BUILDINGENERGY BOSTON

AIA Provider: Northeast Sustainable Energy Association

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The True Performance of Your Hidden HVAC Equipment

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Vermont
Energy Investment
Corporation

CLEAResult

Course Description

How well does central ventilation equipment actually perform? VEIC and CLEAResult have respectively conducted field monitoring of Roof Top Units in commercial/institutional buildings and central Energy Recovery Ventilators in multifamily buildings. The outcomes? Although in some cases not as bad as one would predict, this equipment is often underperforming, neglected, misunderstood, and installed and/or operated incorrectly. Come and learn more about our findings, how to improve current performance, and alternative design ideas to do it differently next time.

Learning Objectives

At the end of the this course, participants will be able to:

1. Understand basic operation and maintenance of packaged RTU equipment

2. Identify system design decisions that can improve ERV/HRV performance

3. Develop a roadmap to increase equipment performance and efficiency

4. Identify efficiency opportunities with existing equipment

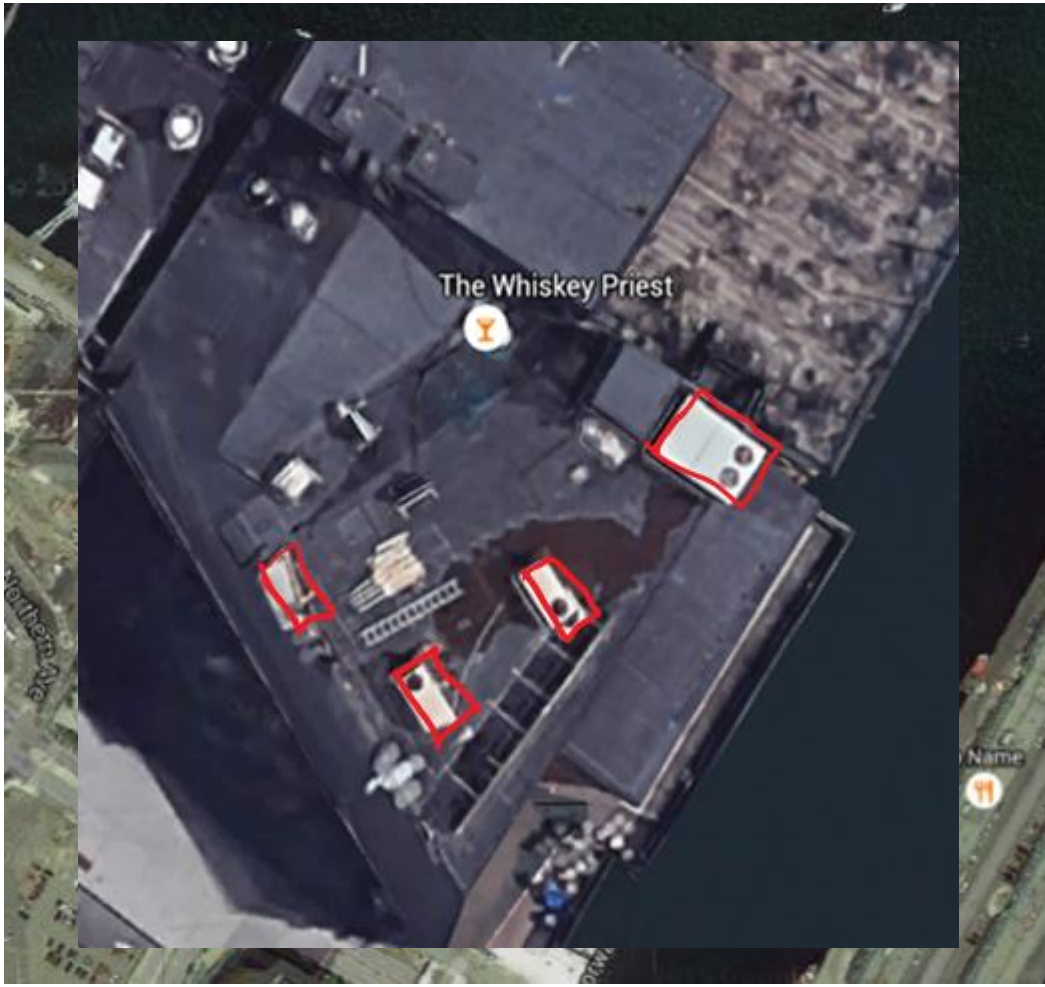
Outline

1. All about rooftop units (RTUs)?
2. Field results of RTU evaluation
3. Next steps in your facility

Vermont Energy Investment Corporation

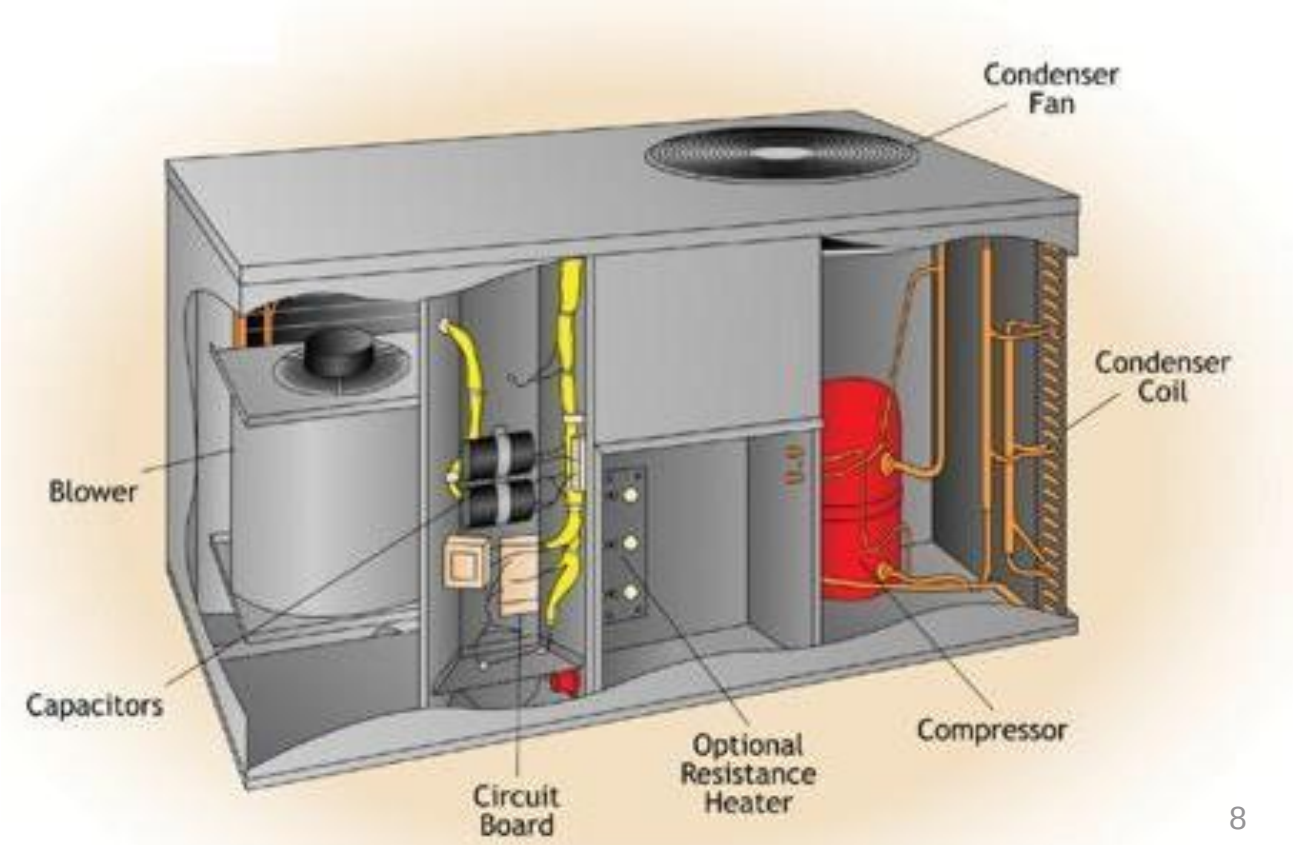
Why Use RTUs at All?

- Simplicity: You get everything you need
  (heating, cooling, ventilation)
- Ready supply
  (1-3 day turnaround time)
- Great option for leased space
- Low first-cost option



Key Energy Components

1. Compressor
2. Supply fan, condenser fan
3. Heating system
4. Economizer

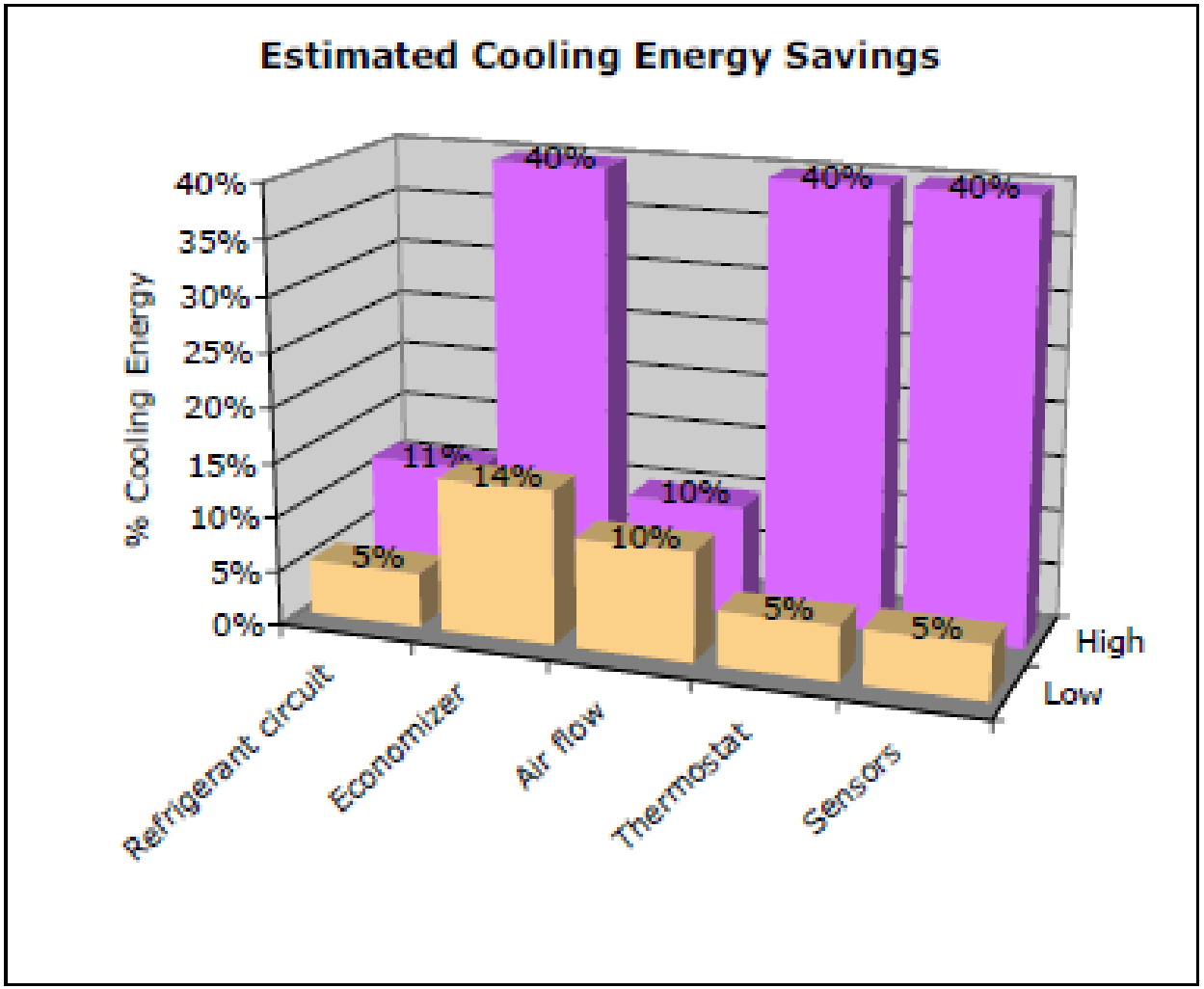


How RTUs Can Be Used in Your Building

- **Multifamily housing:** common areas, for ventilation supply and / or space tempering
- **Mixed-use buildings:** podium construction, for heating, cooling, and ventilation

National Findings: Field Study of 500+ RTUs

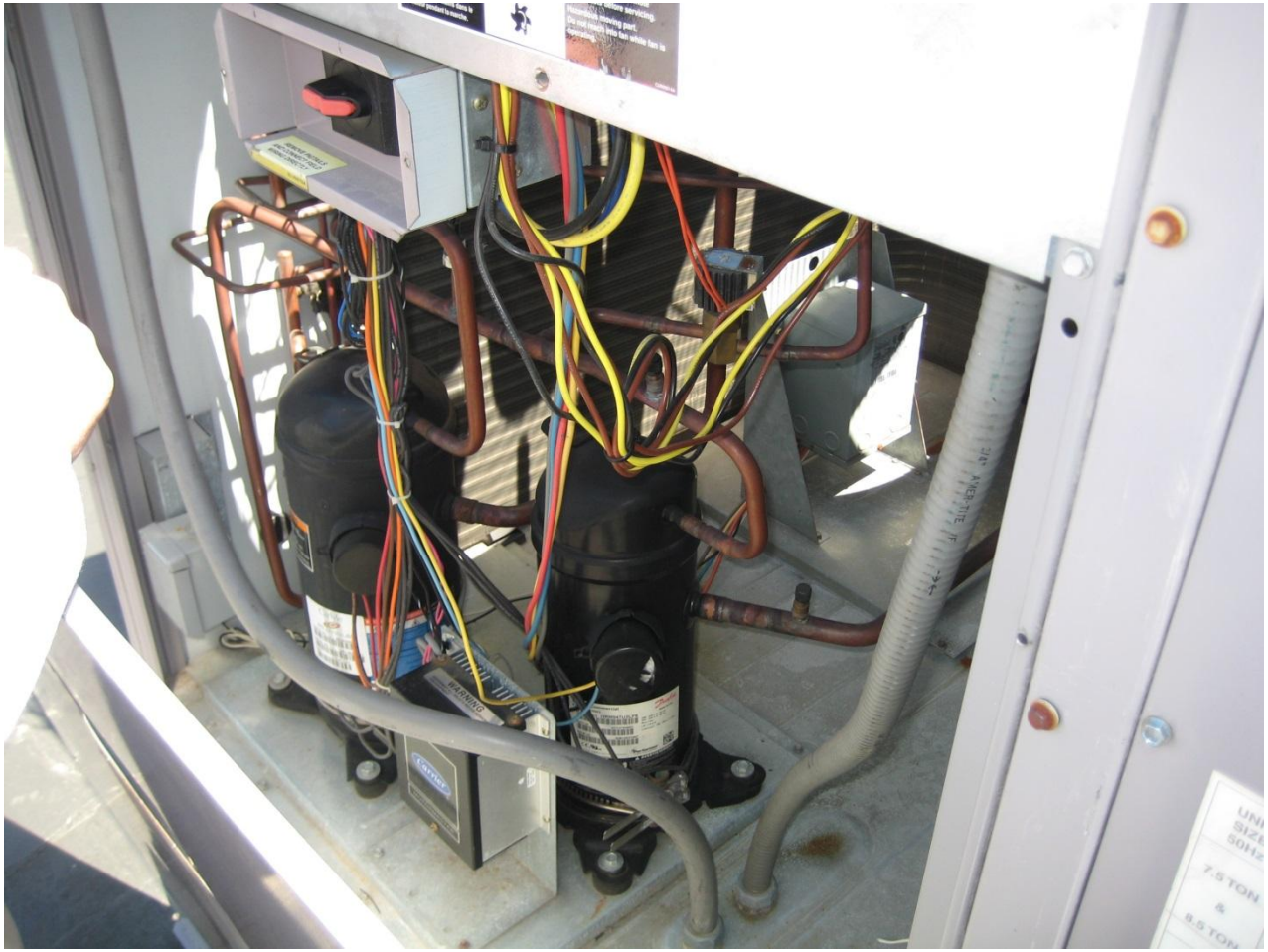
- Out of sight, out of mind
- Not well maintained
- Limp-along attitude
- False sense of efficiency



What Did We Find in the Field?

- Inoperable, “locked-out” compressors
- Jumped compressors
- Compacted coils (clogged)
- Corroded contactors
- Worn belts and shives
- Non-functioning economizers
- Improper system scheduling

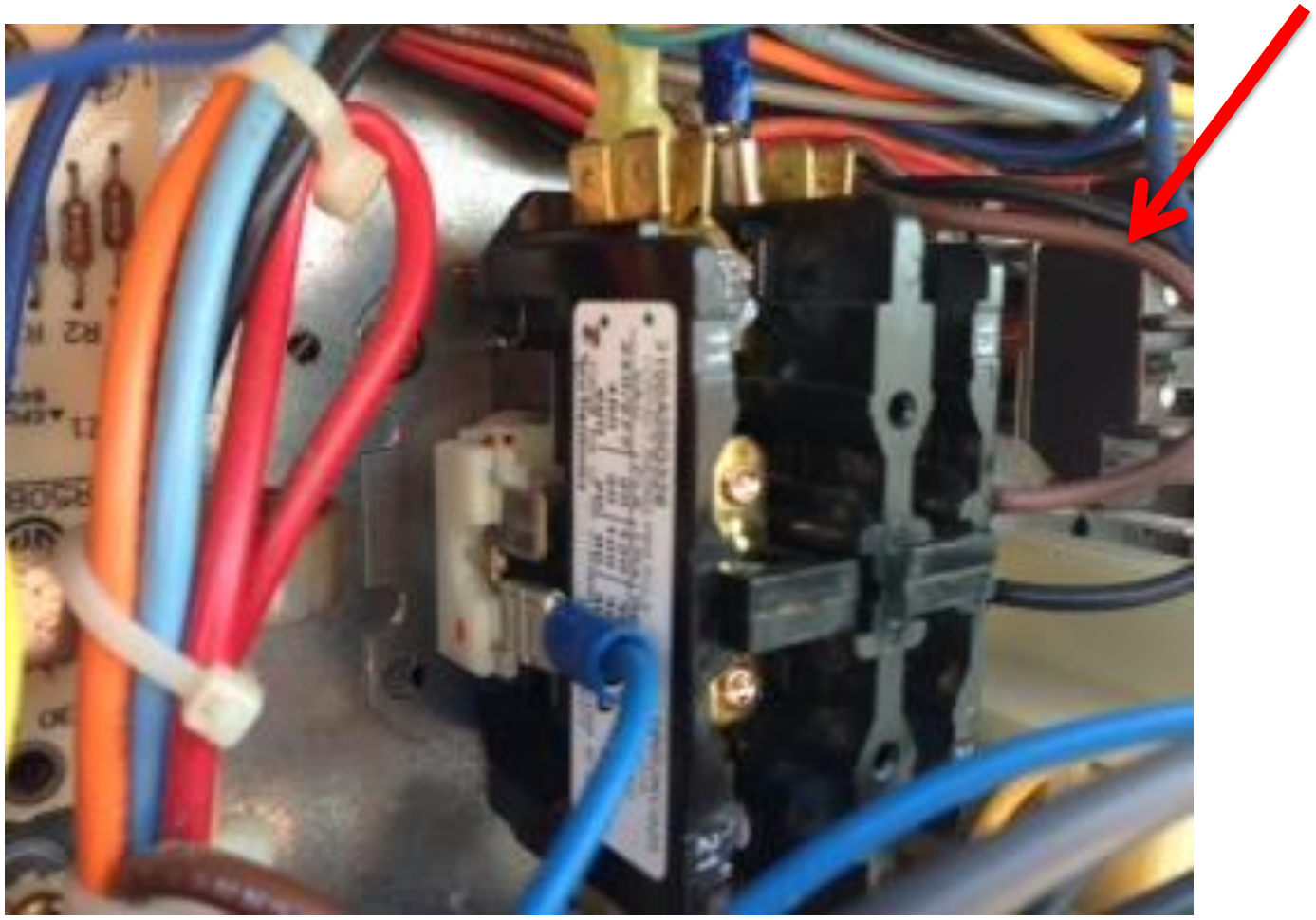
Inoperable Compressors



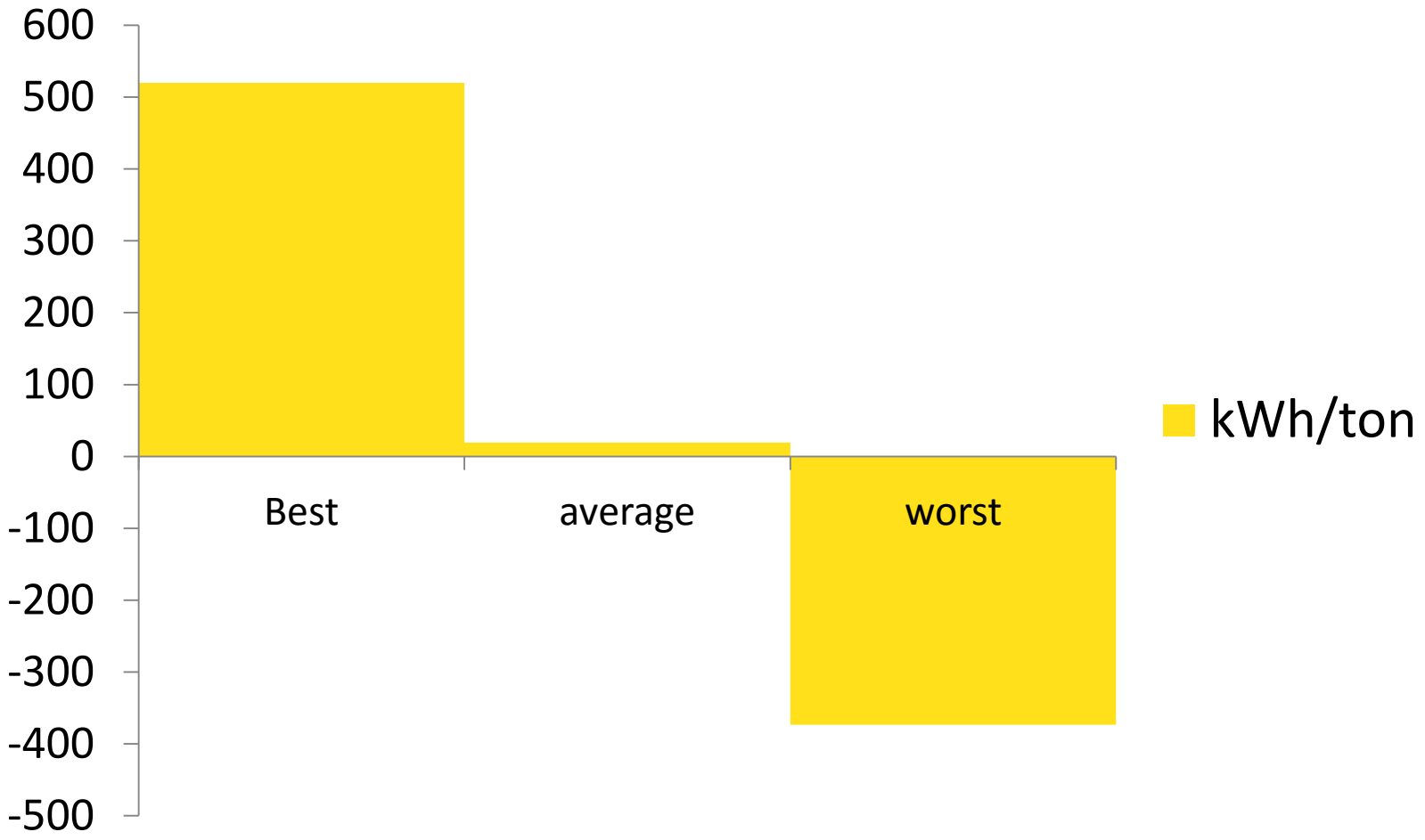
Compacted Condenser / Evaporator Coils

Worn-out bearings and belts

Jumped Compressor

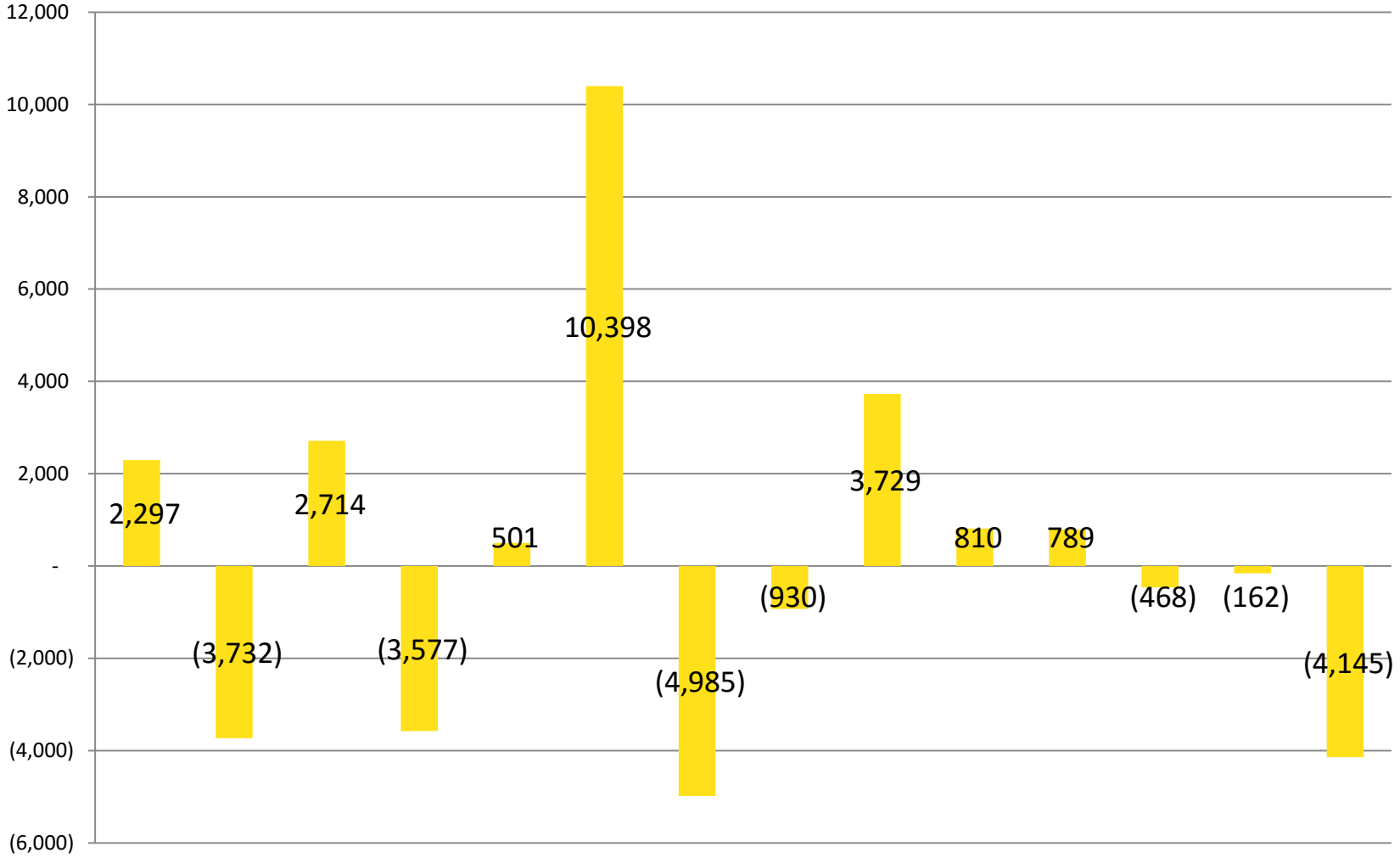


What Was the Energy Impact of the Tune-up?



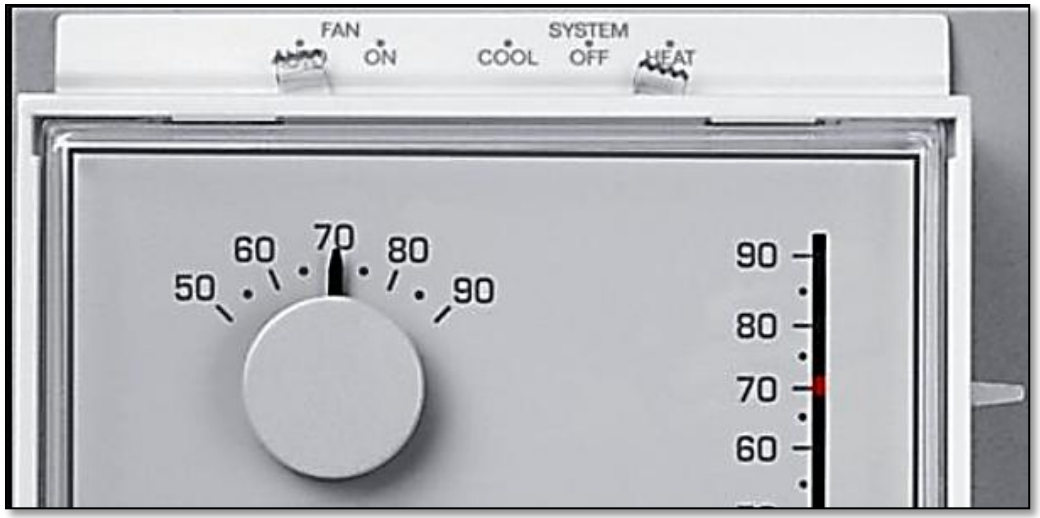
Individual RTU Maintenance Savings

(kWh / Year)

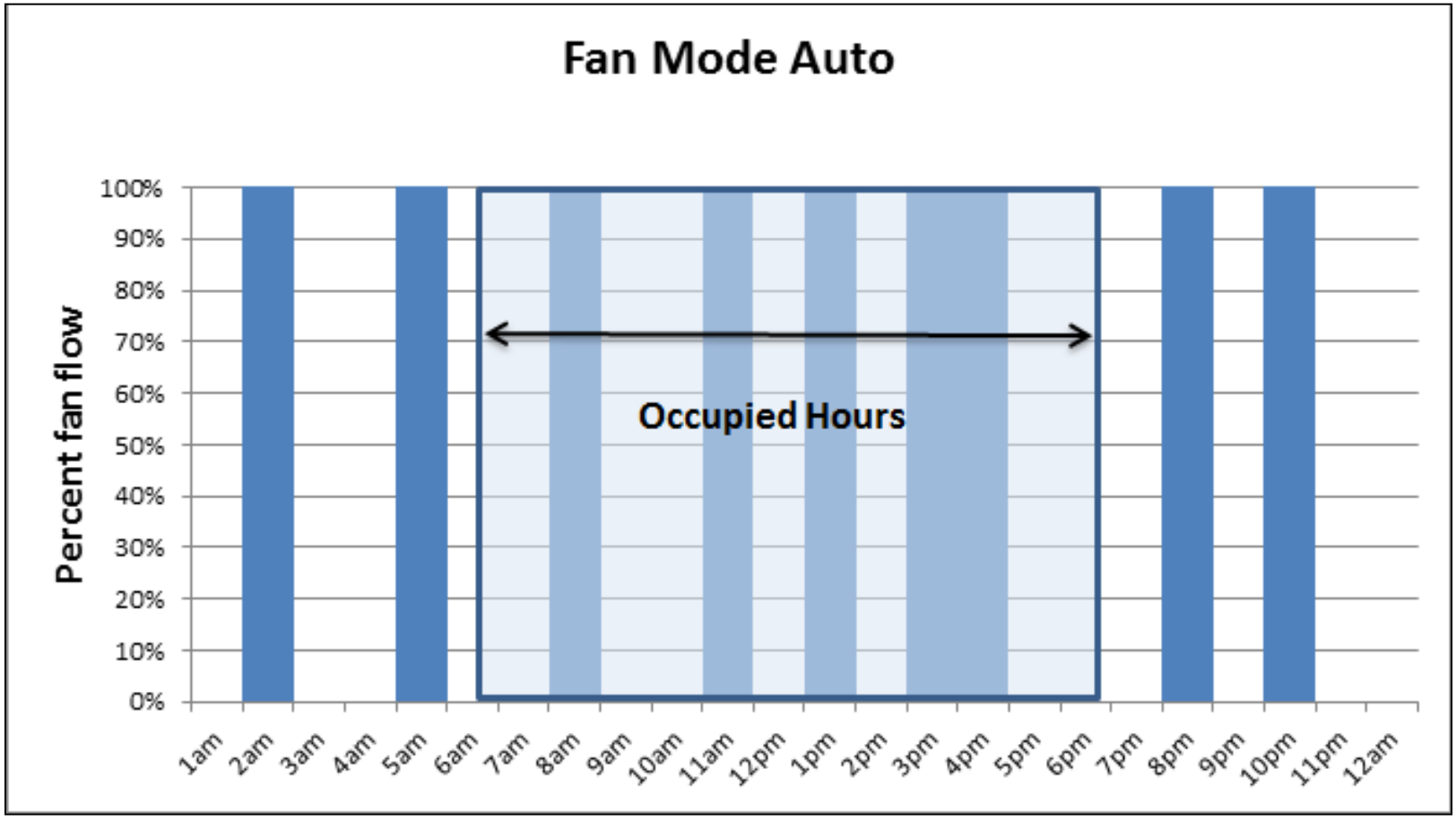


Beyond Maintenance: How Do You Control It?

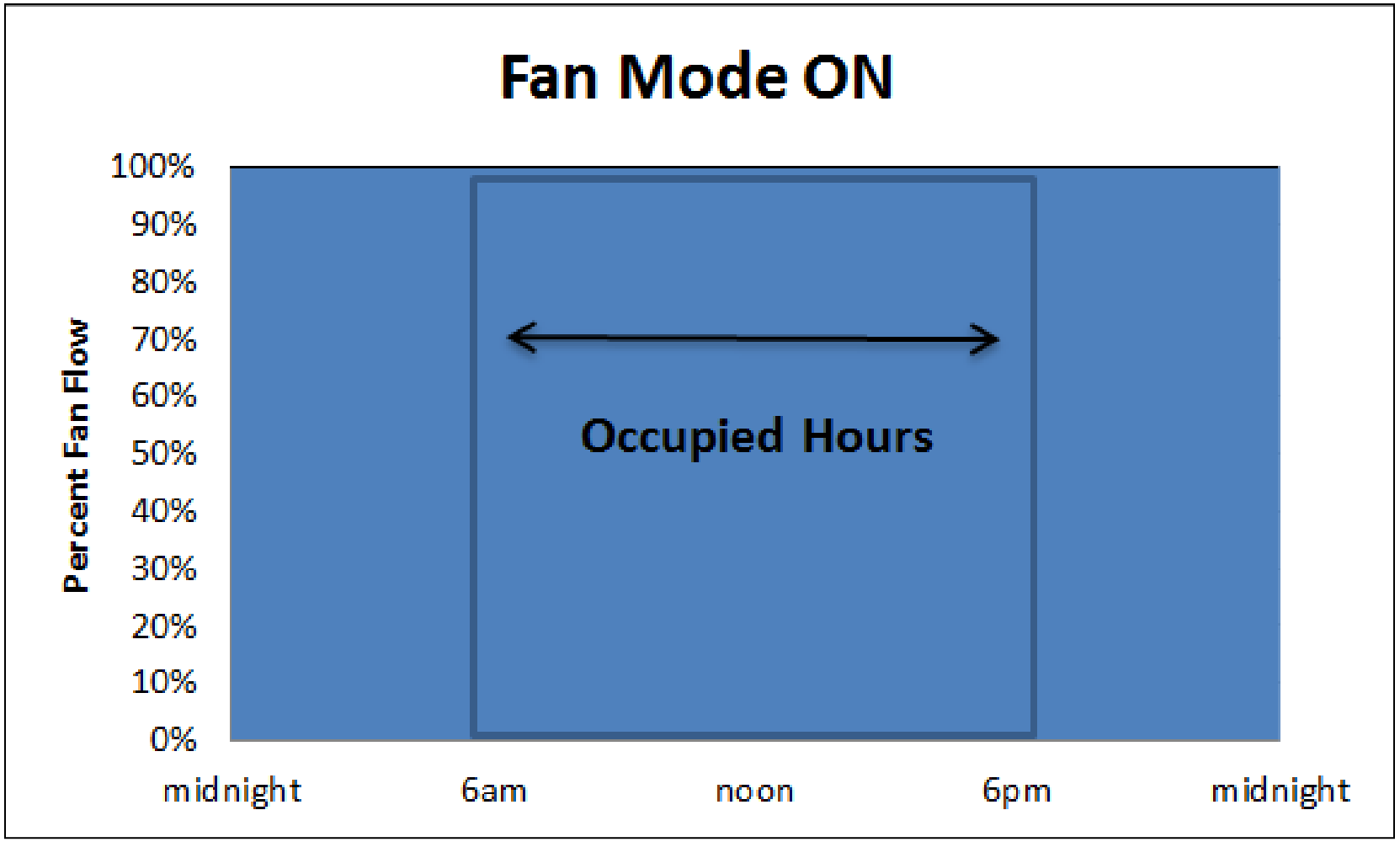
- Customers didn't understand the energy implications—or the IAQ implications—of their thermostat controls



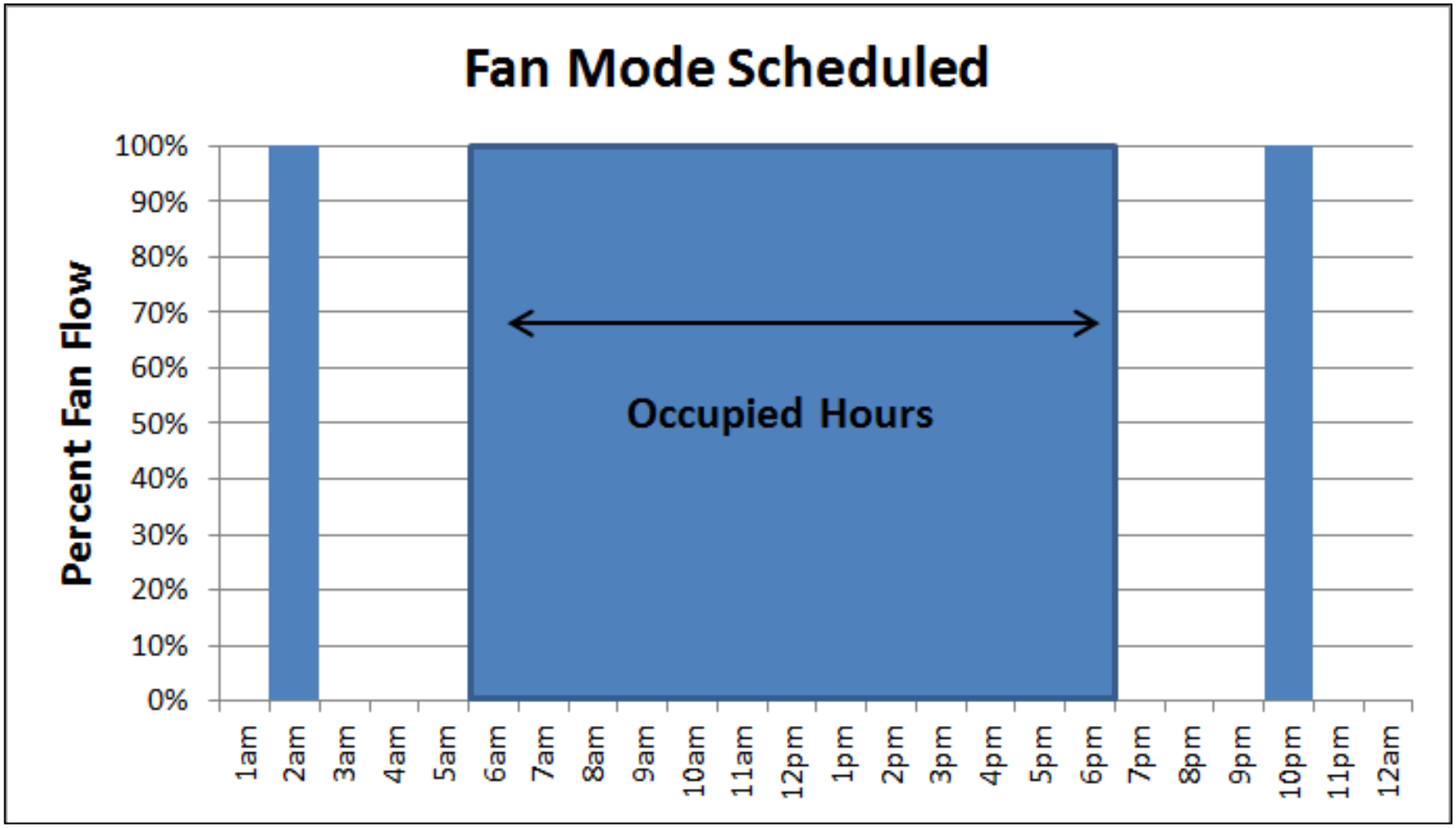
Not Enough Fresh Air



Too Much Fresh Air (Wasted Energy)



Properly Scheduled System



Energy Savings Implications of Proper Scheduling

- Main issue: System was constantly running in ON mode
- $43,000 in annual energy savings from a control change to AUTO mode during unoccupied hours
- Developed a plan to maintain and replace units over the next 10 years

Adding Controls

Advanced Controls

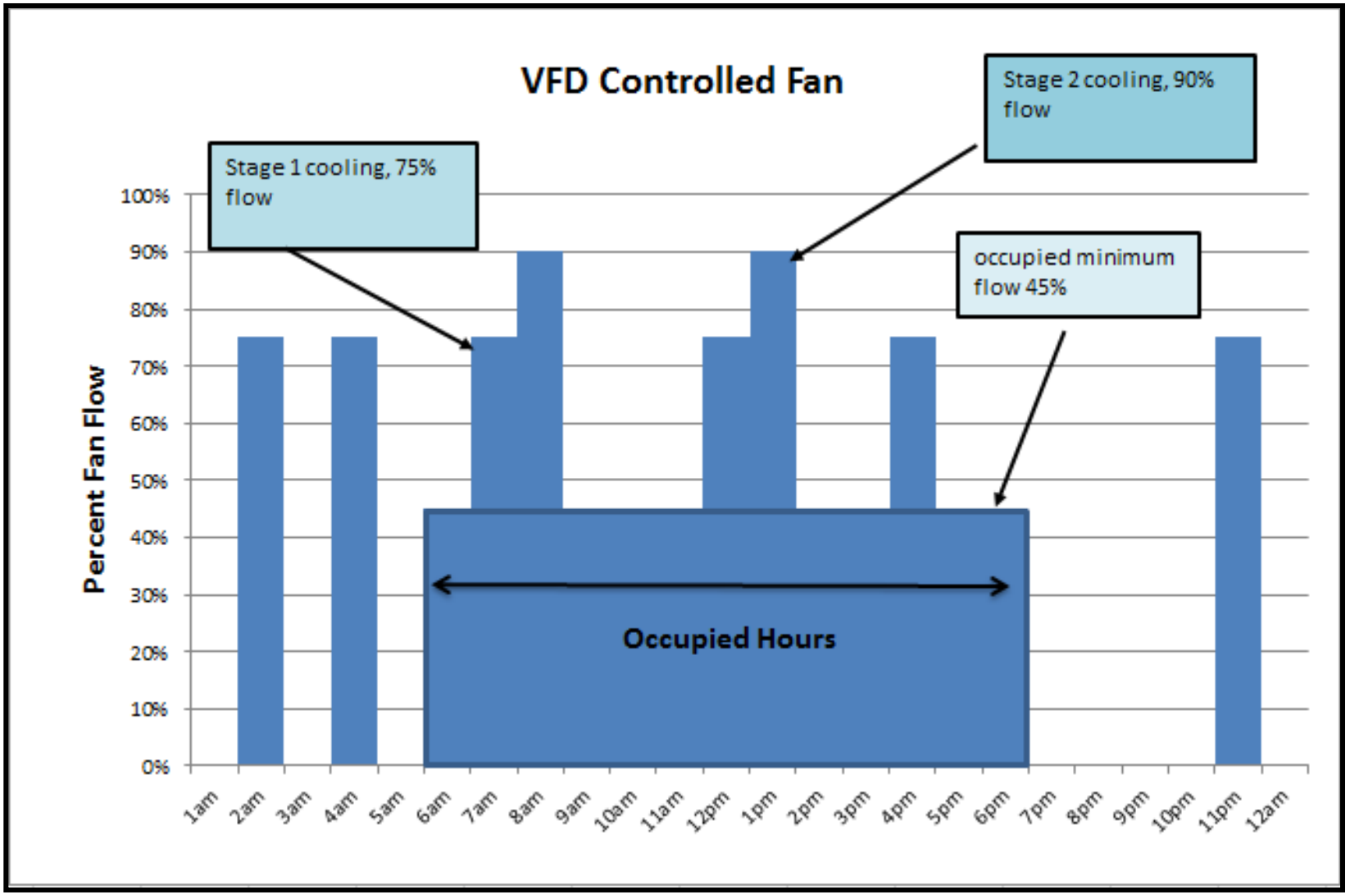
- VFDs on supply fan
- Enhanced economizers
- Fault diagnosis and detection

Good Candidates

- 7- to 30-ton packaged units
- Packed single-zone units
- Age of equipment: 1-15 years

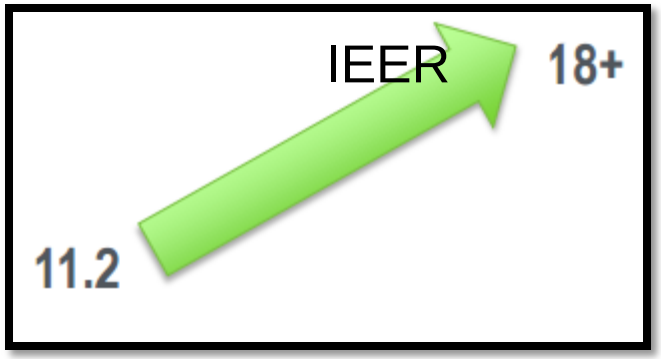
http://transformativewave.com/catalyst

Supply Fan Variable Flow Controls



Planning for Future Replacement

- Essential with current distribution channels
  1. Efficient RTUs have a longer lead time
  2. You need to know what you want
- RTU with DOE performance
- Variable speed supply fan (DCV)
- High-performance economizer
- Energy recovery wheel



U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

ERVs:
The Cadillac of Ventilation Systems?

Image: “Cadillac” by nakhon100 Creative Commons CC BY 2.0

Benefits of Central ERVs

- Indoor air quality
- Pressure balancing
- Reduced maintenance
- Operating cost saving

Purpose of the Study

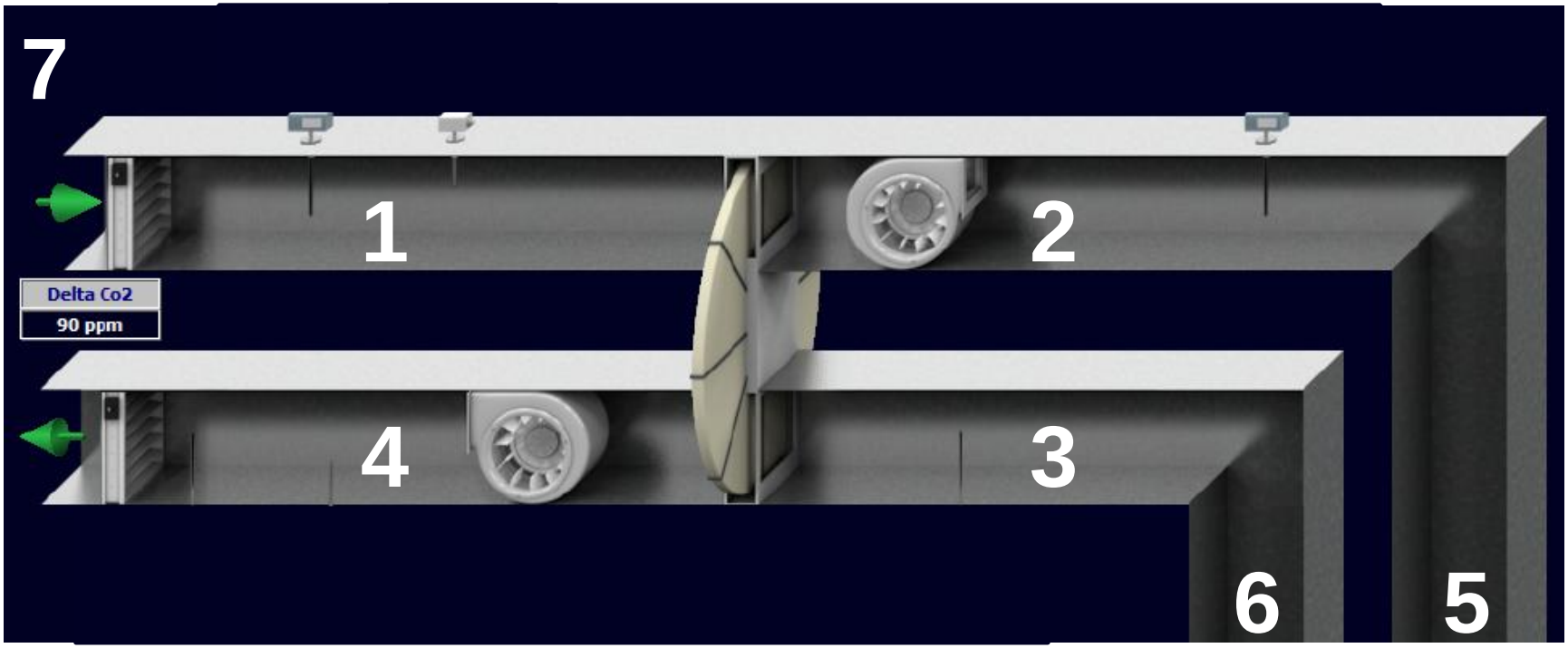
- How are ERVs performing in the field in terms of heat exchange?

- Is there opportunity for improvement?

Data Collection

- Cold weather study
- HOBO Data Loggers for at least 2 weeks
- Seven temperatures per system

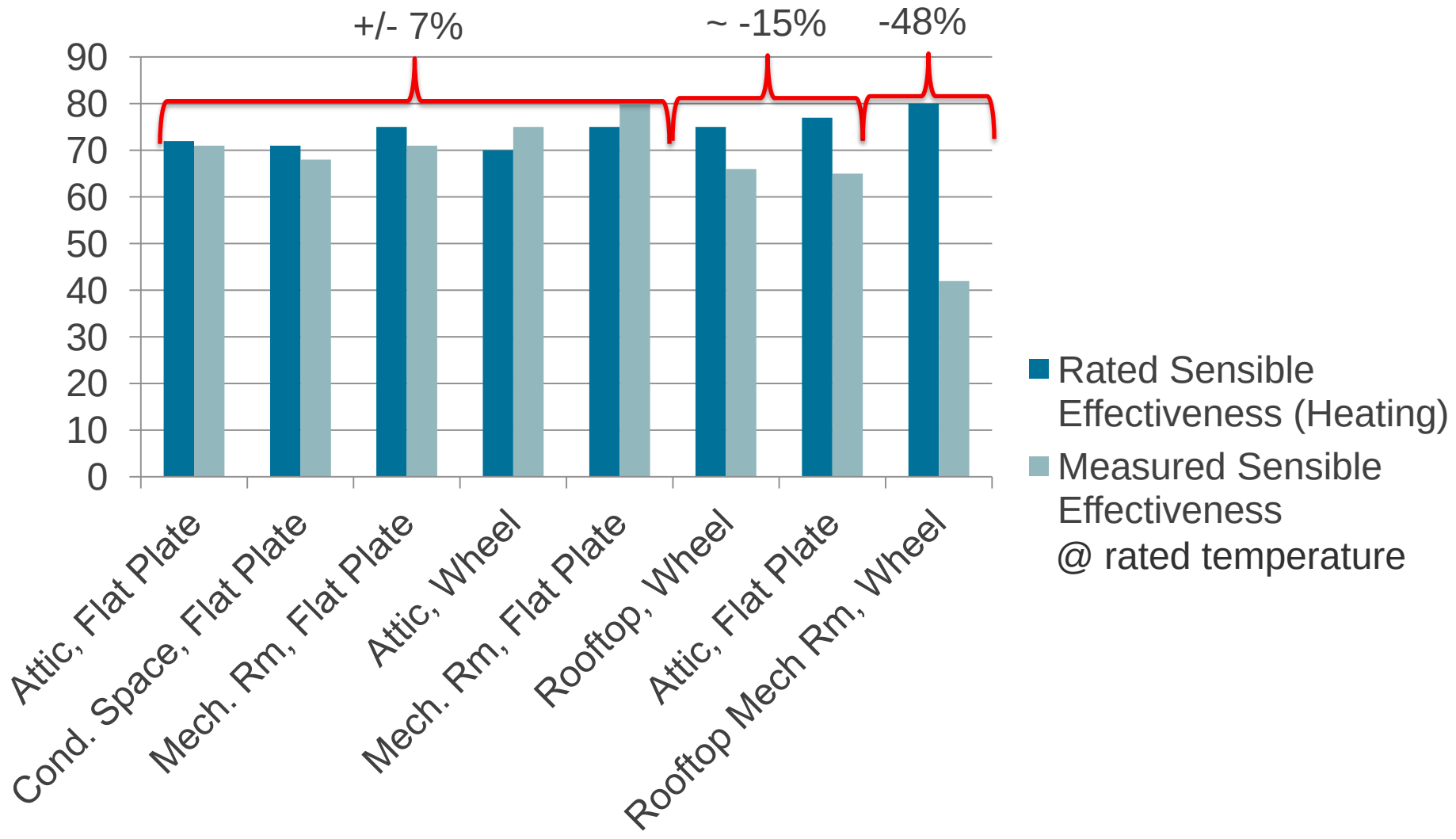
Monitoring Points



Sample Set

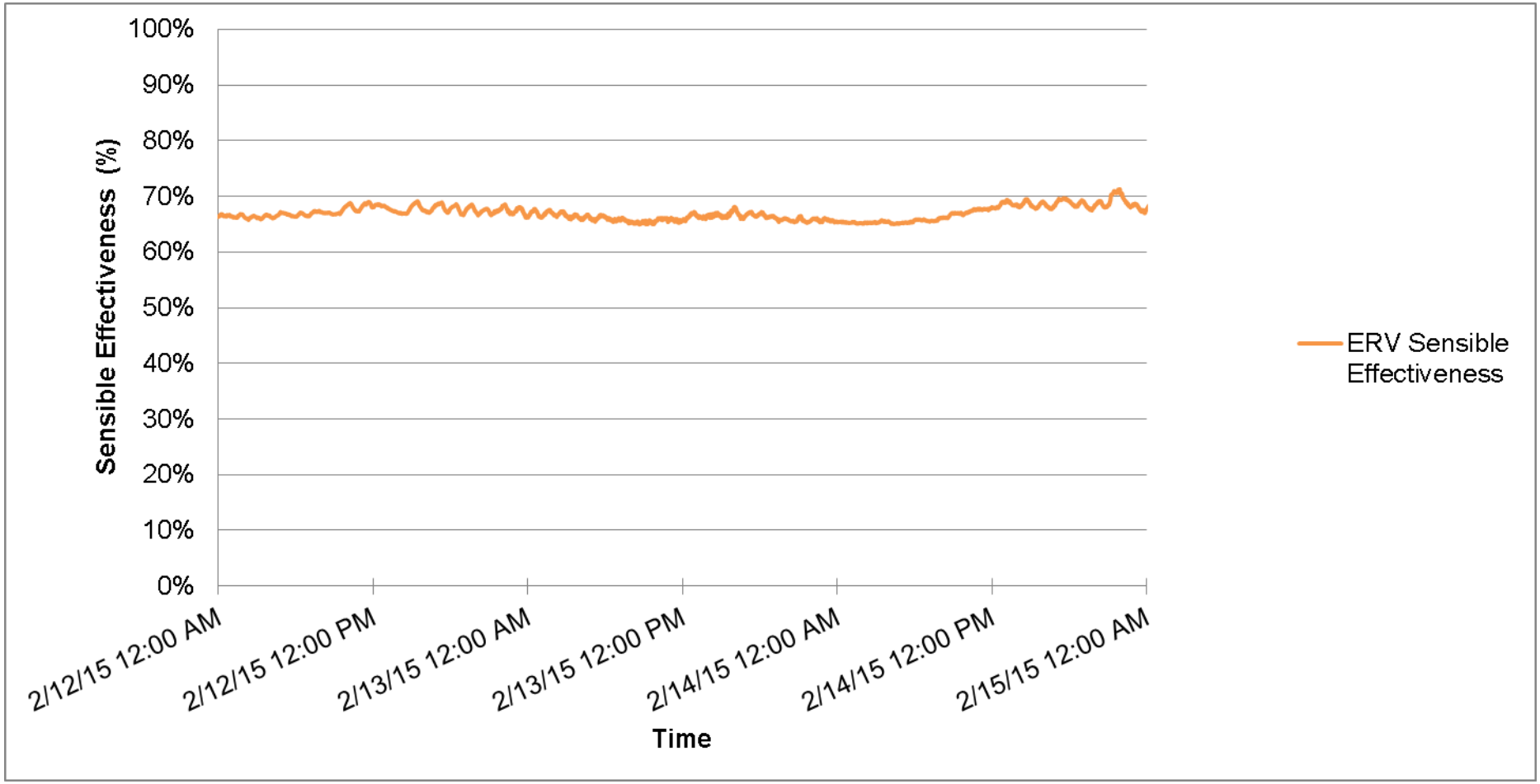
- 12 ERVs
- 7 residential buildings
- 5 flat plate
- 7 enthalpy wheel
- Ranged in size from 80 to 10,000 cfm
- Various configurations

Measured Unit Effectiveness

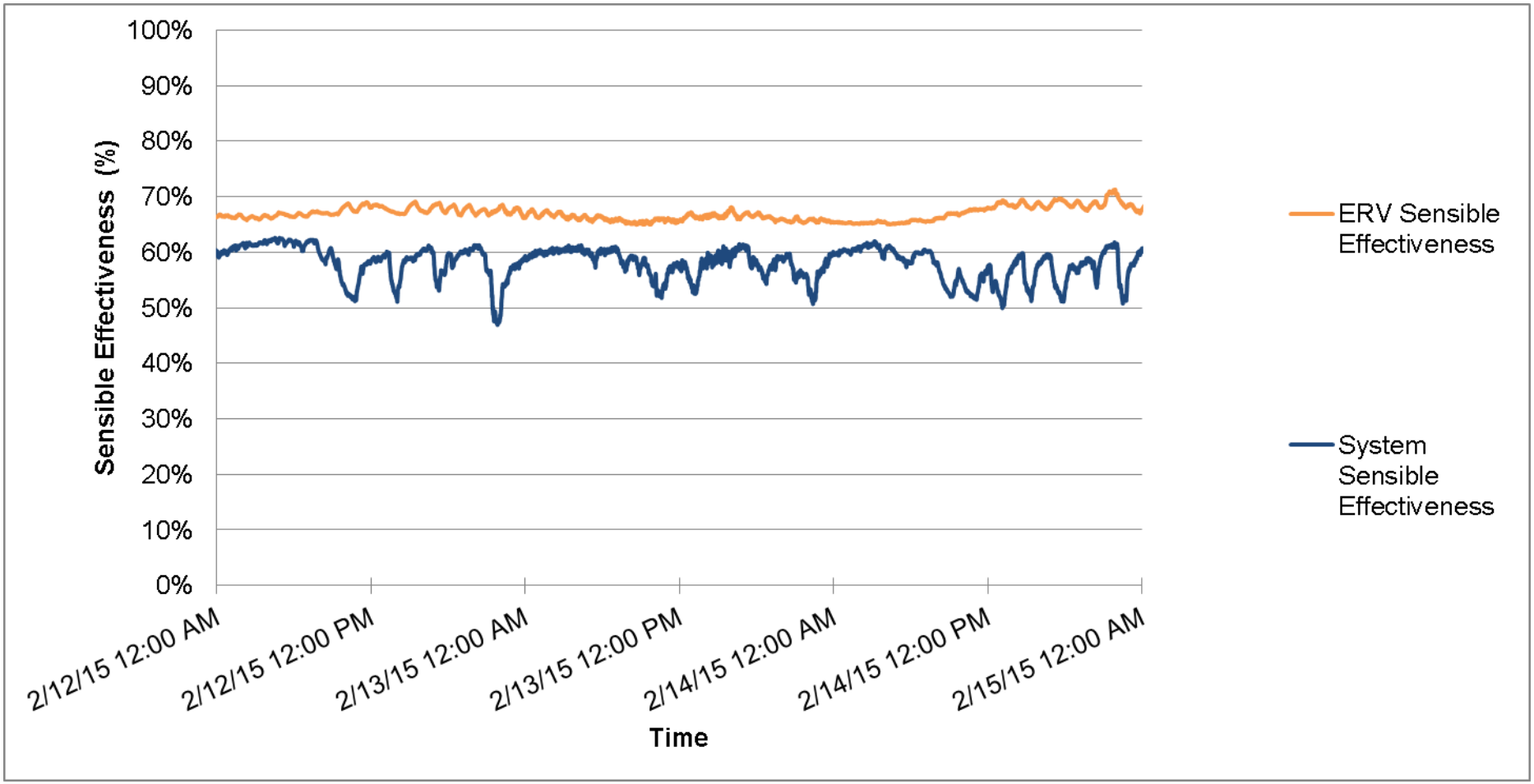


Unit and Ductwork in Unconditioned Attic

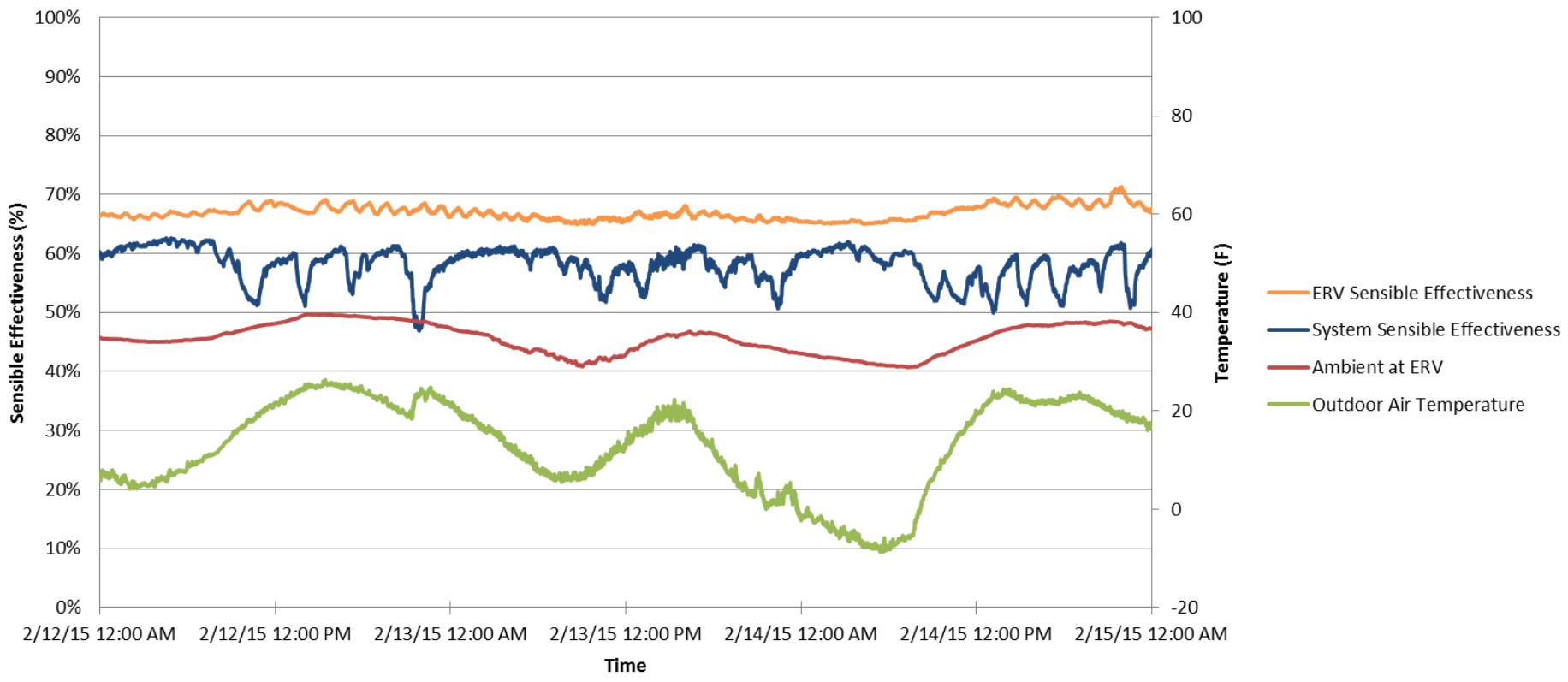
Unit Sensible Effectiveness



System Sensible Effectiveness



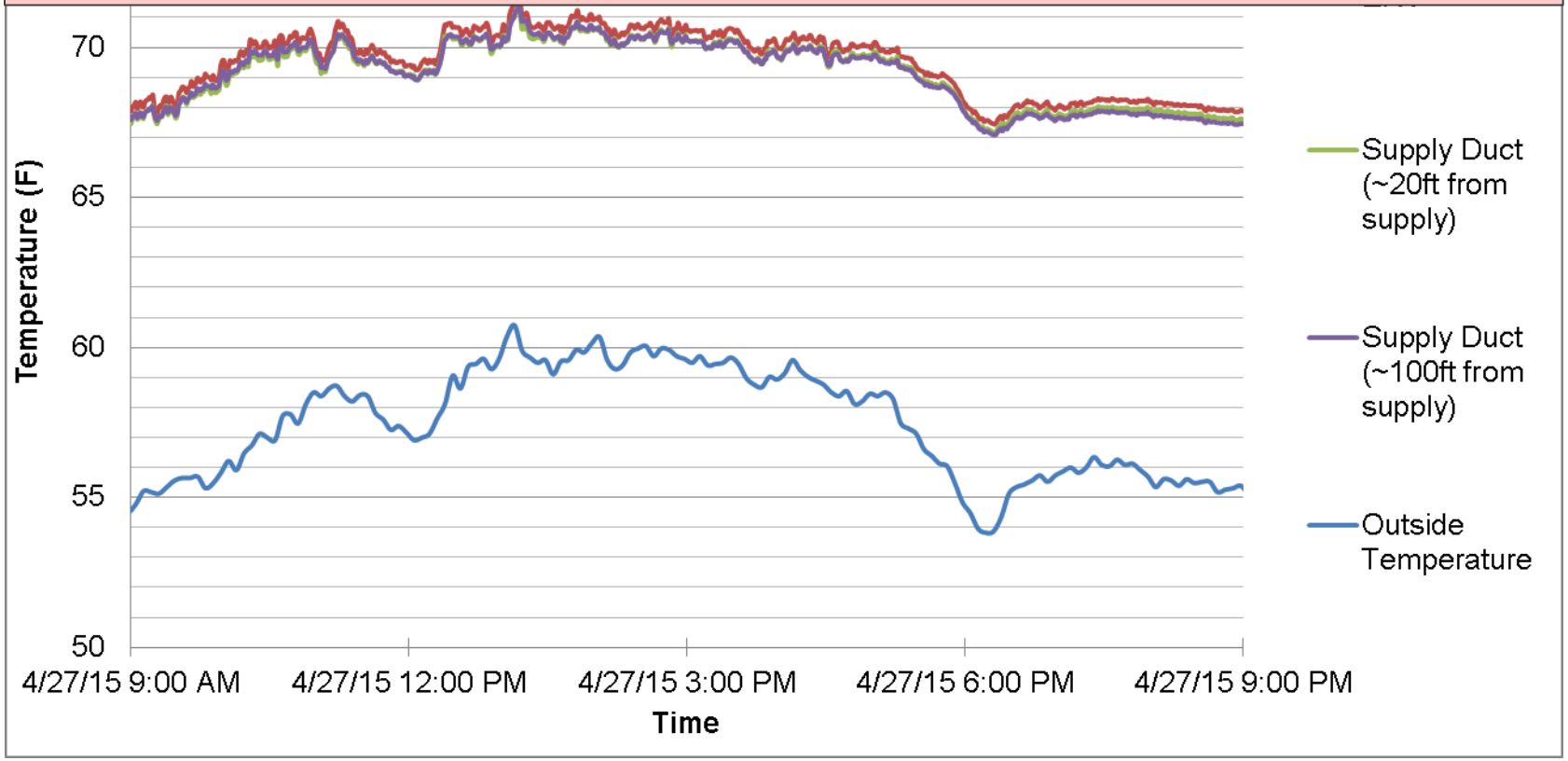
Ductwork Penalty



Rooftop system

Duct Temperatures

Why is ductwork more of a penalty in the attic than on the roof?

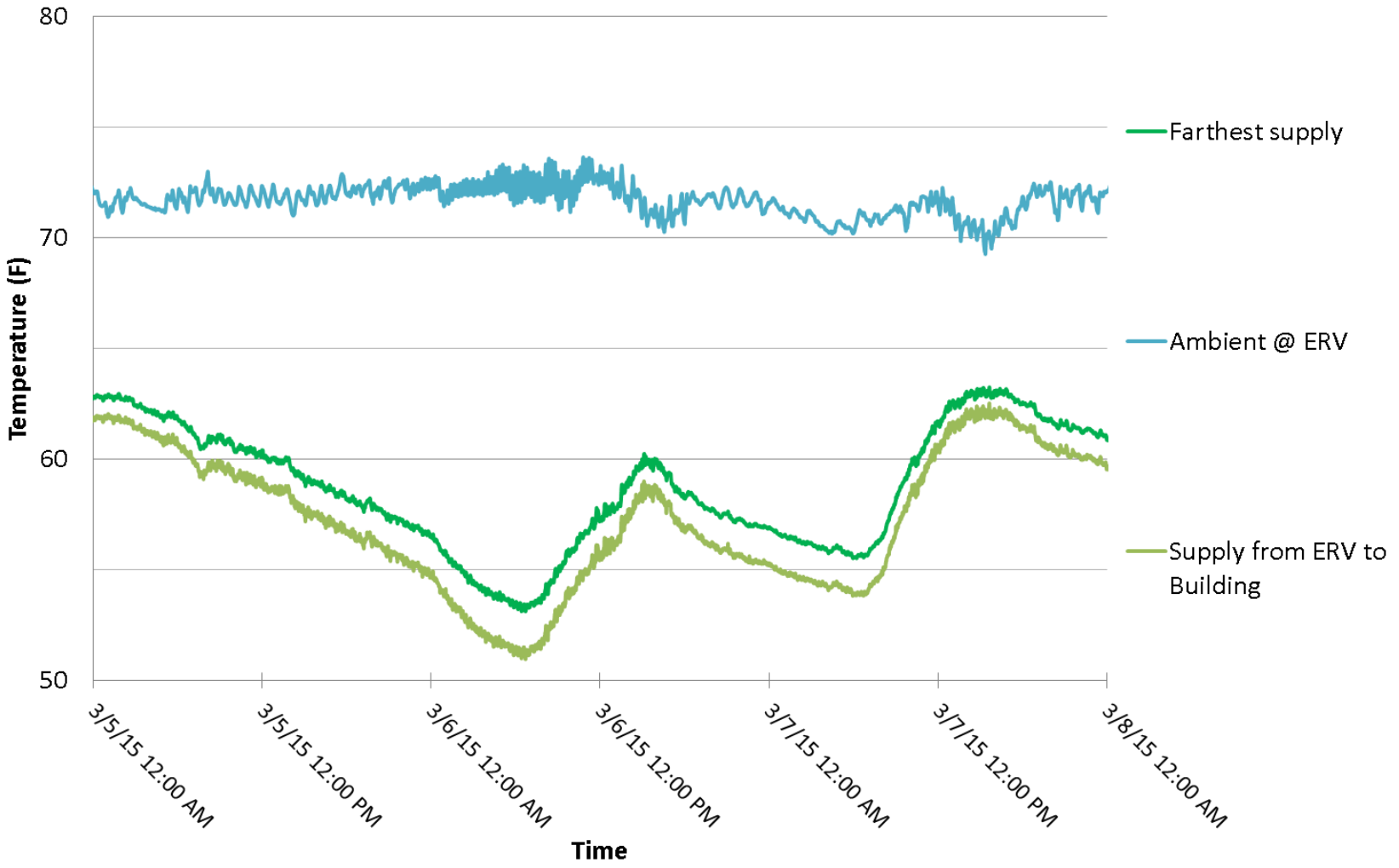


Unit vs. System Sensible Effectiveness

	Rated		Measured	
	Unit	**System**	**Unit**	**System**
Attic	72%	Unrated	71%	60%
Rooftop	75%	Unrated	66%	65%


RenewAire
Energy Recovery Ventilators

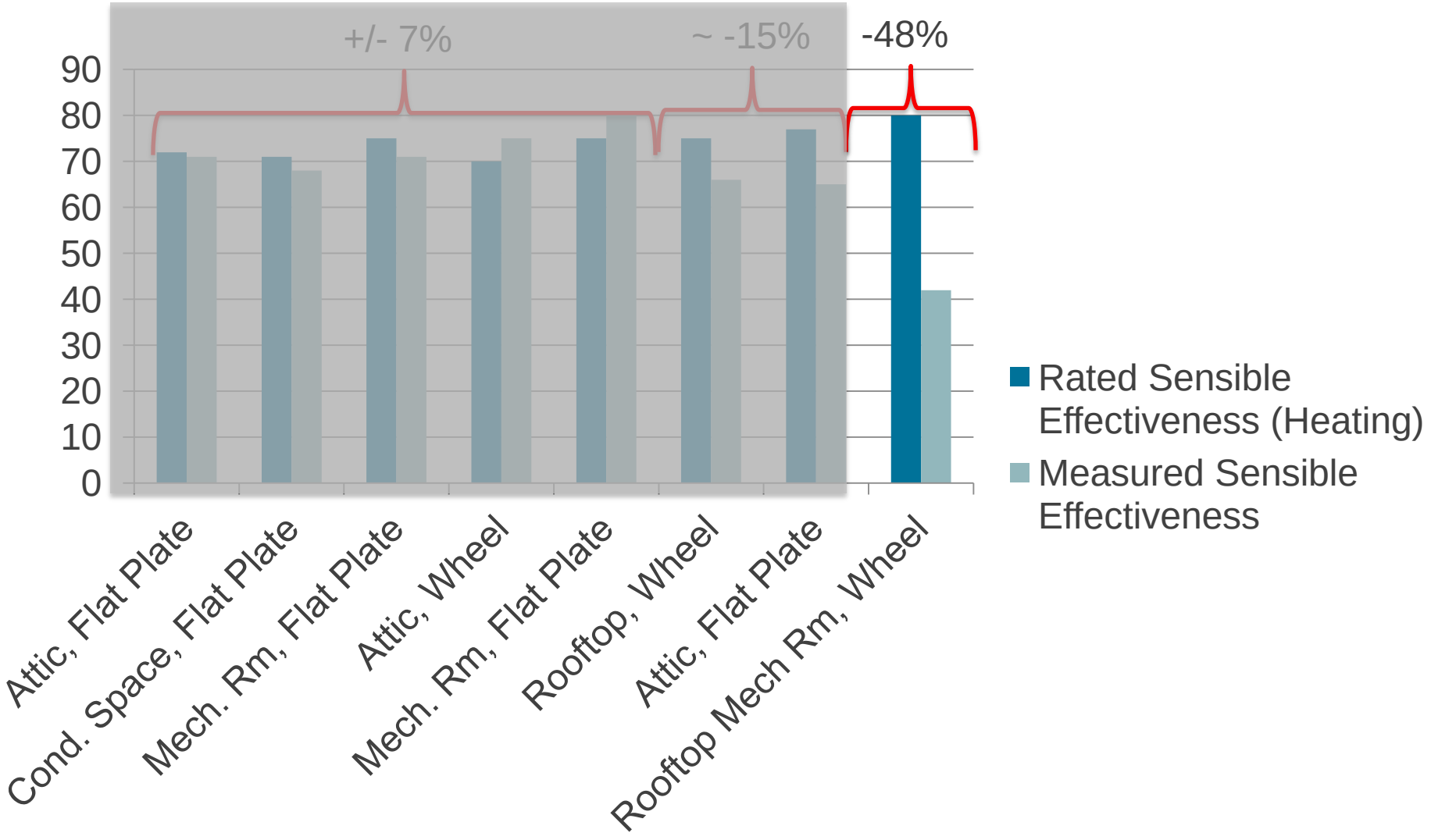
Supply Ductwork in Conditioned Space



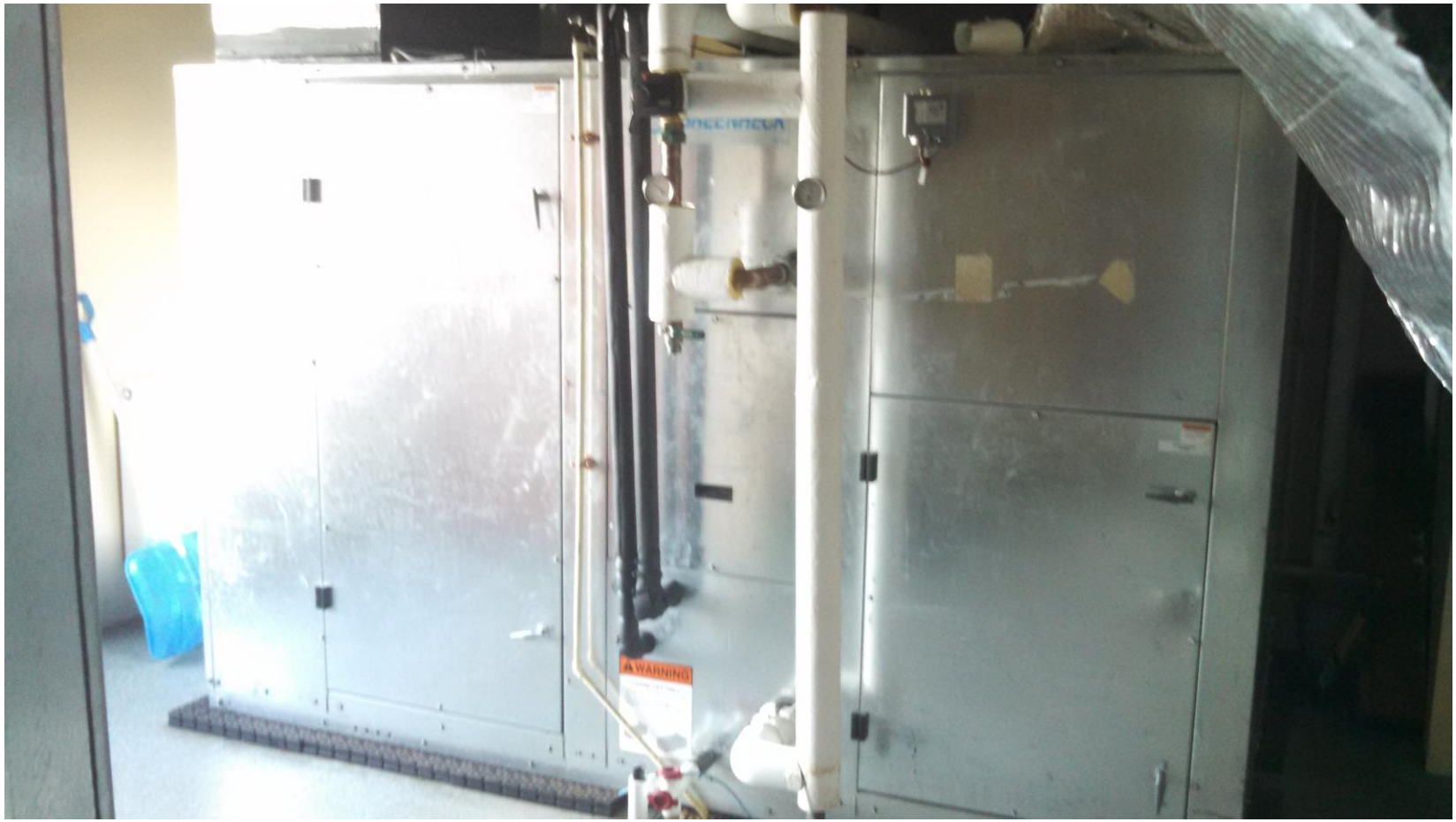
Unit vs. System Sensible Effectiveness

	Rated		Measured	
	Unit	**System**	**Unit**	**System**
Cond. Space	71%	Unrated	68%	71%

Measured Unit Effectiveness



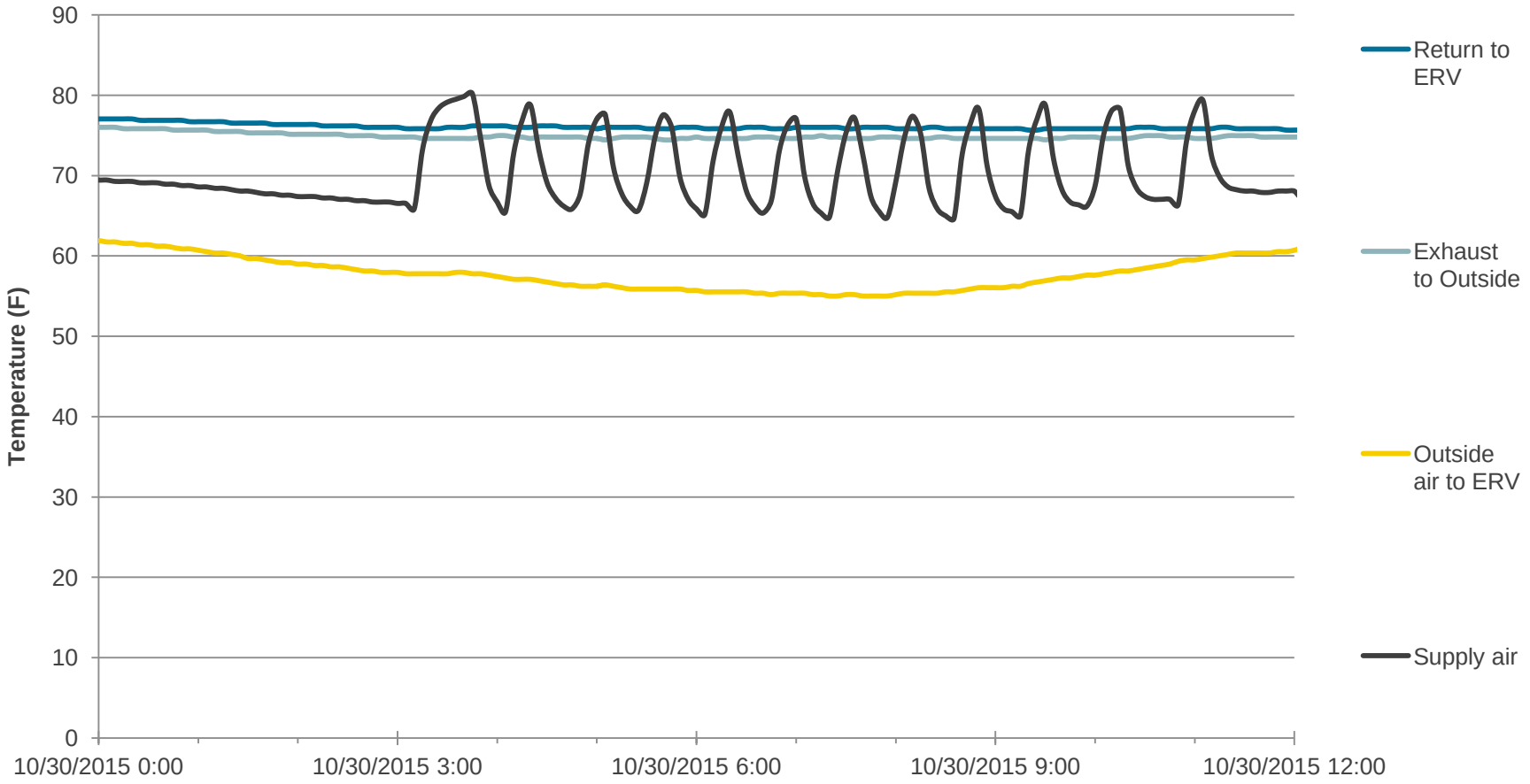
ERV Operation –
Enthalpy wheel, Rooftop mechanical room



Unit Effectiveness

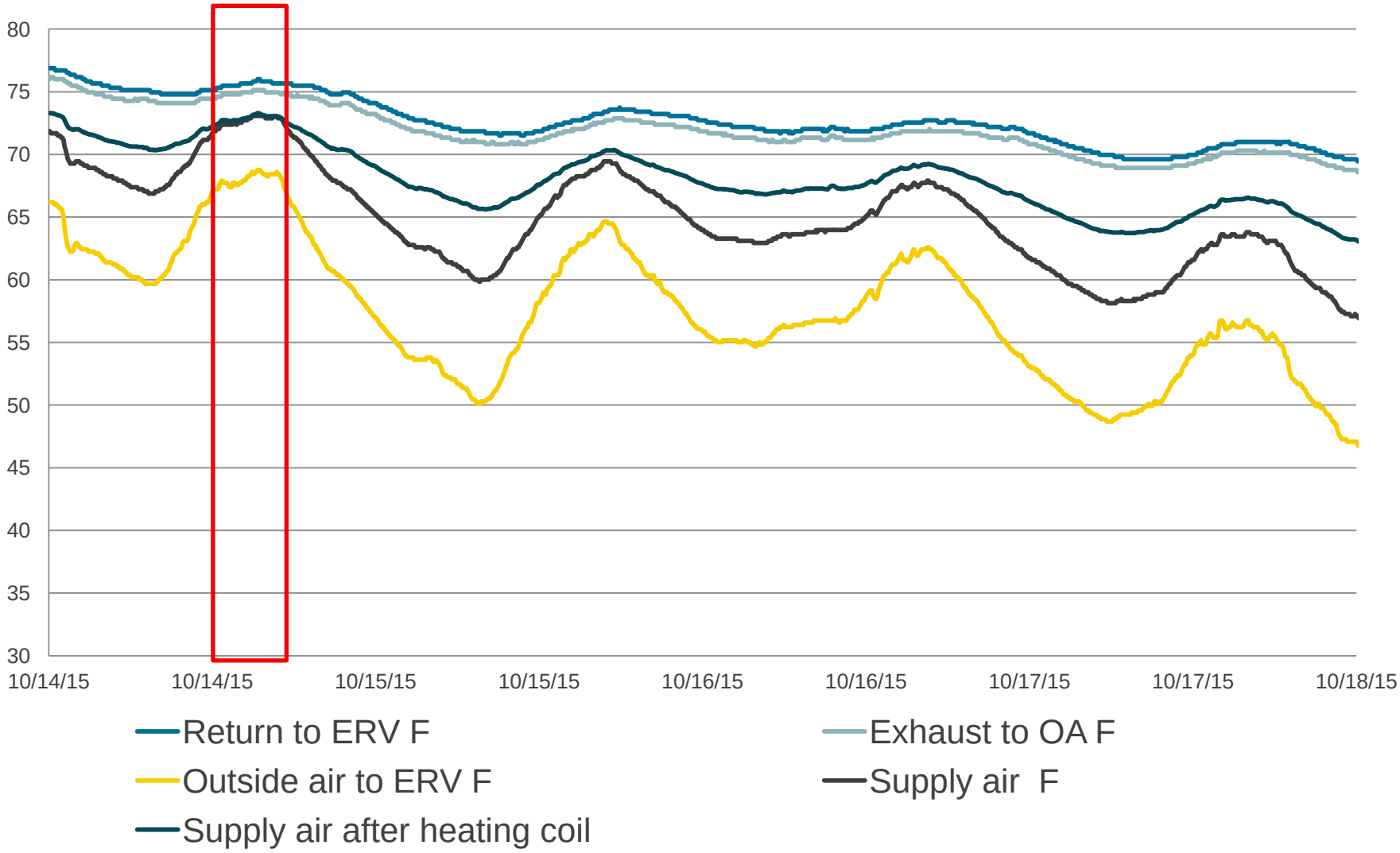
	Rated		Measured	
	Unit	@Temp	Unit	@Temp
Rooftop Mechanical Room	80%	35F	66%	36F*

ERV Operating Temperatures



Designed for Commissioning?

ERV Operation – Enthalpy wheel, Rooftop mechanical room



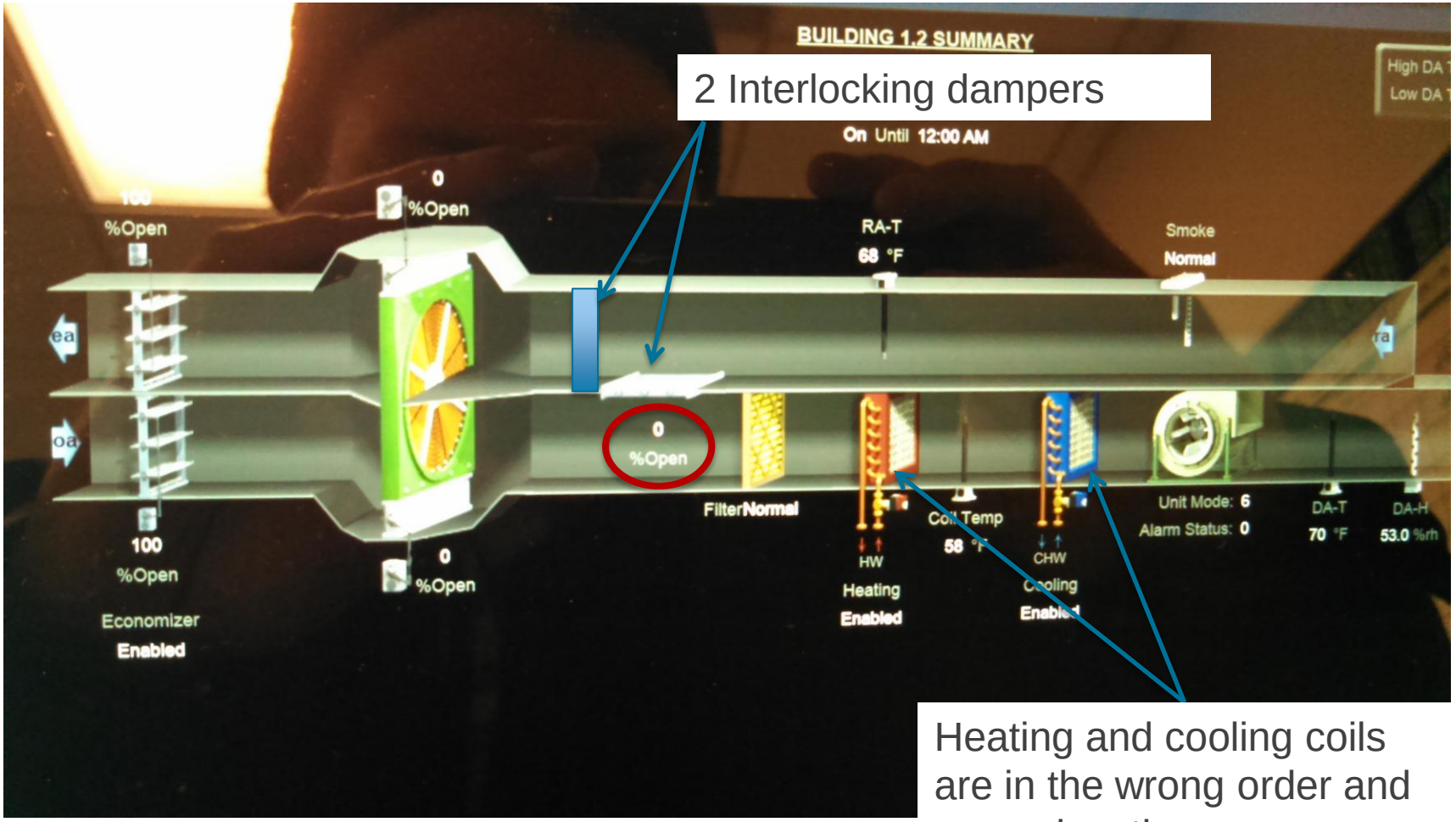
Measurement Challenges

- People live in these buildings

Image: “10 Male Rate” by Kevin Simpson Creative Commons CC BY-SA 2.0

Large Rooftop ERV

Operational Issues



Operational Issues

Key Takeaways

Design for Success

- Think beyond the unit
- Design with commissioning in mind
- Simple(r) controls

Support Building Staff

- **Don’t be overwhelmed:** Start with basics, know your units, and perform annual, comprehensive maintenance.

- **Proper scheduling** yields the best bang for your buck

This concludes The American Institute of Architects
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