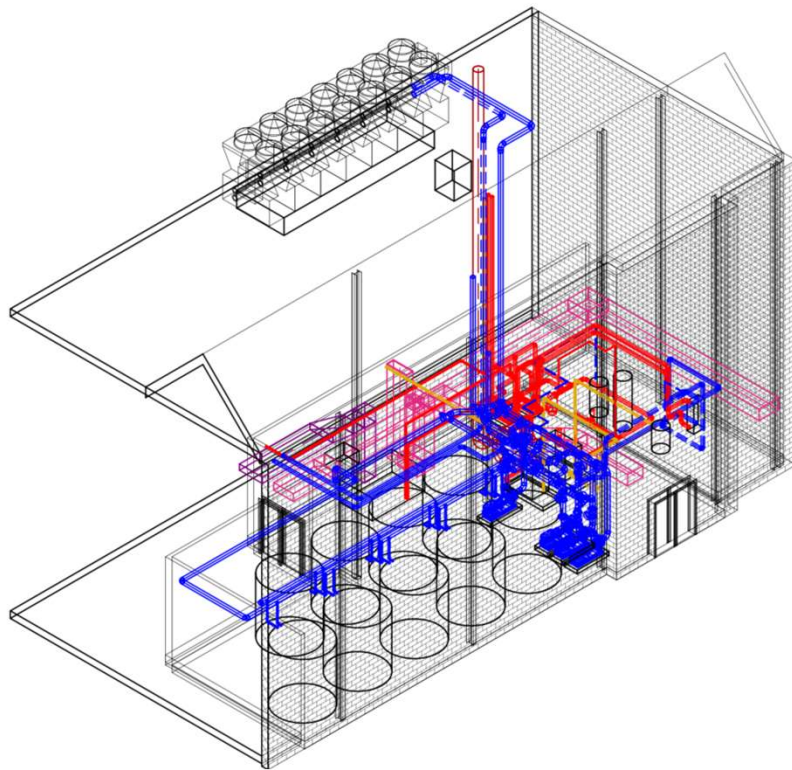


# Heating with Lower Temperature Hot Water



AEE NEW ENGLAND TECHNICAL  
ROUNDTABLE

NOVEMBER 6, 2024

# Agenda

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- *Motivating question*
- *Why is everything designed for 180 °F?*
- *How much do we lose at lower temperatures?*
- *Options for mitigation*
- *Recommended process*

# Quiz Question

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- If you have a building with an existing hydronic heating system designed for 180 ° F supply, how much of the building's heating load could you service with 140 °F from hot water heat pumps?
  - A. 68%
  - B. 72%
  - C. 81%
  - D. 93%
  - E. **It depends...**

# Where did 180 °F standard come from?

400 °F exhaust temperature

3,500 °F flame temperature



# Where did 180 °F standard come from?

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- Very high temperature heat source, difficult to control to lower water temperatures/turndown
- Maximize available heat in working fluid
- Maintain safe margin from water boiling temperature
- Limited benefit to reducing water temperature (i.e. pre-condensing boiler era)
- Potential risk of damaging boiler with low water temperature
- Bigger temperature differential → Lower flows and less **FIRST** cost

# Changing Heating Sources

## COMBUSTION – HIGH EXERGY

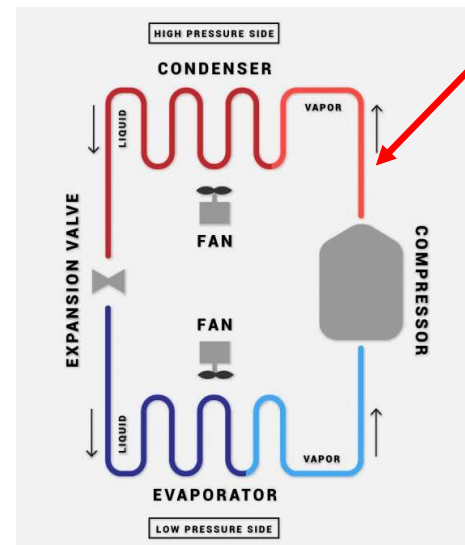
Very high relative source temperatures, not being utilized to their fullest, opportunity for improvement



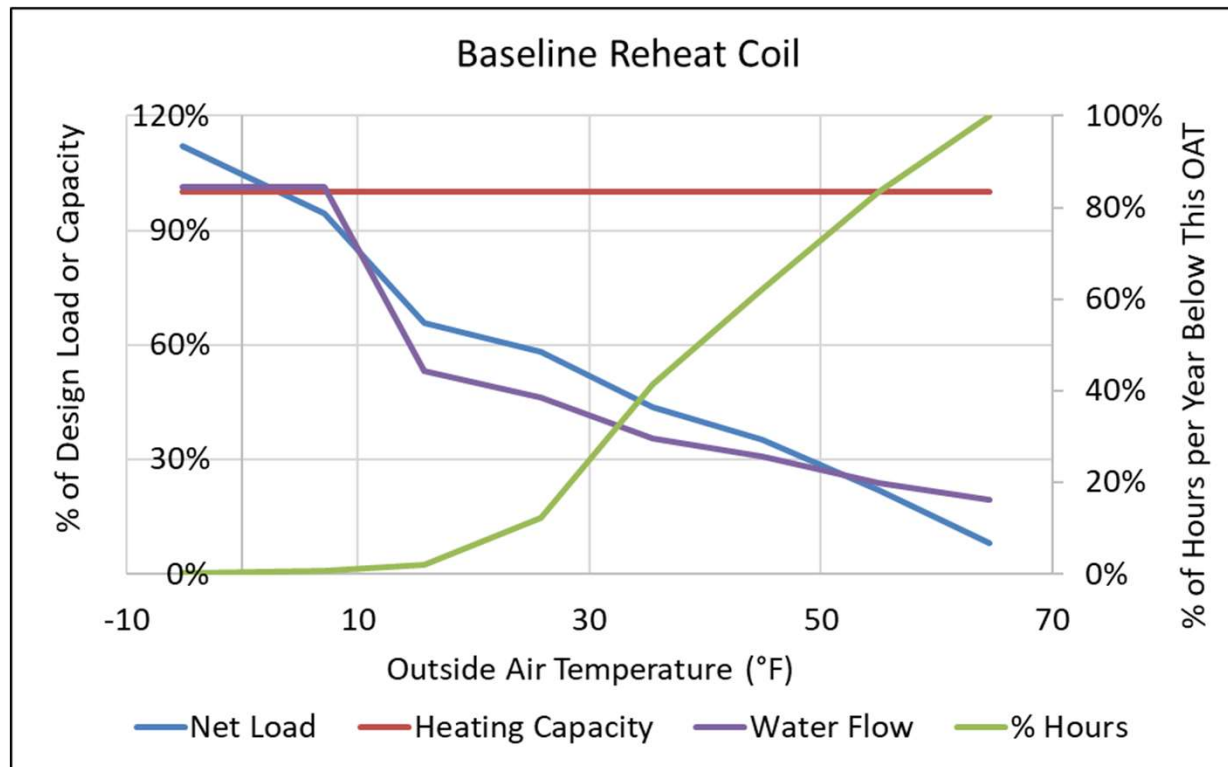
## VAPOR COMPRESSION – LOWER EXERGY

Make only the heat you need

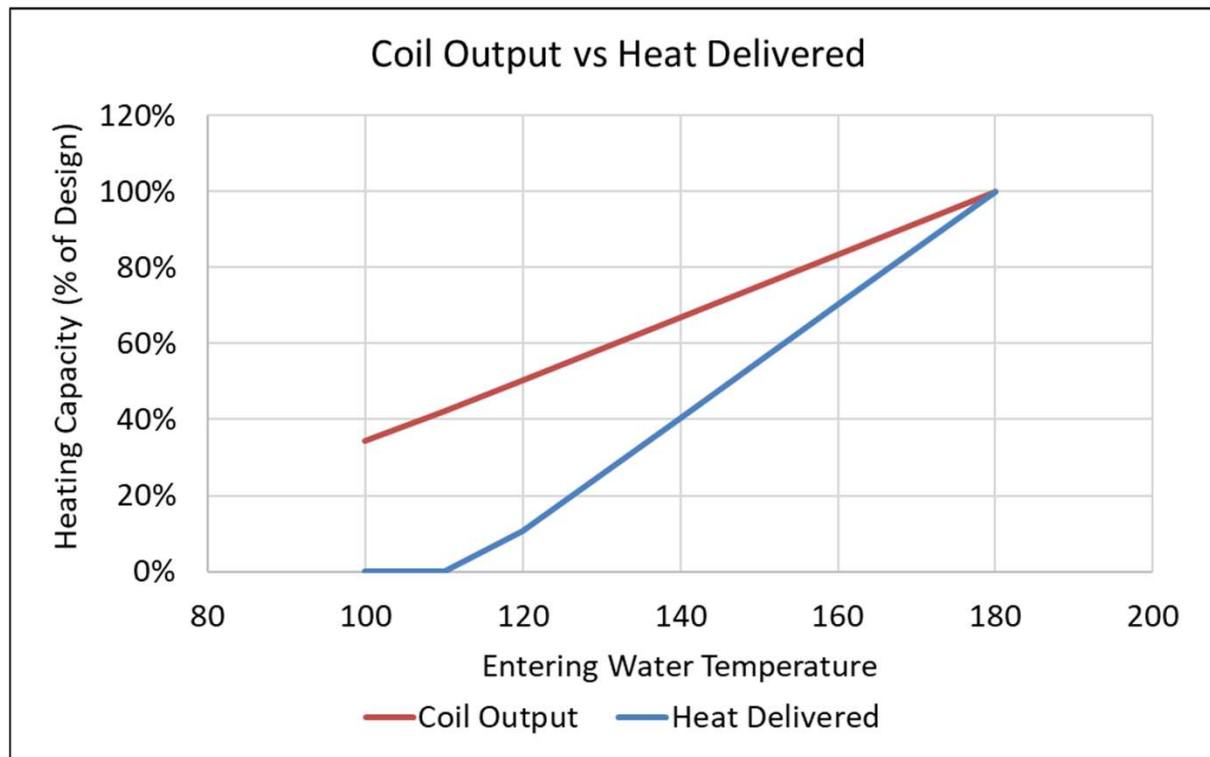
Highest temperature point



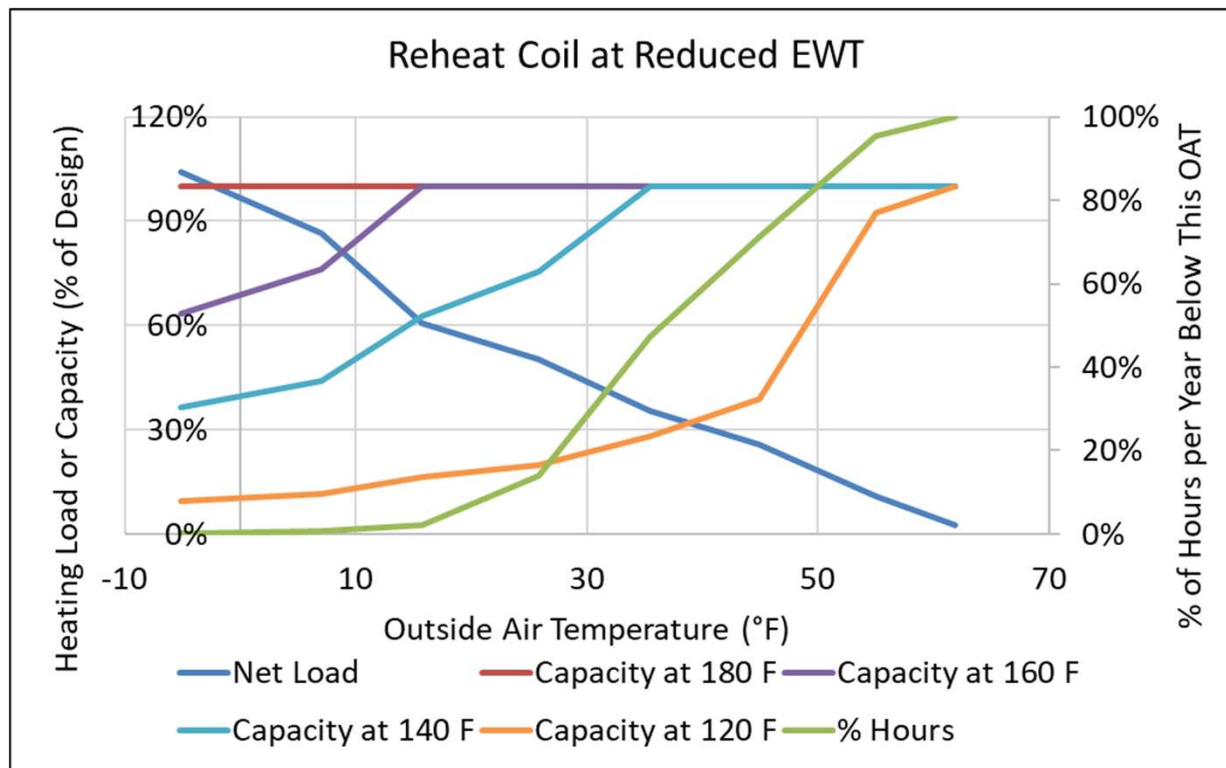
# Example Baseline Coil



# Coil Capacity Isn't the Whole Story



# Example Baseline Coil

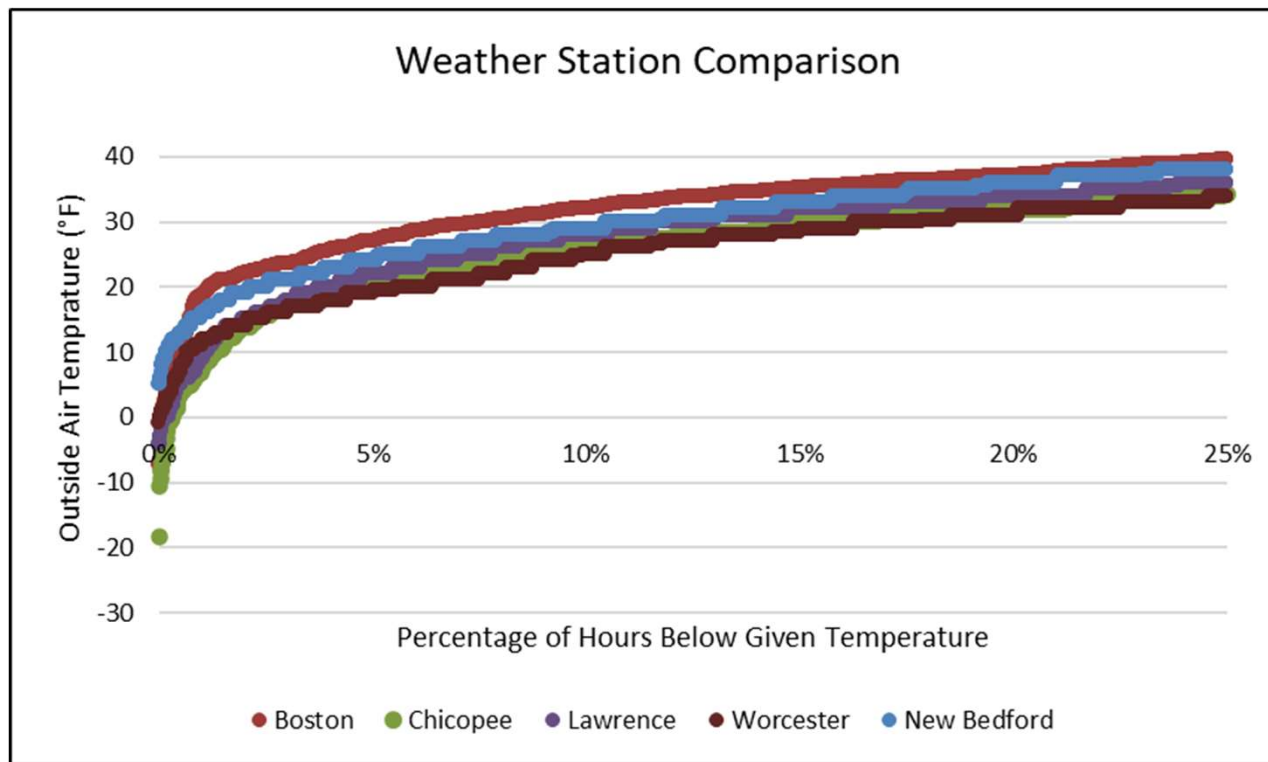


Back to the Quiz Question – what does  
“it” depend on?

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Where You Are

# Where you are



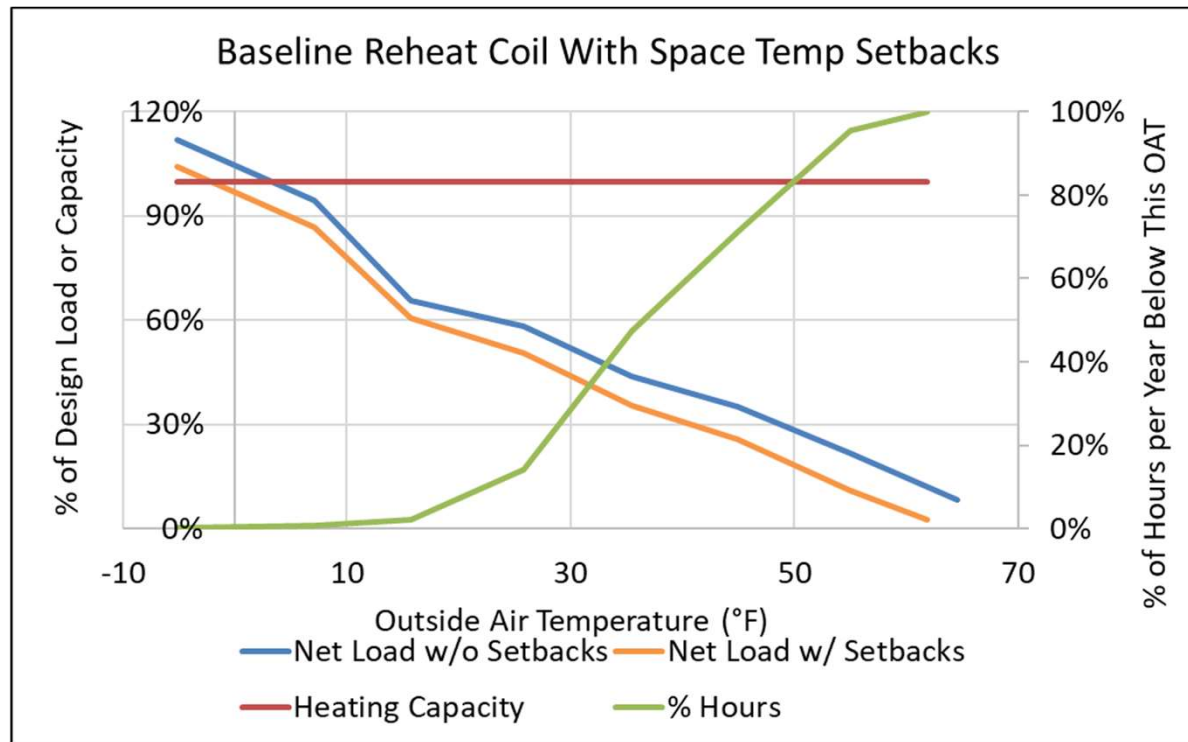
# What does “it” depend on?

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Where You Are

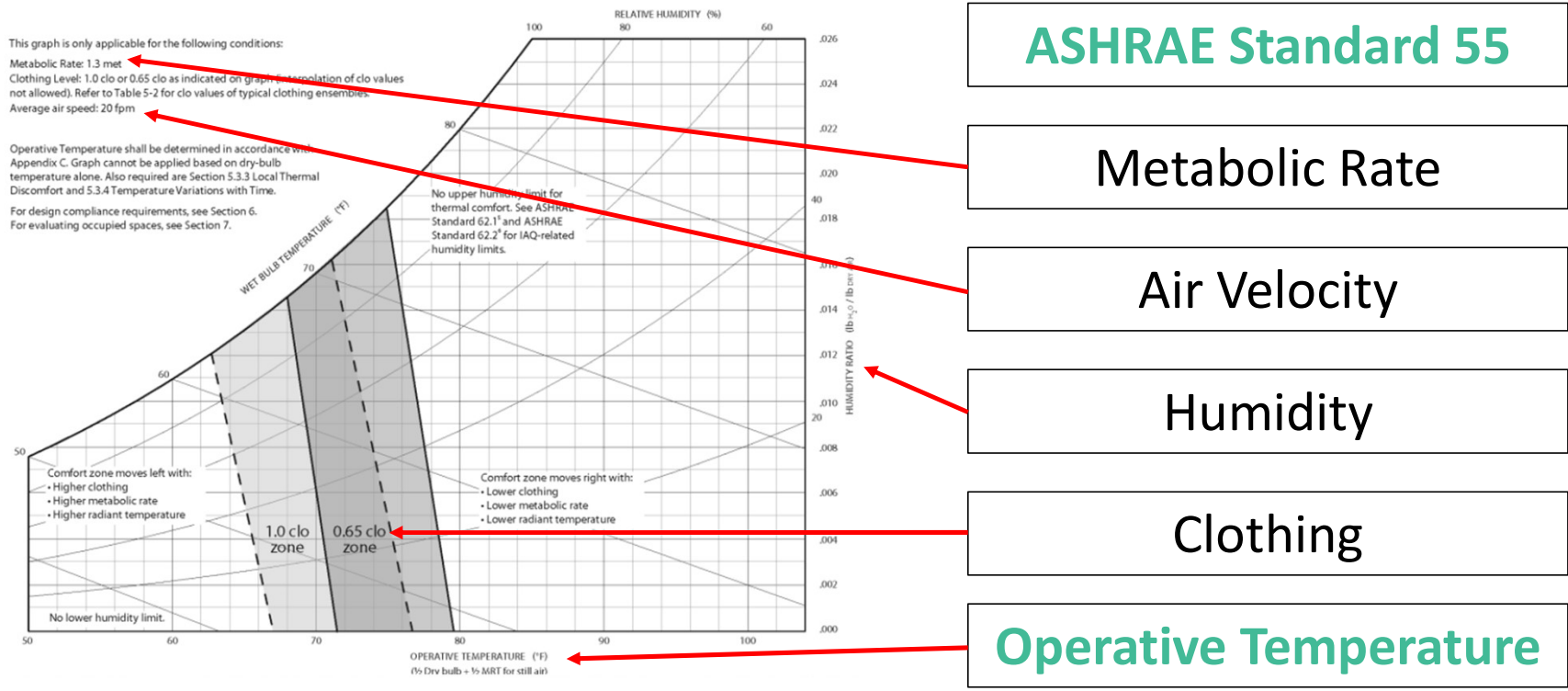
Space Temperature

# Set the Thermostat as Low as You Can



...And 13%  
reduction in  
hours where heat  
is needed at all

# Thermal comfort – what’s the right thermostat setting?



ASHRAE Standard 55

Metabolic Rate

Air Velocity

Humidity

Clothing

Operative Temperature

# What does “it” depend on?

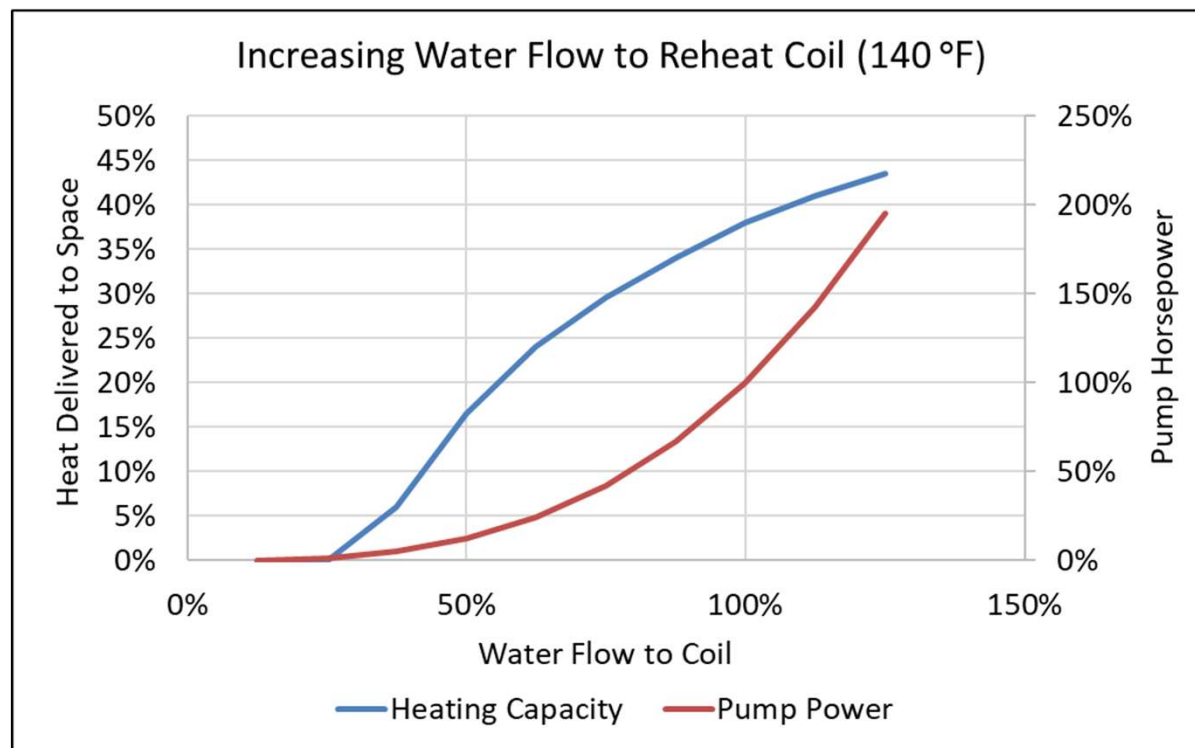
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Where You Are

Space Temperature

Water Flow Rate

# Just pump more water



Diminishing returns for the coil, but not necessarily for the piping

# What does “it” depend on?

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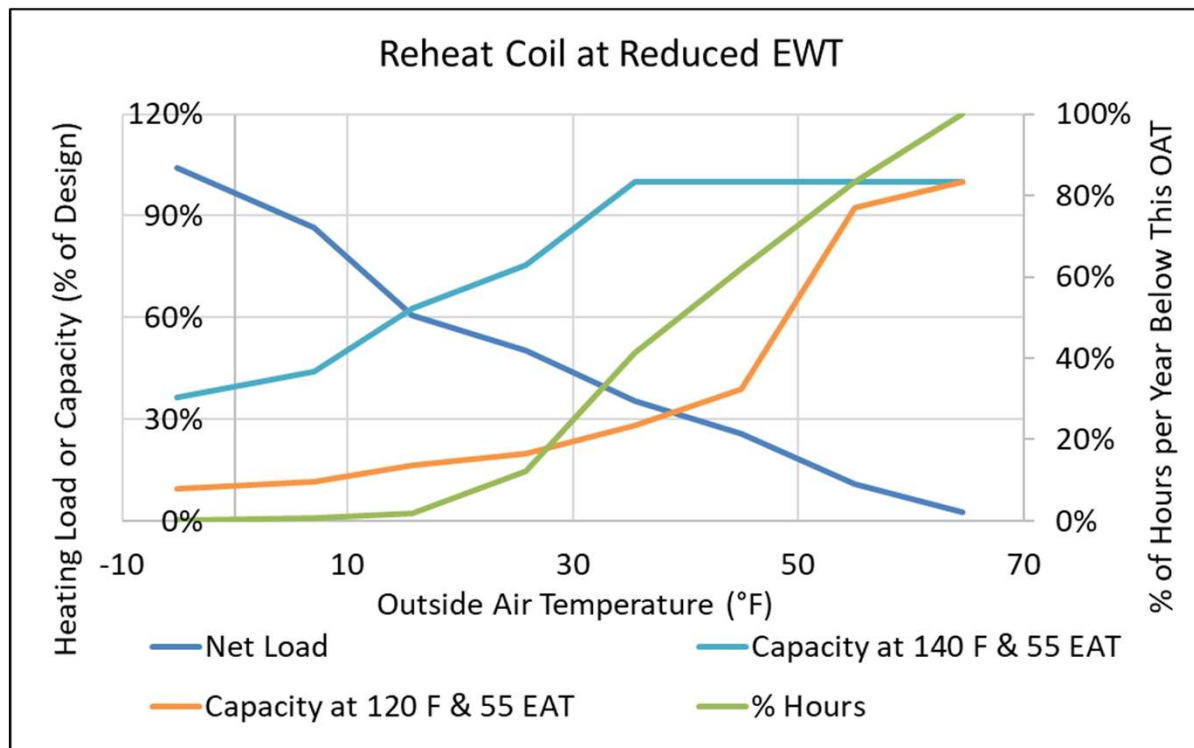
Where You Are

Space Temperature

Water Flow Rate

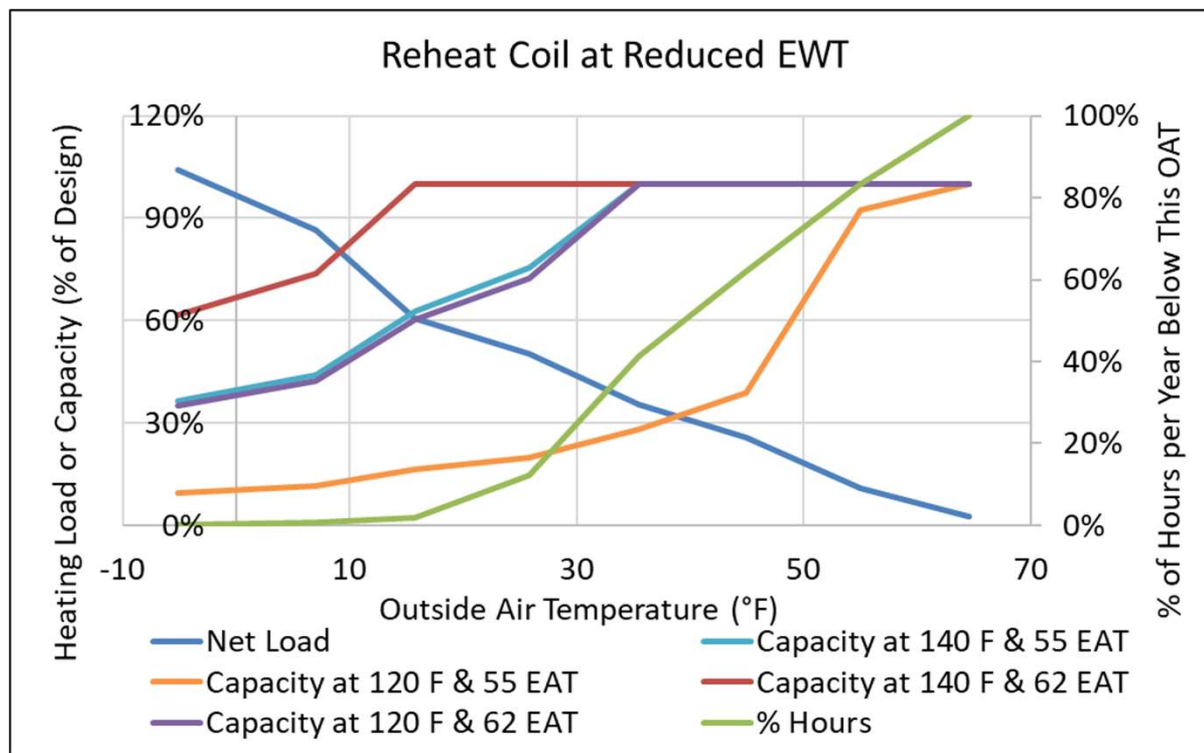
Entering Air Temp

# Discharge air temperature reset



Trim and respond logic – ASHRAE Guideline 36 High Performance Sequences of Operation

# Discharge air temperature reset



Trim and respond  
logic – ASHRAE  
Guideline 36 High  
Performance  
Sequences of  
Operation

# What does “it” depend on?

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Where You Are

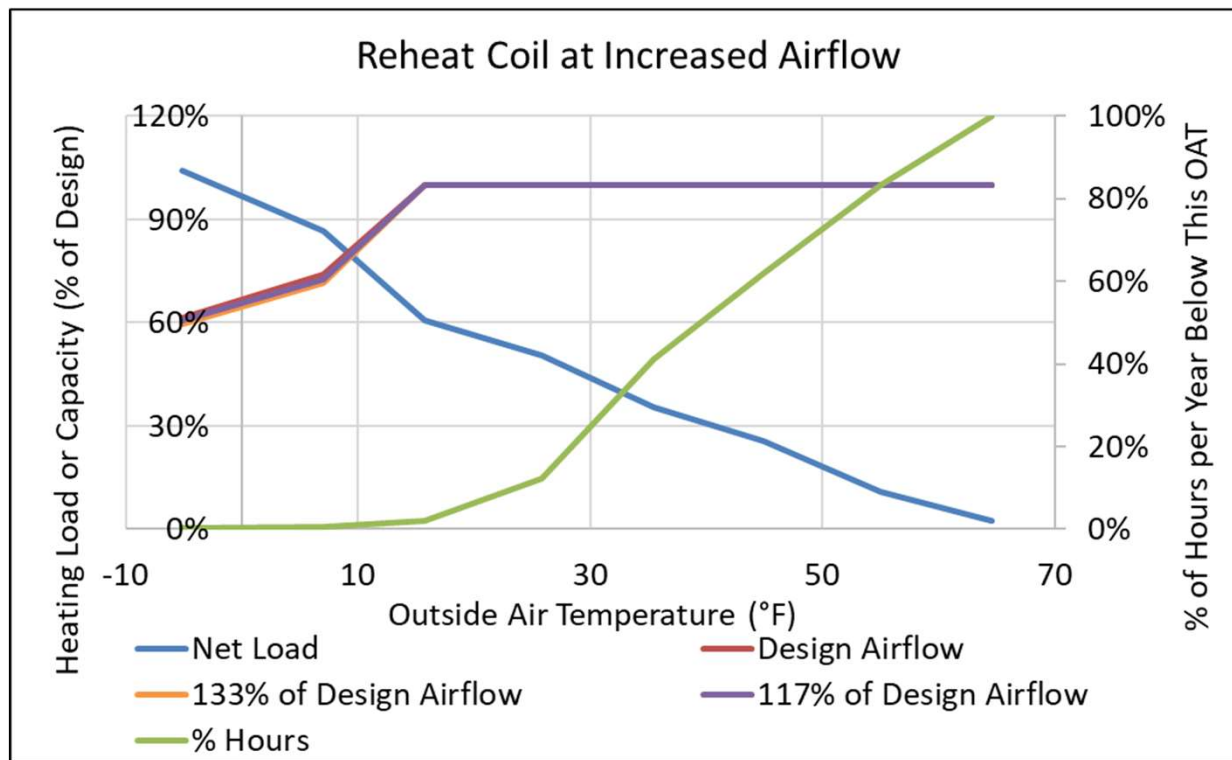
Air Flow Rate

Space Temperature

Water Flow Rate

Entering Air Temp

# Just pump more air



Counterproductive  
– especially when  
you take into  
account comfort  
effect of increased  
velocity

# What does “it” depend on?

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Where You Are

Air Flow Rate

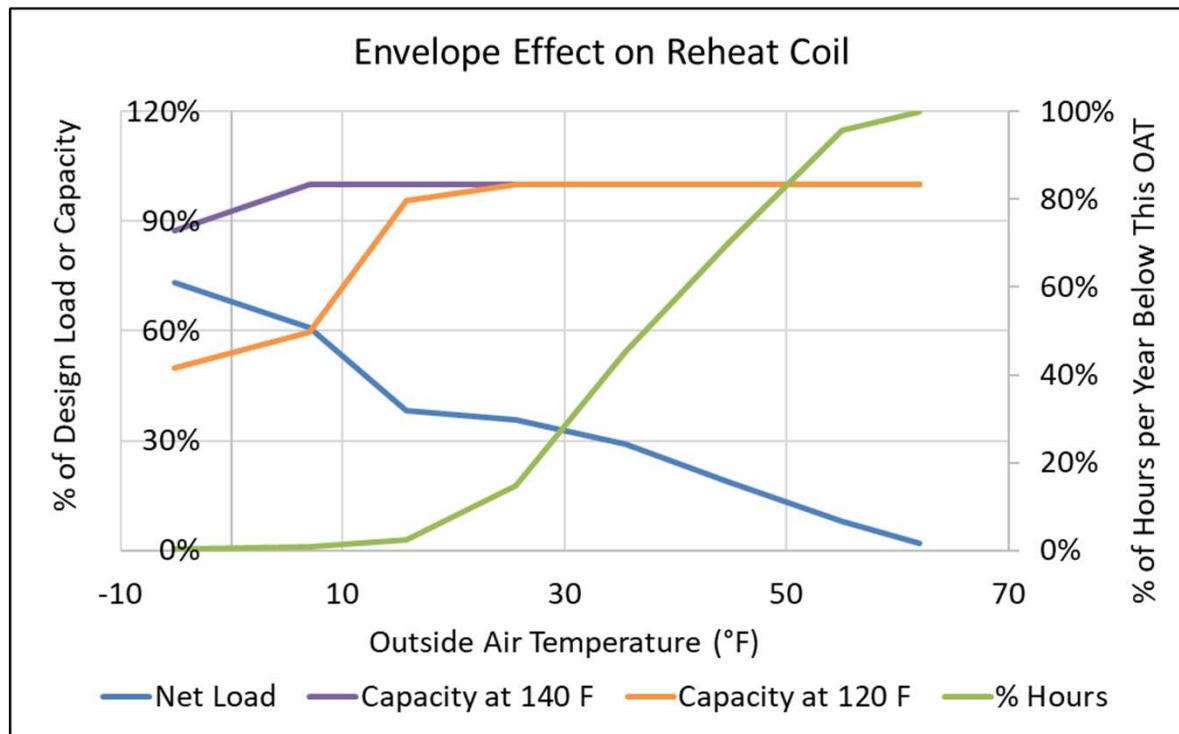
Space Temperature

Building Envelope

Water Flow Rate

Entering Air Temp

# Keep the heat in the building



- 25% reduction in infiltration from air-sealing
- Window inserts
- Roof/attic insulation

Helps both load and capacity ends of the equation...

Another 10% reduction in run hours

# What does “it” depend on?

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Where You Are

Air Flow Rate

Space Temperature

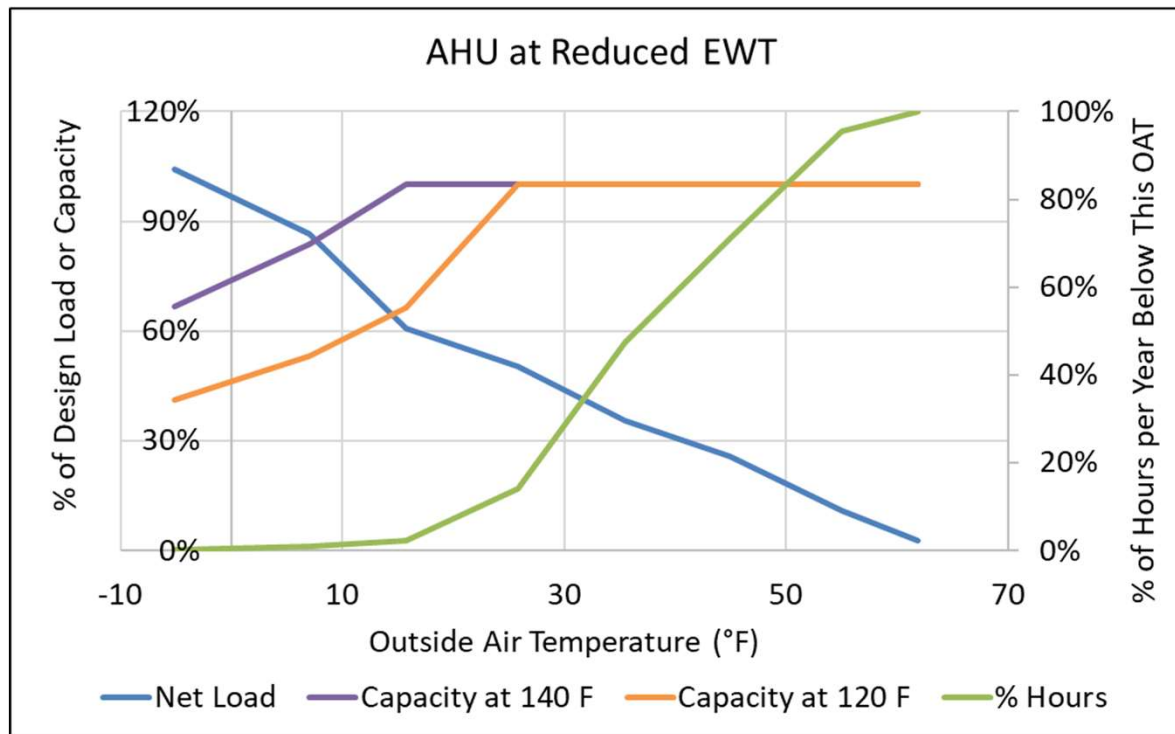
Building Envelope

Water Flow Rate

System Type

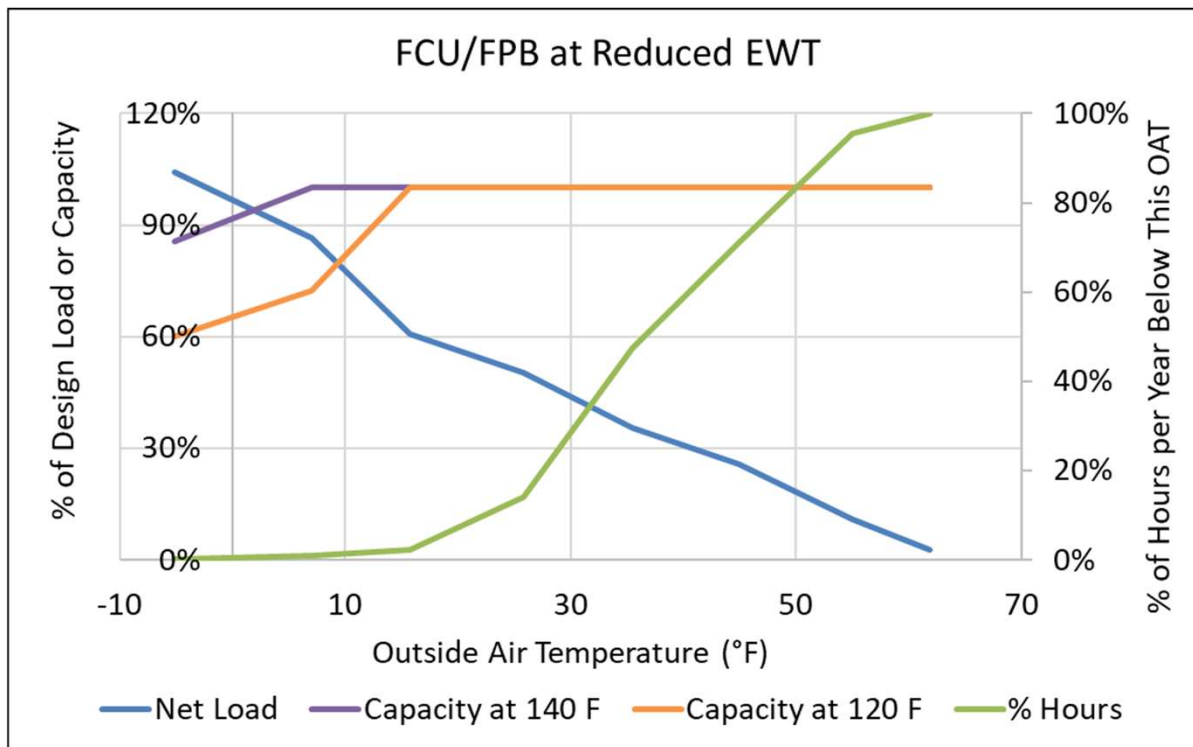
Entering Air Temp

# What if it's an AHU instead?



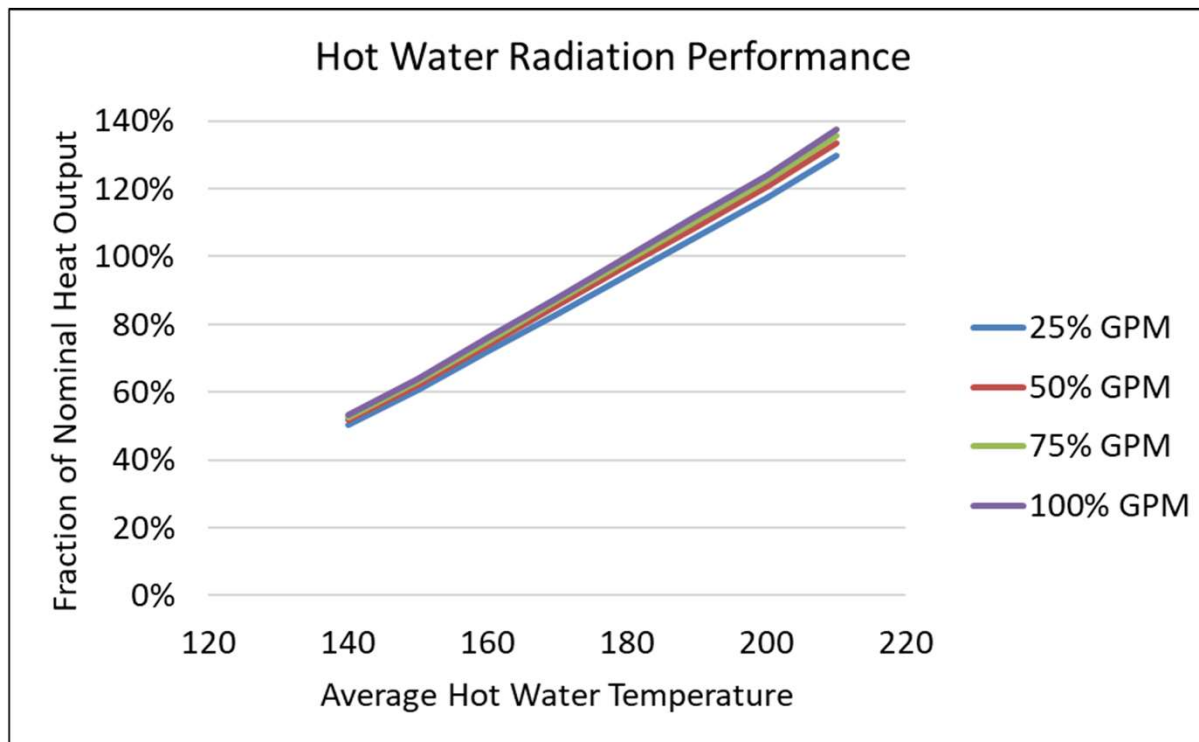
- Coil handles both ventilation and space loads
- Lower entering air temp at colder OAT
- But maybe don't need OA for coldest hours...

# What if it's an FCU instead?



- Like the AHU, but higher/fixed ventilation air temp (make sure to have **DAT reset on DOAS**)
- May be able to shut off ventilation during coldest hours

# What if it's a radiation instead?



- Water flow rate makes negligible difference
- Prioritize water flow to convection heaters if you have a choice

# What does “it” depend on?

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Where You Are

Air Flow Rate

Space Temperature

Building Envelope

Water Flow Rate

System Type

Entering Air Temp

Other

# Other factors to consider

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Presence of (or need to add) glycol

Building air balance

Coil cleaning & filtration

Electric demand management

# Key Takeaways

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- Unfortunately, no rules of thumb. Need to do the math on every project.
- Don't just go off the original drawings. Check the performance data on what was actually installed vs. the loads you calculate.
- Data beats no data – measure, meter, and test.
- Talk with the Owner about their priorities among:
  - First cost
  - Operating costs
  - Degree of carbon reduction
  - Openness to invasive construction and/or exposed utilities



Thank You!

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B2Q Associates  
Andover, MA