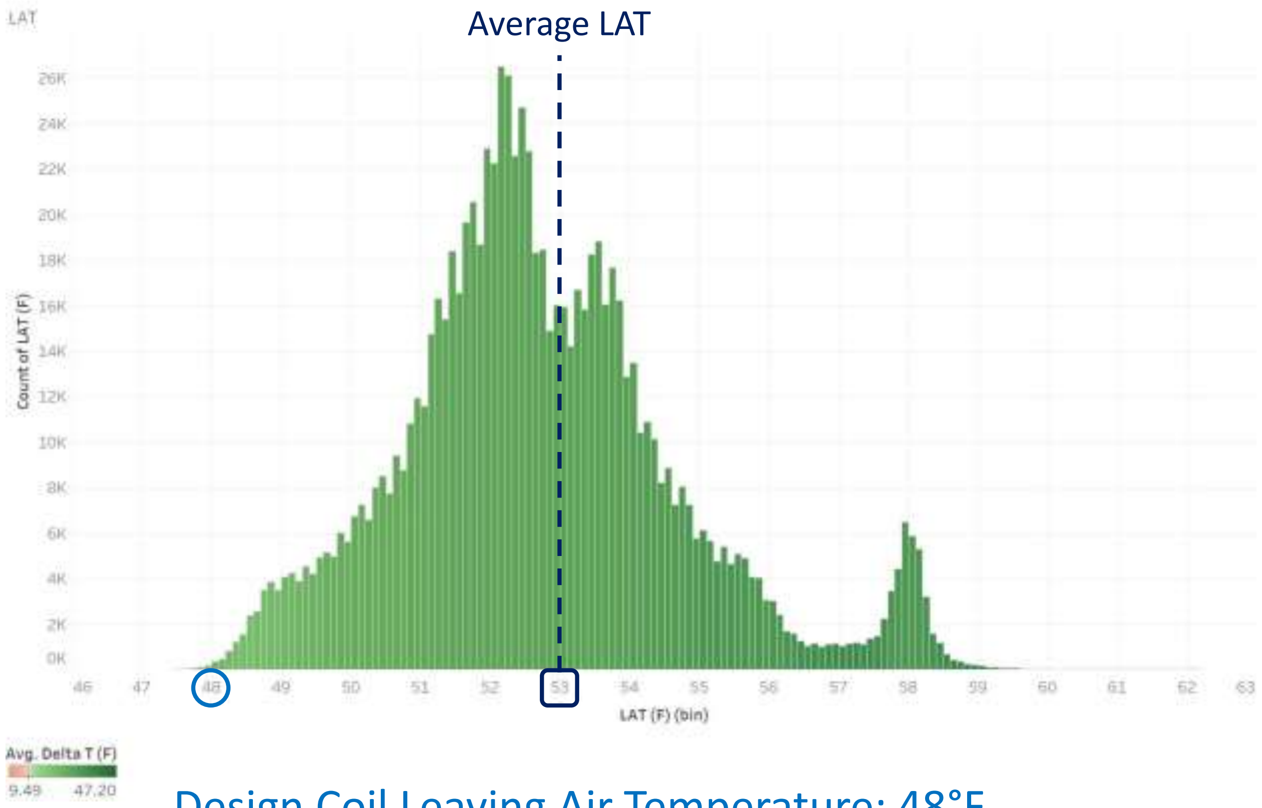
Coil Performance – Load vs. Flow

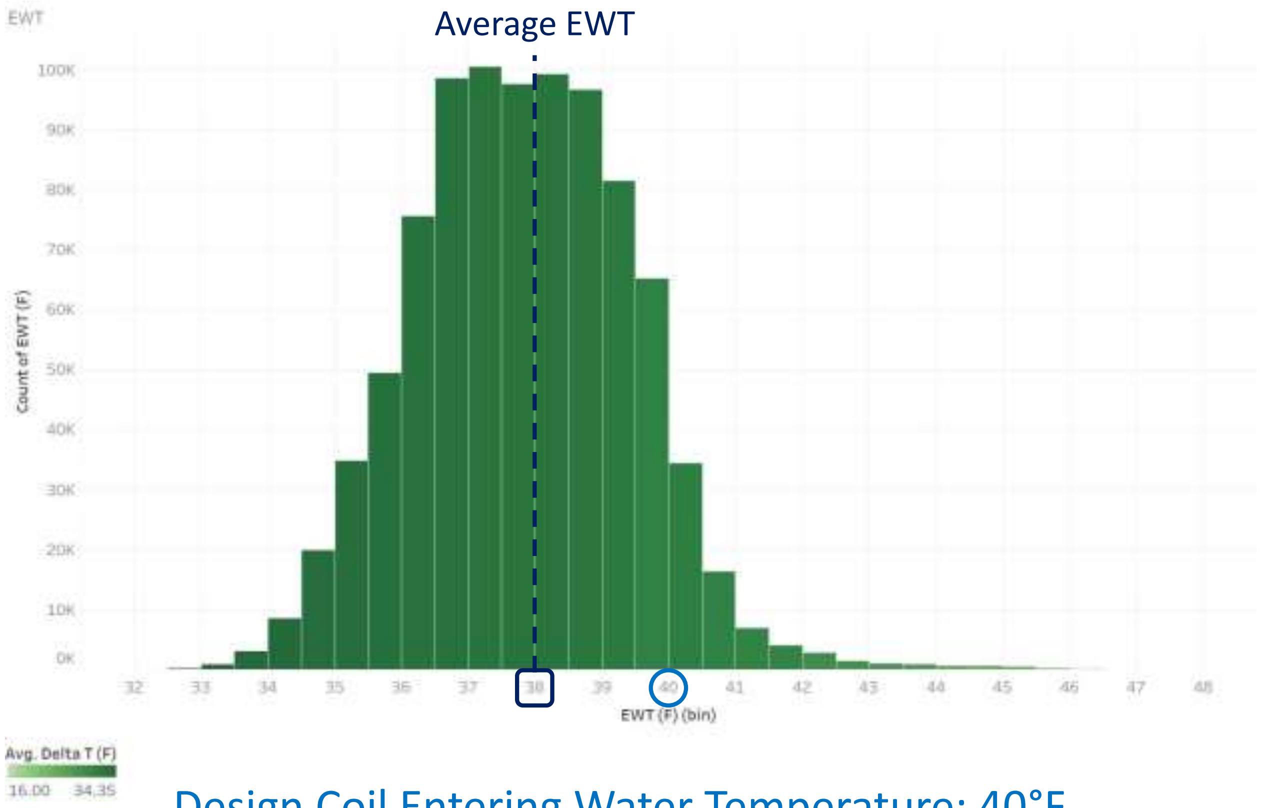


- Only conditions where entering water temp. and leaving air temp. are within ±2°F of the coil design

- Less run time, but still exceeds design conditions

Operating Conditions – LAT & EWT





Design Coil Leaving Air Temperature: 48°F
Average Leaving Air Temperature: 53°F

Design Coil Entering Water Temperature: 40°F
Average Entering Water Temperature: 38°F

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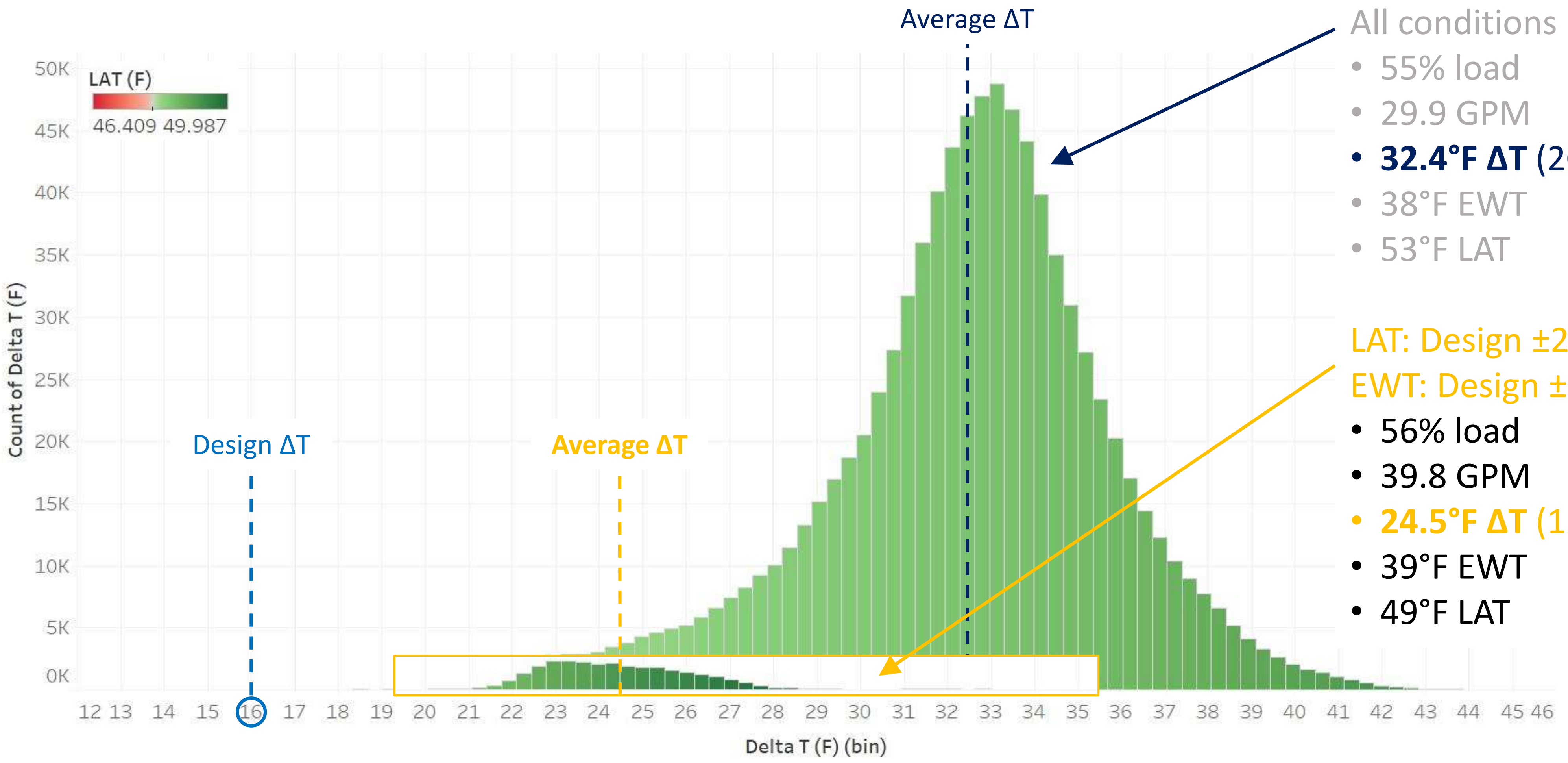
Coil ΔT Profile – CA Hospital



Avg. Performance

All conditions

- 55% load
- 29.9 GPM
- **32.4°F ΔT** (202%)
- 38°F EWT
- 53°F LAT

LAT: Design ±2°F

EWT: Design ±2°F

- 56% load
- 39.8 GPM
- **24.5°F ΔT** (153%)
- 39°F EWT
- 49°F LAT

Coil Design Details

- Duarte, CA
- Research Lab
- 15,000 CFM
- 47% O.A. Min.
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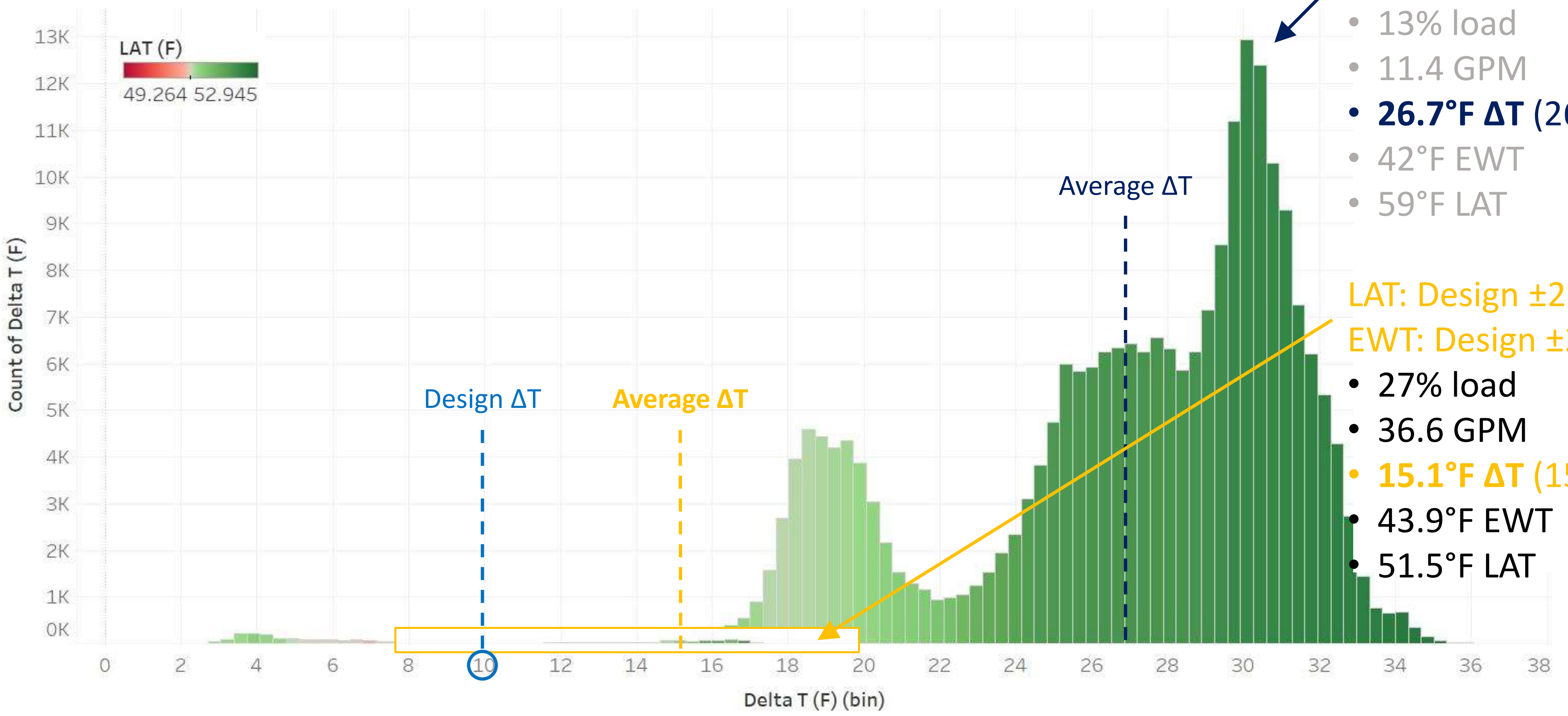
Coil ΔT Profile – AZ College



Avg. Performance

All conditions

- 13% load
- 11.4 GPM
- **26.7°F ΔT** (267%)
- 42°F EWT
- 59°F LAT

LAT: Design ±2°F

EWT: Design ±2°F

- 27% load
- 36.6 GPM
- **15.1°F ΔT** (151%)
- 43.9°F EWT
- 51.5°F LAT

Coil Design Details

- Yuma, AZ
- Classroom
- 19,000 CFM
- 27% O.A. Min.
- 85.8 Tons
- 206 GPM
- 45/55°F CHW
- 10°F ΔT
- 51.1°F Coil LAT

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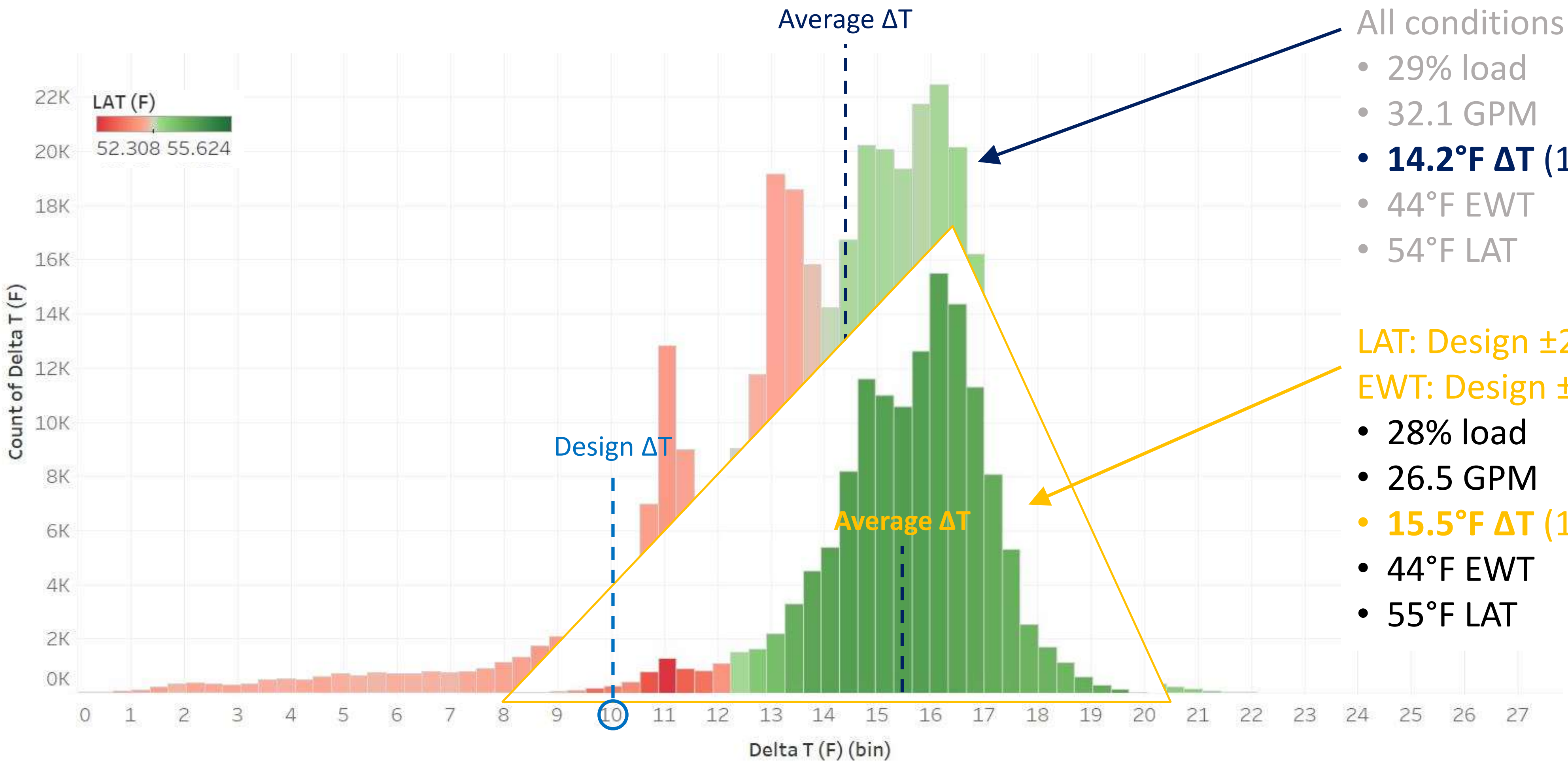

Avg. Performance

All conditions

- 29% load
- 32.1 GPM
- **14.2°F ΔT** (142%)
- 44°F EWT
- 54°F LAT

LAT: Design ±2°F

EWT: Design ±2°F

- 28% load
- 26.5 GPM
- **15.5°F ΔT** (155%)
- 44°F EWT
- 55°F LAT

Coil Design Details

- Kansas City, MO
- Medical Office
- 15,510 CFM
- 33% O.A. Min.
- 62.1 Tons
- 149.1 GPM
- 45/55°F CHW
- 10°F ΔT
- 53.7°F Coil LAT

Findings & Results

- Most coils are oversized
- 20-25% recovery of stranded capacity permitted new construction on the campuses *without* adding chillers
- Colder supply water enabled hospital expansion without increasing infrastructure, while now running fewer pumps
- Performance is used as an early warning of comfort or energy issues

Summary

- Coils should exceed design ΔT, regardless of location or service
- Set part load coil performance targets – design is for design!
- Data from within the distribution system is valuable for troubleshooting, operation and design, when in context
- Use stable control with data to evaluate "smart" resets
- Coil heat transfer drives the system

Q&A // THANK YOU

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