Commissioning for Net Zero

BUILD. CONNECT. ACHIEVE.

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

Course Description

Commissioning for net zero new construction and high efficiency buildings is not simple or easy. This presentation identifies many of the most common issues commissioning providers may find on these projects, ranging all the way from faulty installations and controls to issues with energy collection, storage and recovery systems. You will learn about other activities such as M&V you might encounter while commissioning for net zero (and how to leverage them), how to identify strategies for cost-effective commissioning, and where owners might want to draw the line. The two CCP-certified presenters will end the presentation with some real life examples that allow the audience to try identifying issues.

Learning Objectives

1. Identify typical systems used in high efficiency and net zero buildings
2. Name at least four common deficiencies found in these high efficiency systems
3. Distinguish which of these systems are most likely to benefit from commissioning, and why
4. Determine strategies/opportunities for cost effective commissioning of these systems in net zero projects

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Certified Commissioning Professionals through the BCA and Existing Building Commissioning Professionals through AEE.

Characteristics of High Efficiency & Net Zero Projects

Some Characteristics of High Efficiency & Net Zero Projects

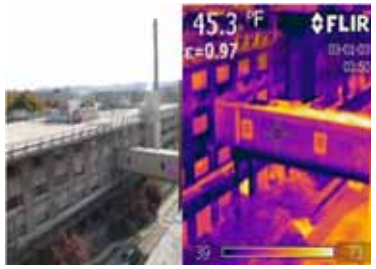
Features of Net Zero Projects

Low Energy Use!

1. Generate (& Store/Reclaim) Energy
   - Generation system informs HVAC choices
   - Ex. Heat Pump & Solar PV
2. Energy Uses Tuned & Optimized
   - Advanced Controls
   - System Interactions
   - Reactive/On-Demand (DCV, occupancy sensors)
3. Non-HVAC System Impacts
   - Appliances & lights use less energy
   - Unintended Consequences (low flows)
   - Occupant Behavior

Well Sealed & Insulated Envelope

1. Impacts System Requirements & Operation
   - Mechanical vs Natural Ventilation
   - Oversizing, Cycling & Uneven Distribution
2. Envelope is a System (equipment interactions)
   - Thermal Mass
   - Thermal Bridging
   - Location of Air Barrier
3. Envelope Commissioning
   - Visit Timing, Impact on Schedule
   - Goals, Scope and Communication



Owners (and rest of Team) Care!

1. NetZero: Not Business as Usual
   - Owner, designer, installers, invested in project
   - Detailed planning during design
   - Building performance tracked (M+V)
2. Owner/Team Involvement in Commissioning
   - Education is huge.
   - Channel enthusiasm, provide tools
3. Incentive/Certification Program(s)
   - Extra Hoops, Identify them Early
   - Worth the Trouble

AND LOTS MORE

- But many of those will be covered in the following slides

Typical Systems, Issues & Consequences

Typical Systems, Issues & Consequences

- Solar PV, Solar Thermal, Wind
- Geothermal, Passive Solar, Thermal Mass
- Economizers, ERVs, HRVs, Demand Control Ventilation
- Condensing Boilers and Pumps
- Controls (BMS, EMS)
- Lighting Controls
- Heat Pumps
- Water side recovery systems (DHW recovery, Process Heat Recovery-Cogen, etc)

Energy Collection Systems
(Solar PV/Solar Thermal/Wind)

- Solar PV
  - Panels,
  - Inverters,
  - Batteries,
  - the Grid…
- Wind
  - Turbines,
  - Batteries
  - The Grid…
- Solar Thermal
  - Panels
  - Thermal Storage Tanks

Important Components

Energy Dashboard

Solar PV – Not just on buildings

Shading, Manufacturer Defects, Wiring issues, Design/Sizing, Site Conditions

Energy Collection and Storage
(Geothermal/Passive Solar/Thermal Mass)

- Geothermal

  Heat Pumps,

  Wells/Shallow Coils,

  Lake Source Cooling (Cornell)

- Passive Solar/Thermal Mass

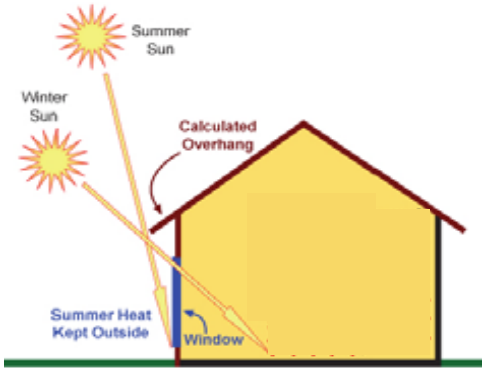
  Windows,

  Solar Shades,

  Thermal Mass

  Radiant Floor,

  Solar Pre-heat Wall (preheats ventilation air)



Solar Pre-heat Wall

summer/winter settings, control methods and schedules, interaction with other strategies (demand control ventilation, heat recovery, etc)

Energy Recovery Systems
(Air and Water Side)

- Air Side Heat Recovery

  Heat Recovery Ventilators,

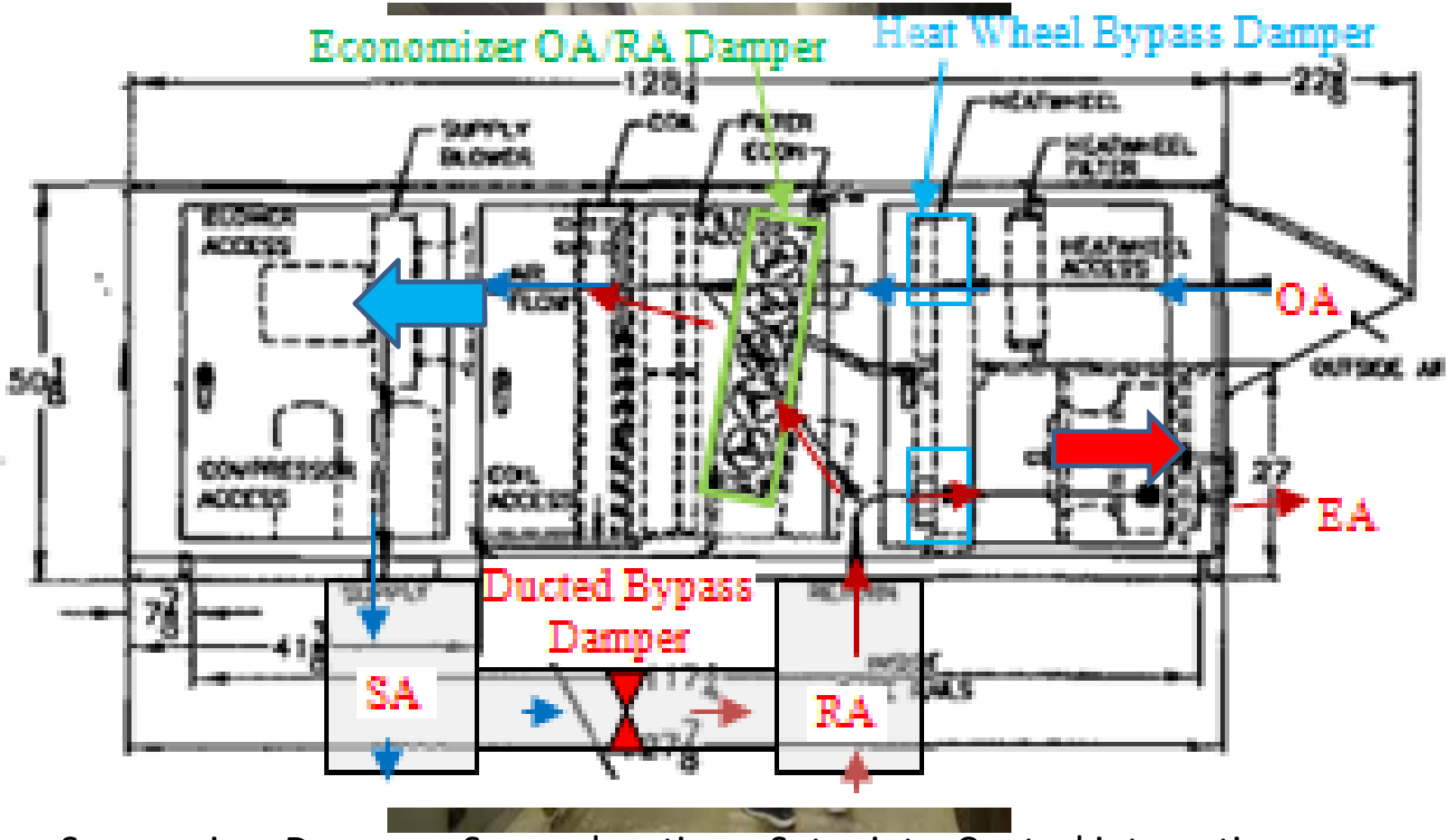
  Energy Recovery Ventilators,

  Run-Around Heat Exchanger
- Water Side/Other Heat Recovery

  DHW Heat Recovery

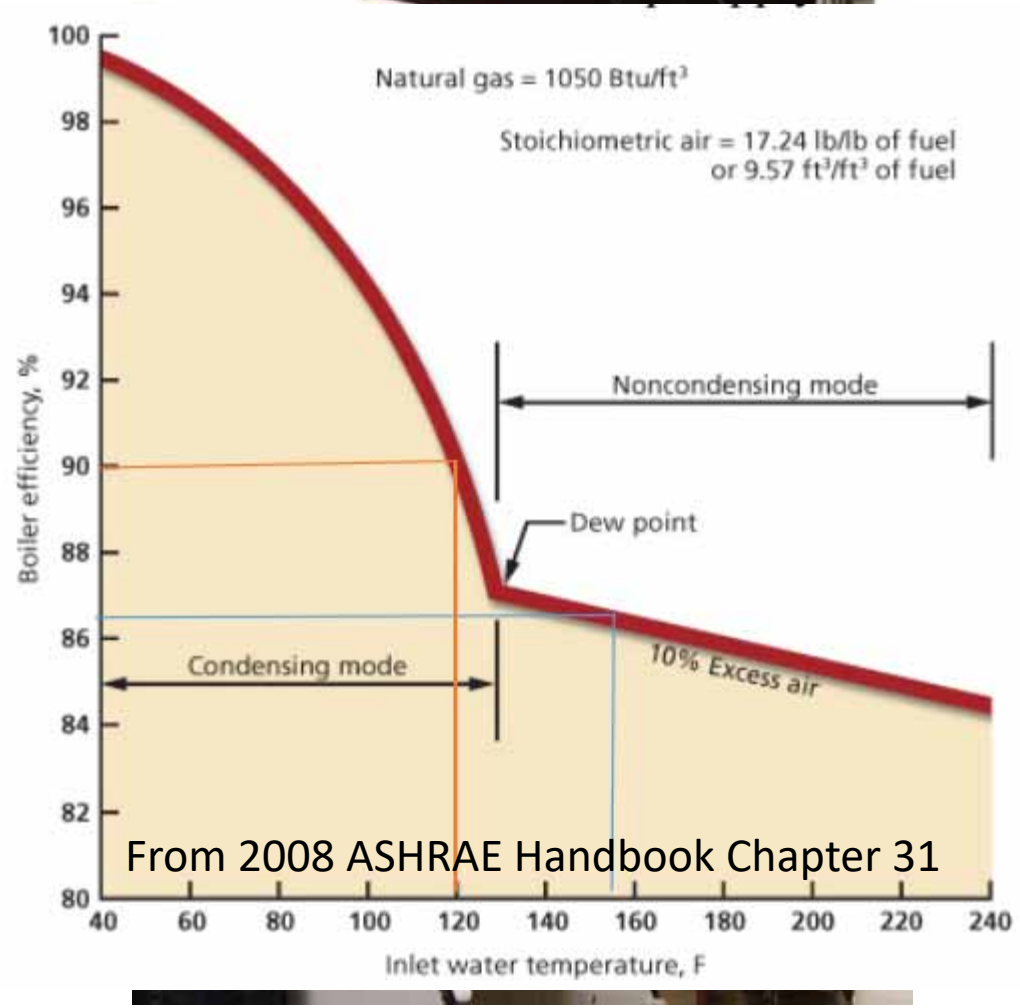
  Process Heat Recovery (CHP, etc.)

Economizers, ERVs, HRVs and Demand Control Ventilation



Sequencing, Dampers, Sensor locations, Setpoints, Control integration, Unforeseen IAQ issues

Condensing Boilers and Pumps

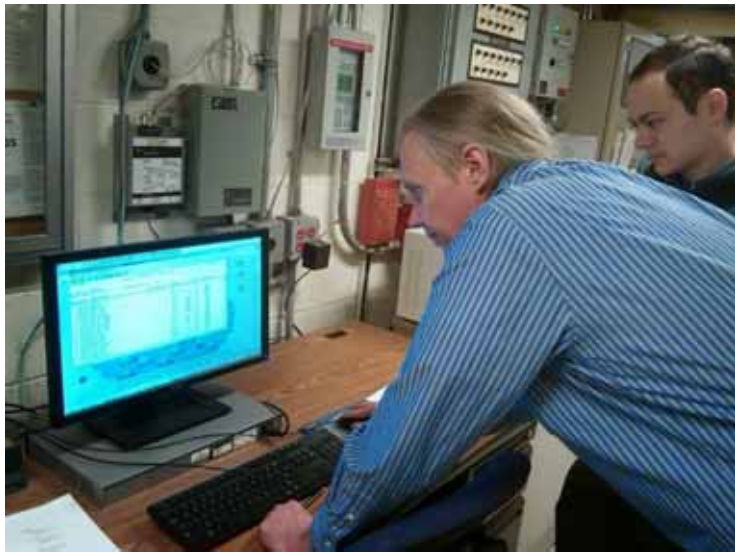


From 2008 ASHRAE Handbook Chapter 31

Setpoints, Sequencing, Condensate treatment, Pump speed

Tuning and Optimizing
(For High Efficiency Systems)

- Boilers– Condensing Range
- Demand Control Ventilation
- Occupancy Controls
- Adaptive/Predictive Scheduling & Controls
- Meeting/Reducing peak demands to reduce equipment size



Lighting Controls

Blind Spots, controls and setpoints, incorrect wiring, emergency power issues, faulty ballasts/bulb selection, burn out

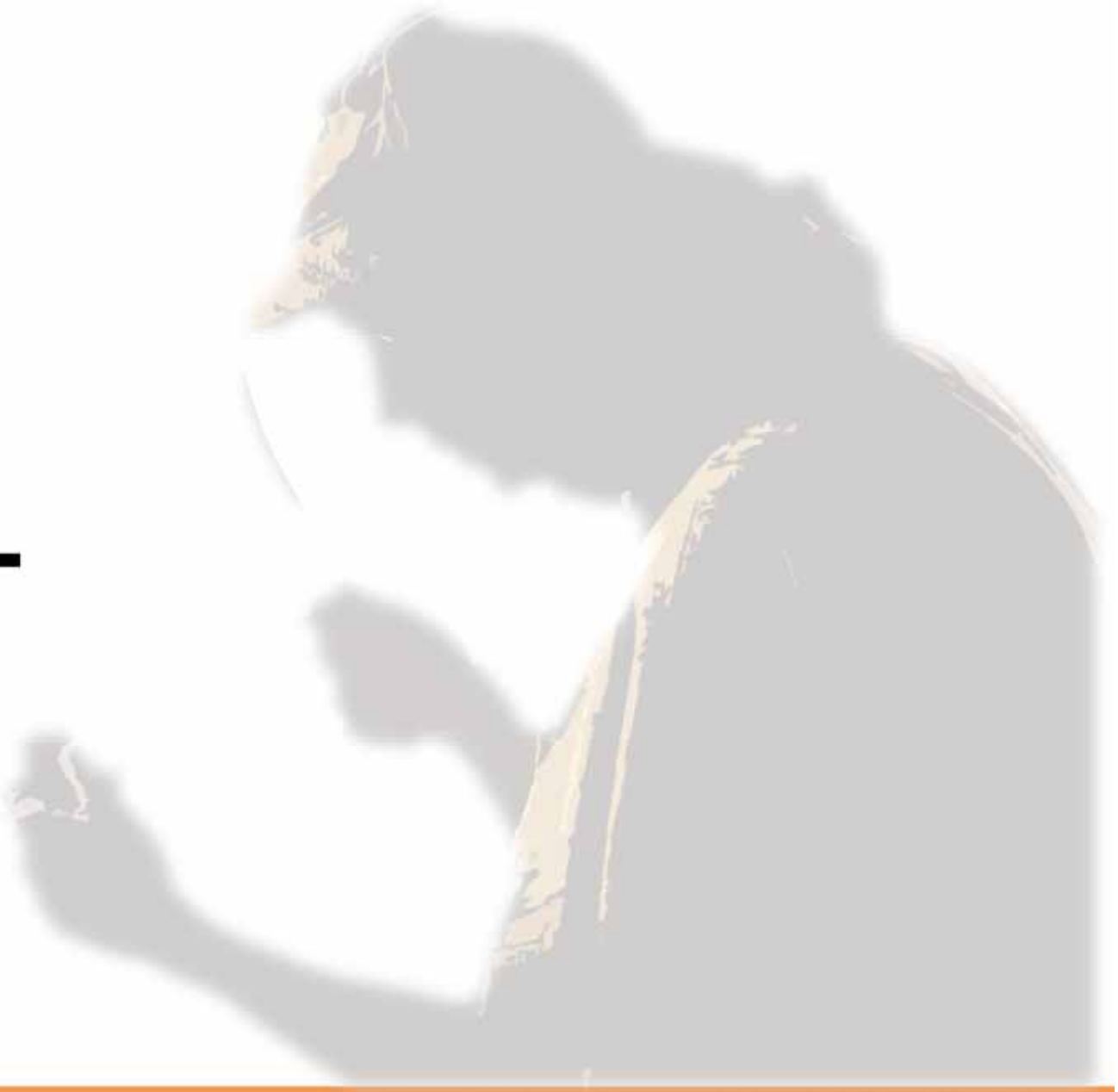
Heat Pumps

Clogged filters, controls and setpoints, incorrect refrigerant charge, location of indoor and outdoor units, condensate removal, faulty safeties (freeze up)

Control Systems

Schedules, Sequence Priority, Setpoints, Unfinished programming, Safeties, Documentation, Integration , tuning and ‘make it fit’ style programming

Taking a look at the Cost-Benefit Balance

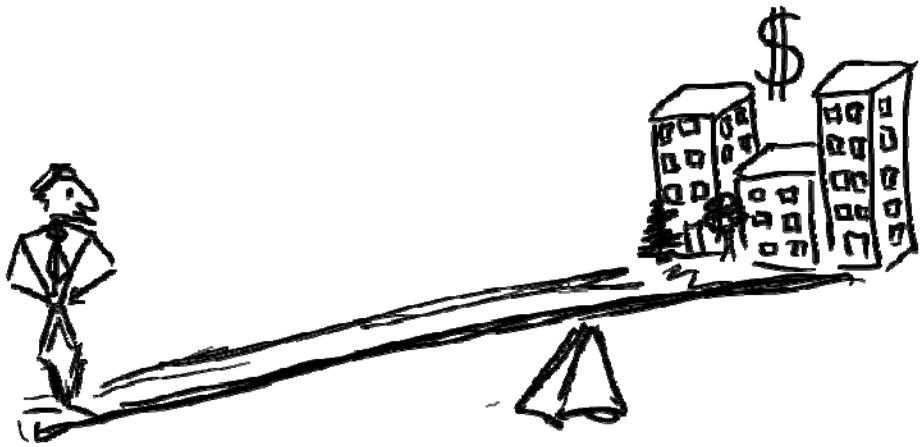


What Makes Sense?

Always an ongoing question – a lot will depend on the owner, their budget and comfort level with systems failing

Additional testing drives price up, but can provide more assurance that systems work as intended

For net zero projects, it may also depend on what the margin of safety is to make net zero



What Makes Sense?

Questions to ask yourself :

-What are the potential consequences of a failure?

-How likely is the component to fail?

-How easily/quickly can it be checked?

-Am I adding value by doing this or can it be done just as well by another party?

Does it Make Sense?

One way to look at it:

Will it cost more to perform tests on a unit than it will cost later to replace a small number of failed units?

If yes – maybe these units should have basic operational checks built into the Prefunctional checklists and have walkthrough tests done while onsite to check other systems.

Ways of decreasing cost

Sampling and spot checking

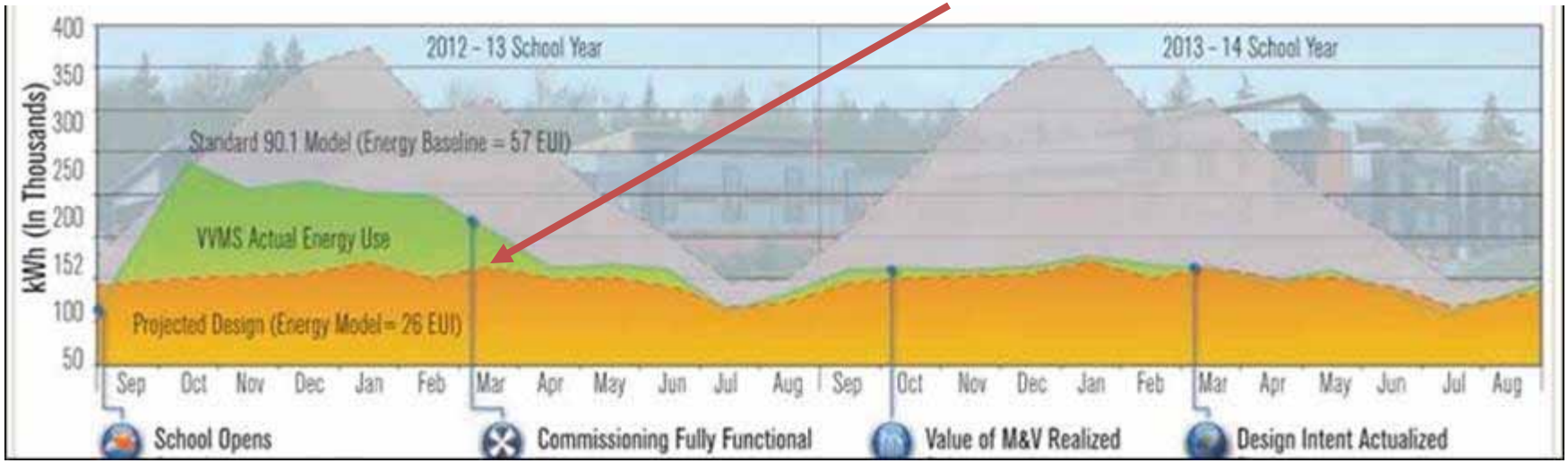
Perform a minimum number of full tests, allocate more time for targeted tests on specific issues seen in the past and issues noted during first couple full tests.

Leverage what you have (M+V, Energy Model, Enhanced BMS systems)

Build trust with contractors and owner's staff, train them to perform the bulk of the testing and to check ongoing operations frequently

Ways of decreasing cost/ Increasing Effectiveness

Build trust with contractors and owner's staff, train them to perform the bulk of the testing and to check ongoing operations frequently…

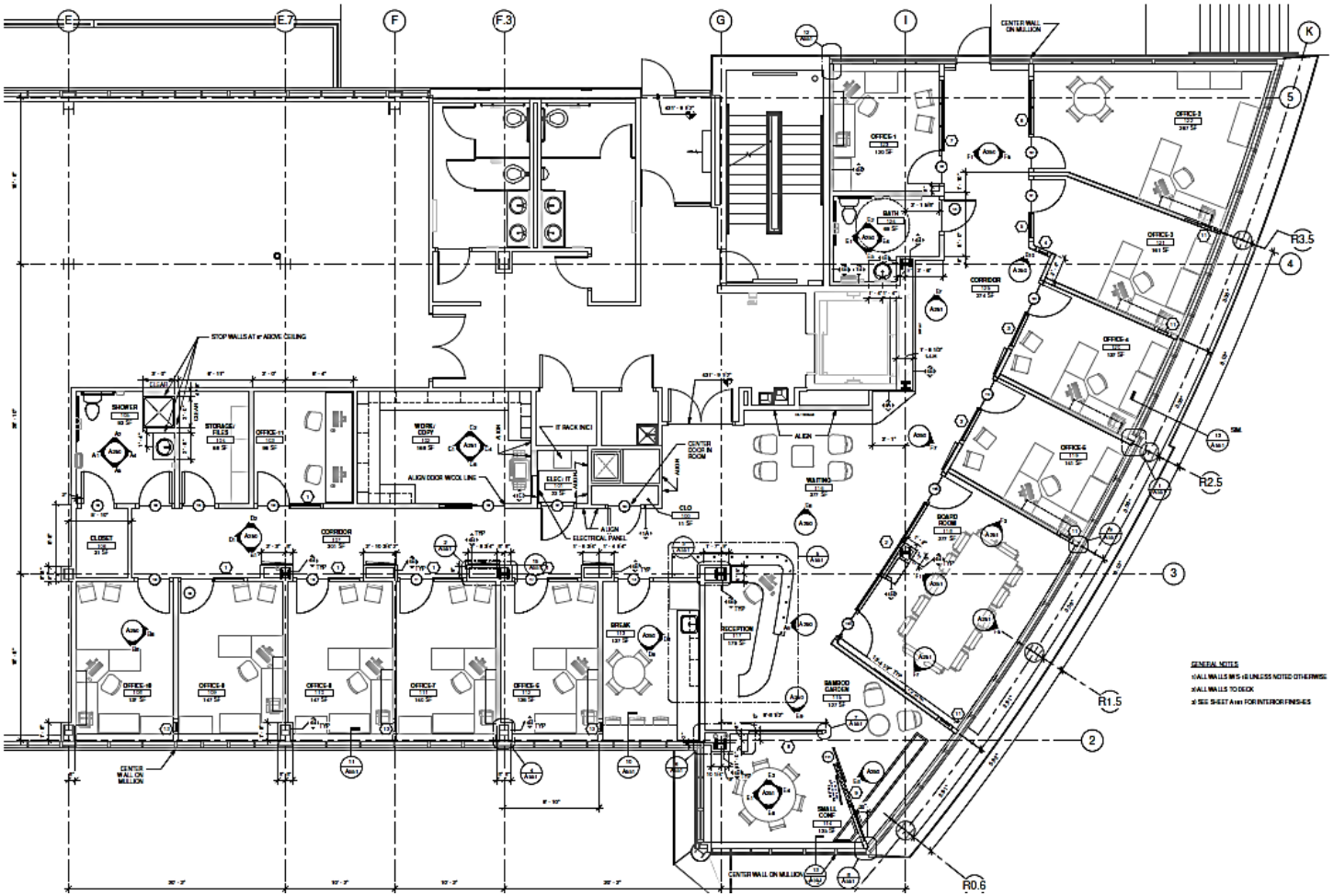


Great Chart sent to us by Josh Harwood (original source Institute of Net Zero)

Interactive Example

Lets look at a ~4,250 SF office

Has some pretty cool features



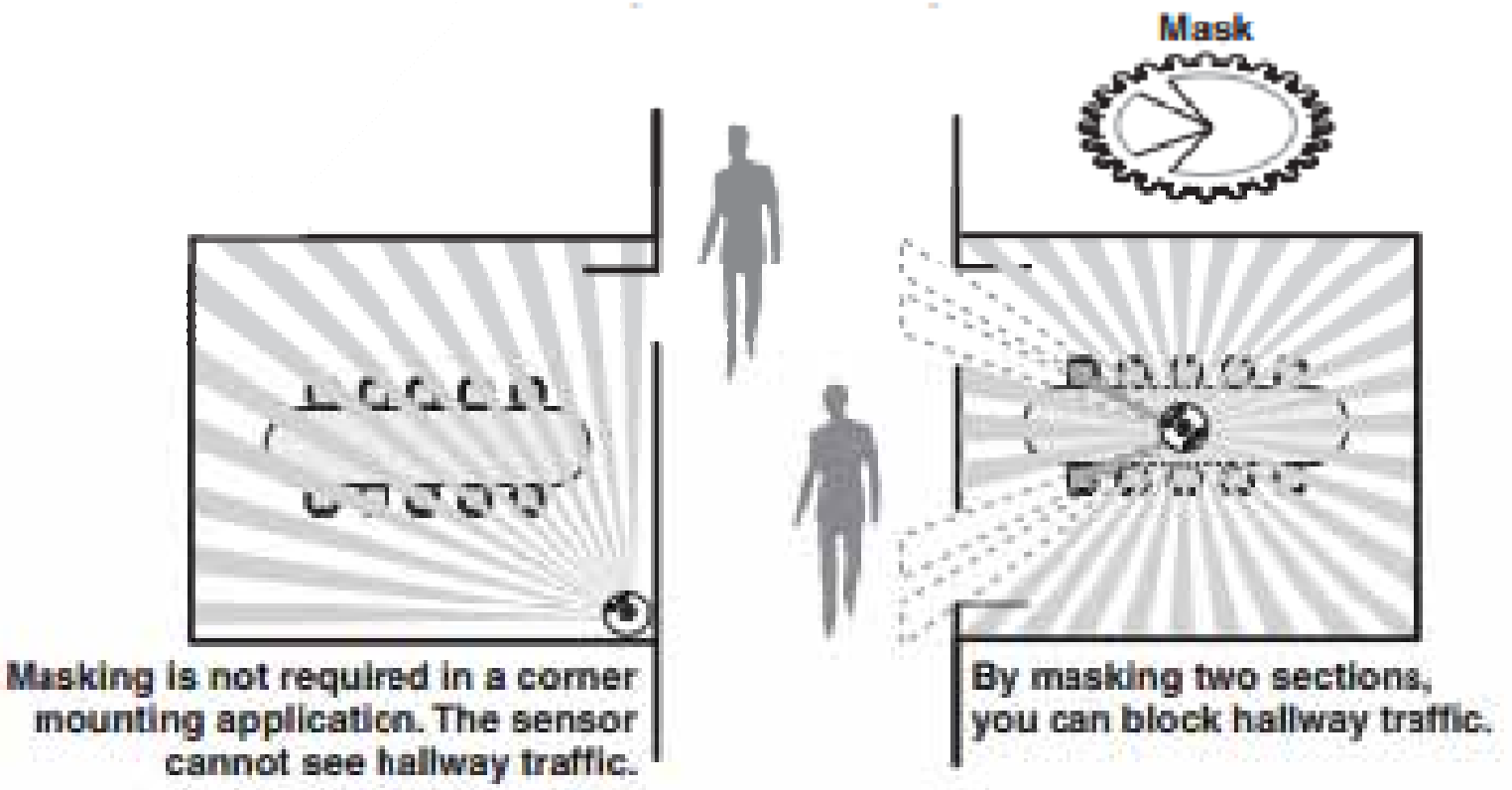
- Occupancy controlled VAV system
- Daylighting/Dimming controls

Occupancy controlled VAV zones

Issue:

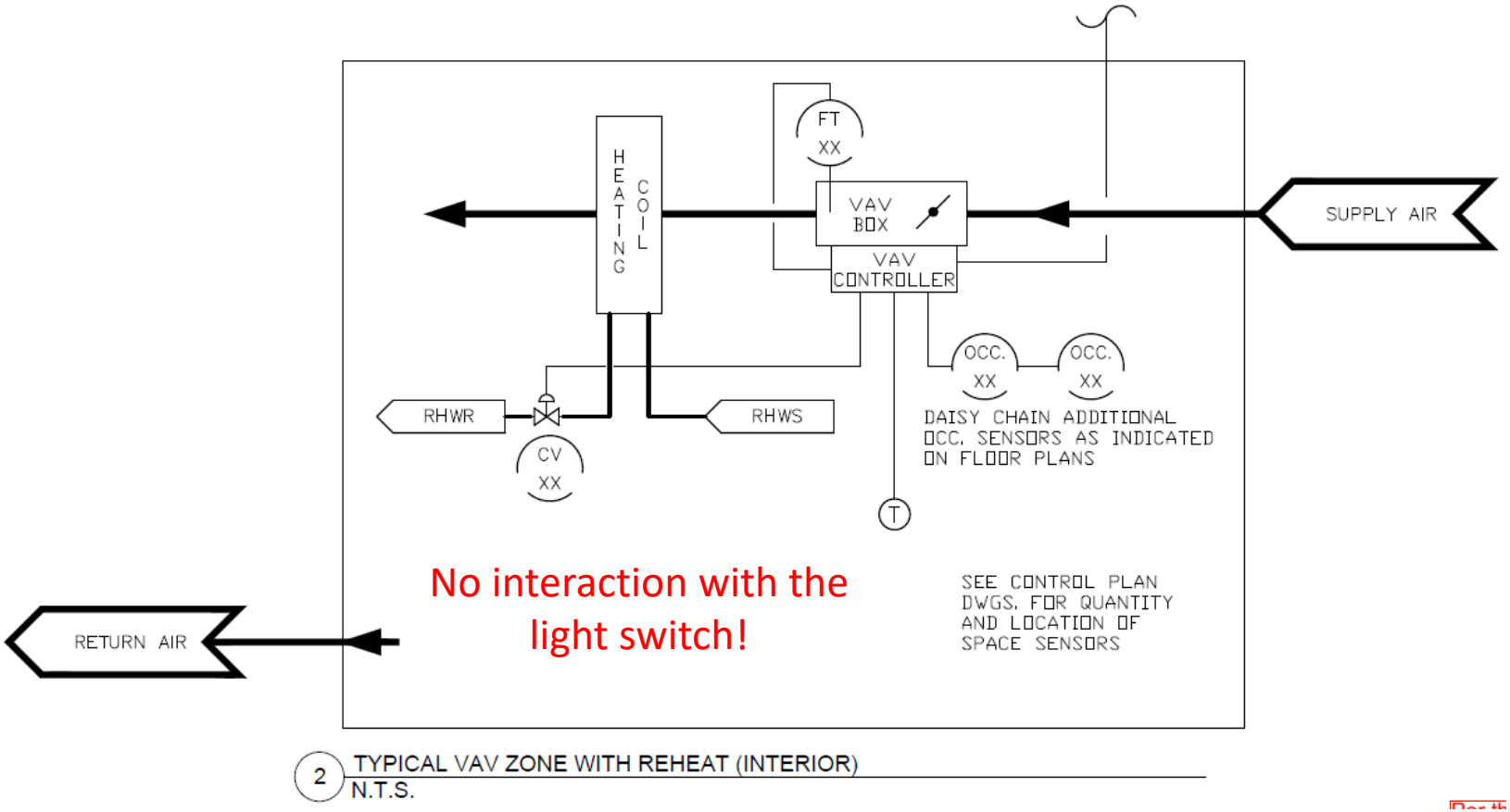
- Morning warm up

There were a couple other issues



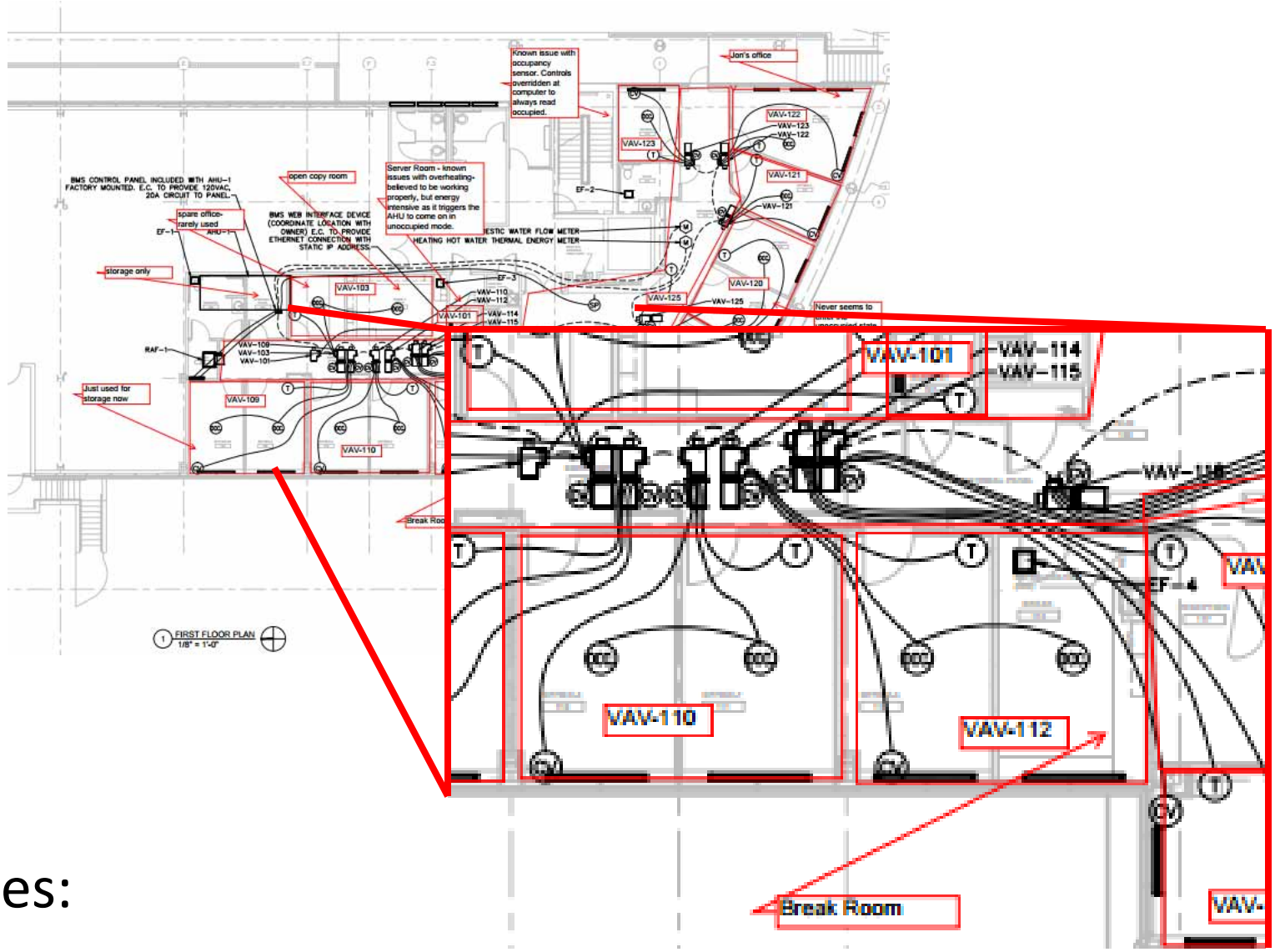
Issues:

- Morning warm up, **Nuisance triggers**



Issues:

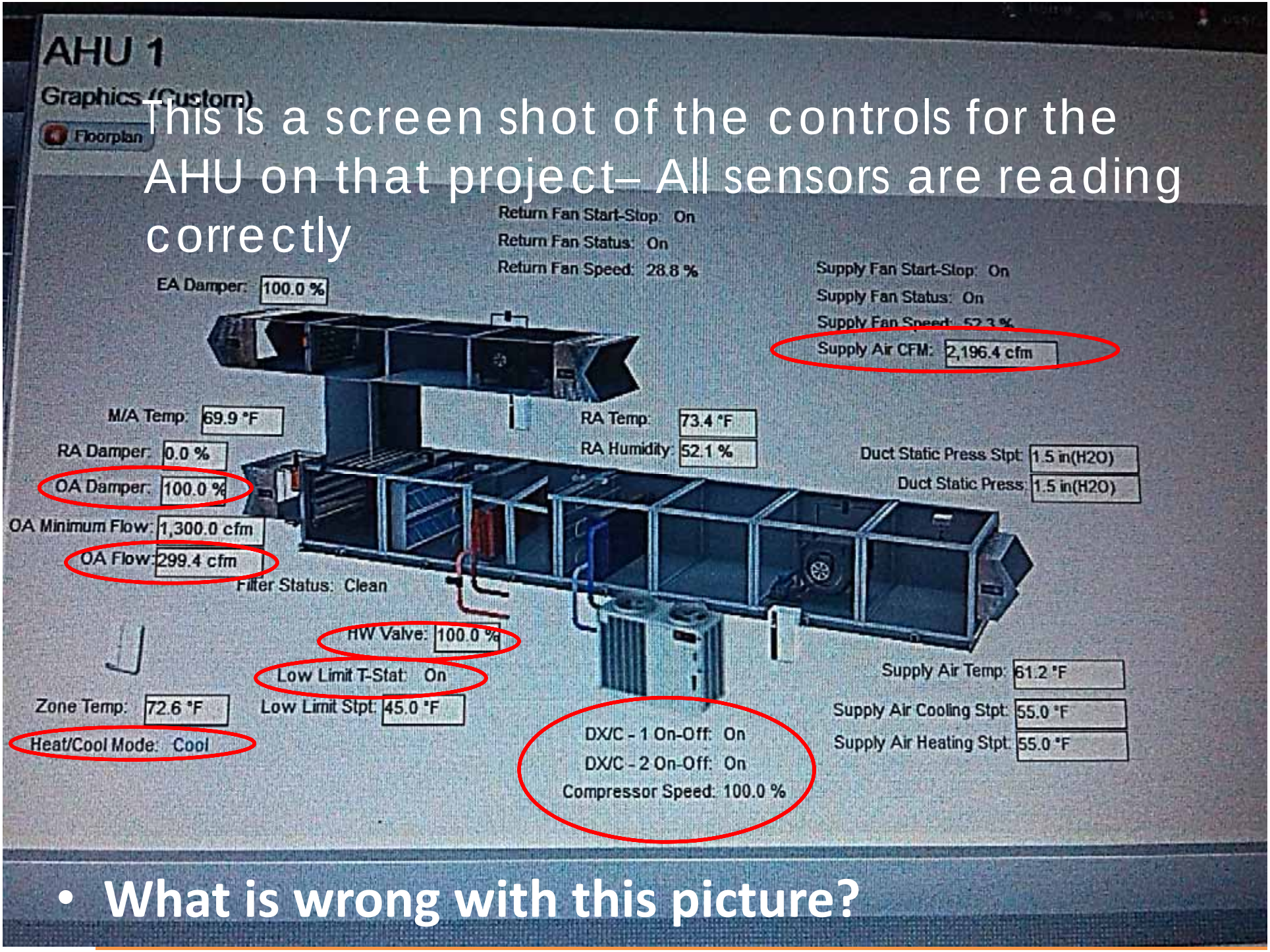
Morning warm up, Nuisance triggers, **Controls integration**



Issues:

- Morning warm up, Nuisance triggers, controls integration, **and what about zones with two rooms?**

Questions!



- **What is wrong with this picture?**

Remember the low outdoor airflow?

We found the problem…

Be Safe, Be Well and Do Good Work...

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Relief air dampers on an Roof

Zoned r
system

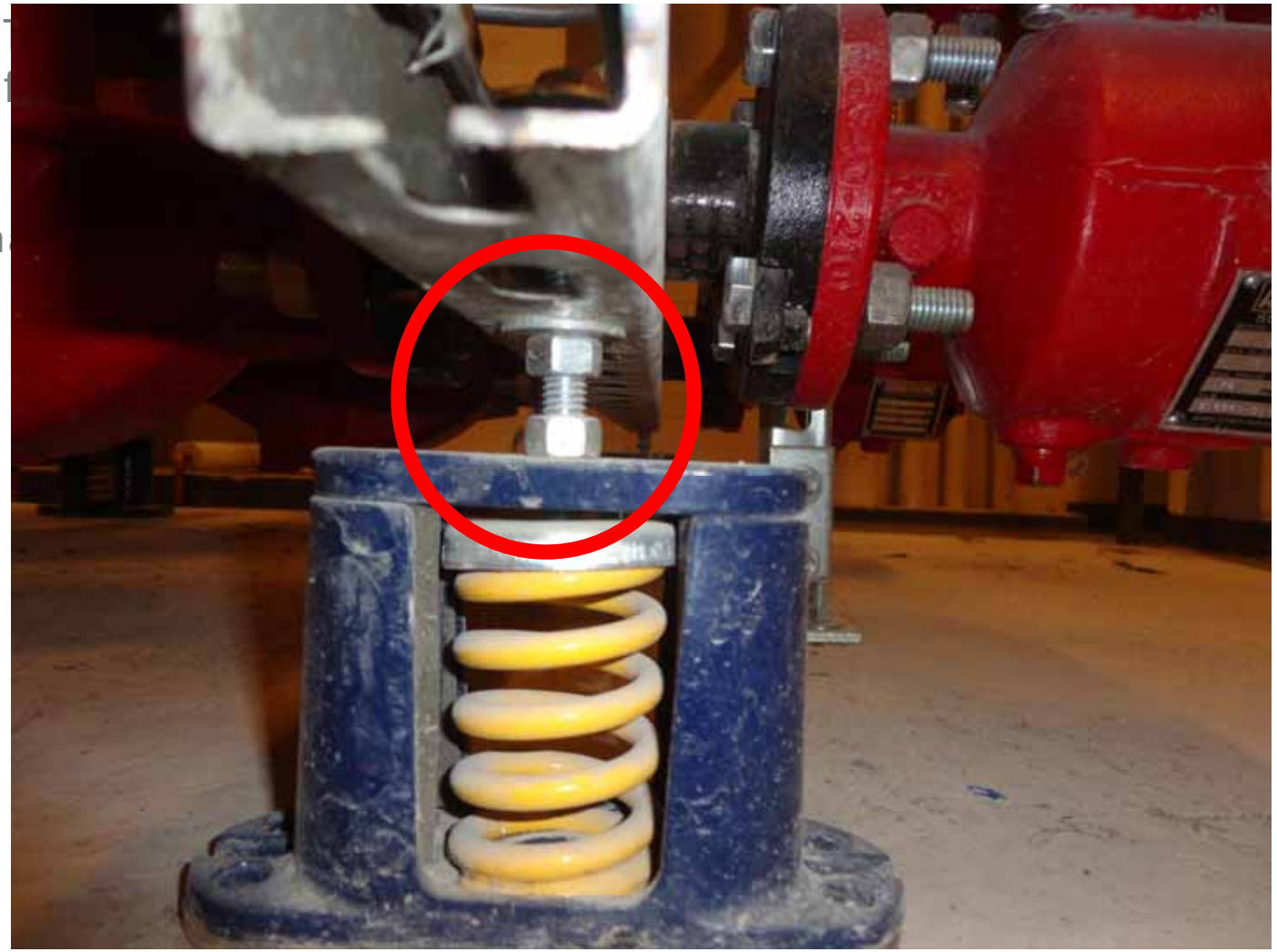
What is wror

This is a belt driven fan bringing

And just to make sure…

Where is the belt?

Wh



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Air Hand

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