

Modern Unitary Heat Pumps: What to Use & When

Melissa Schumann, Large Commercial Rooftop Portfolio Leader
Andrew Jenkins, Systems Product Leader

May 2025

WAVES of **INNOVATION**
TOGETHER WE RISE





Special Thanks to our Sponsors:



Agenda

What to use and when?



Payback



- Policy
- Incentives/Rebates
- The Future
- Efficiency

Application Considerations



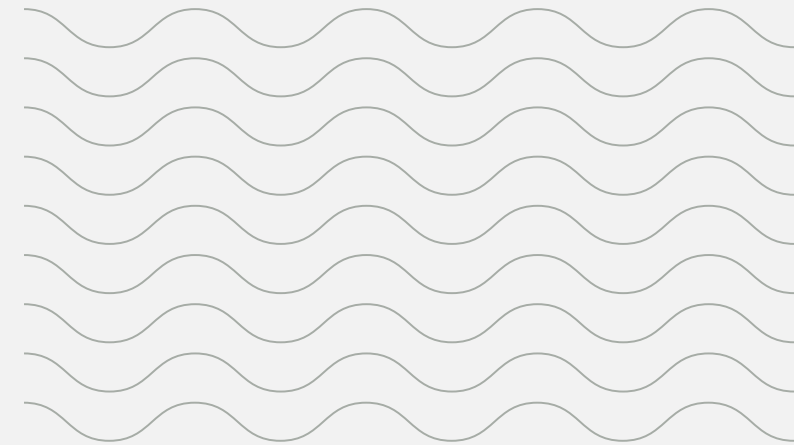
- Heat Pump vs. Dual Fuel
 - Auxiliary heat
- Managing Defrost
- Sizing
- VAV — Where is the heat?
 - Trim and Respond

A2L System Mitigation



- Leak detection and system response
- Replacement scenarios

Takeaways



Policy Levers Shaping the CHVAC Marketplace



Regulations

Building Codes

Product Regulations

Natural Gas Bans

Air Quality Regulations

Climate-Related Risk
Reporting Requirements

Clean / Renewable
Energy Standards

Taxes

Federal & State Tax
Incentives

Carbon Taxation

Natural Gas Taxation

Emissions Taxation

Standards

Appliance Standards

IAQ Standards

Clean Heat Standard

Extreme Heat Standard

Building Efficiency &
Emissions Performance
Standards

Net Zero Building Codes

Furnace Energy
Conservation Standard

Subsidies

Grants

Low-Interest Loans

Utility Rebates

Custom / Scaling
Incentives

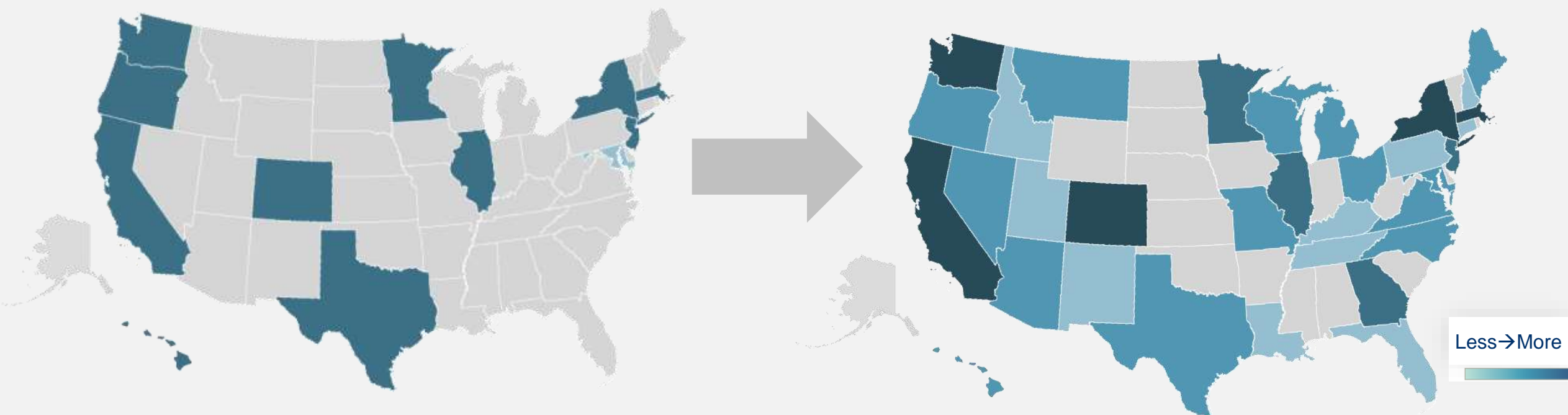
Imposed at
the
Federal,
State,
Municipal,
&
Industry
level

Building & Energy Regulatory Landscape Shifting



Usual Suspects (last 30 years)

Majority of the U.S. impacted at some level today



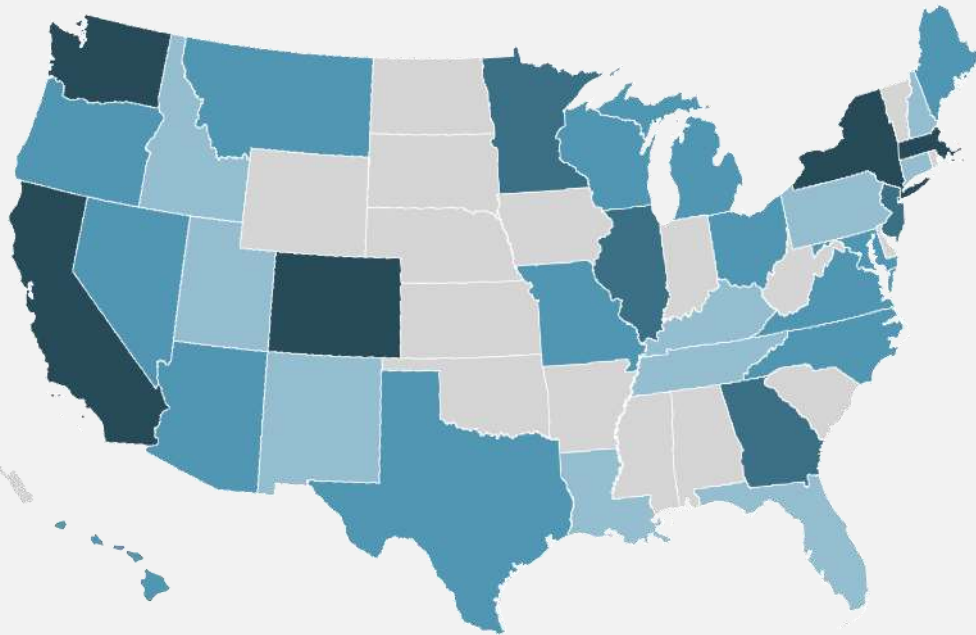
The global, national, industry, and local policy landscape is shifting faster and more dynamically than ever before.

...it Looks Similar on the \$ Front...by Design

Based on 2022-2024 data



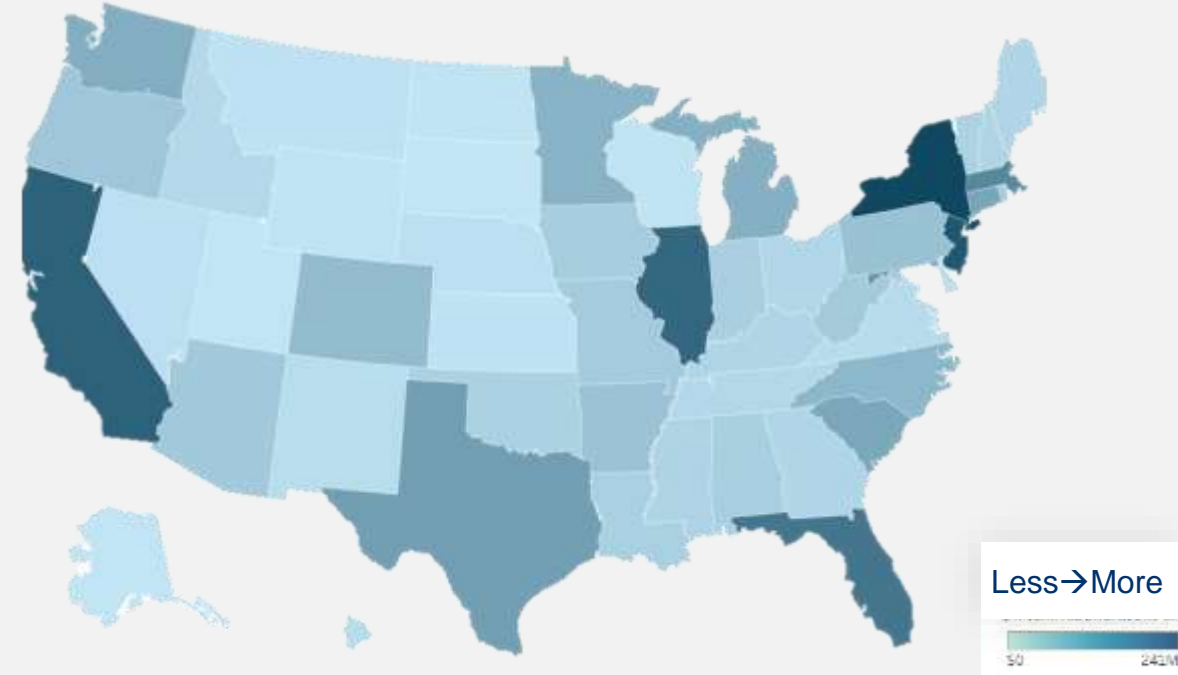
Where We're Seeing the Most Regulatory Action



Legislation, Regulations,
& Policies forcing...



Where the Most \$s are Awarded for Building & Energy Resiliency*



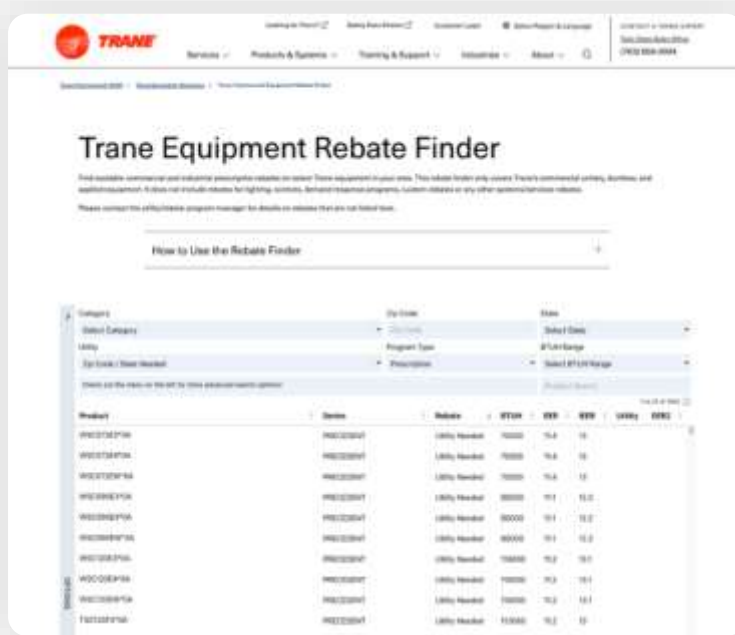
Funding & incentives
to help with...

*source: EIA Electric Power Annual report

Examples: Xcel Energy Colorado and Wisconsin



Rebates could cover the cost of switching to dual fuel!



Trane Commercial Equipment Rebate Finder



The Future



Trane Continues To Invest In Heat Pump Initiatives

Aligns with our core mission



Commercial Building Heat Pump Accelerator



- Launched April 2024
- Increase heating capacity of light commercial rooftop heat pumps at lower ambient
 - 100% heat pump capacity at 5°F, operate to -15°F
 - 140% heat pump capacity at 5°F, operate to -15°F
- Multiple phase program with lab validation
- Field test units installed for usage fall/winter 2025
- Co-development with customers

Large Rooftop Heat Pump Development

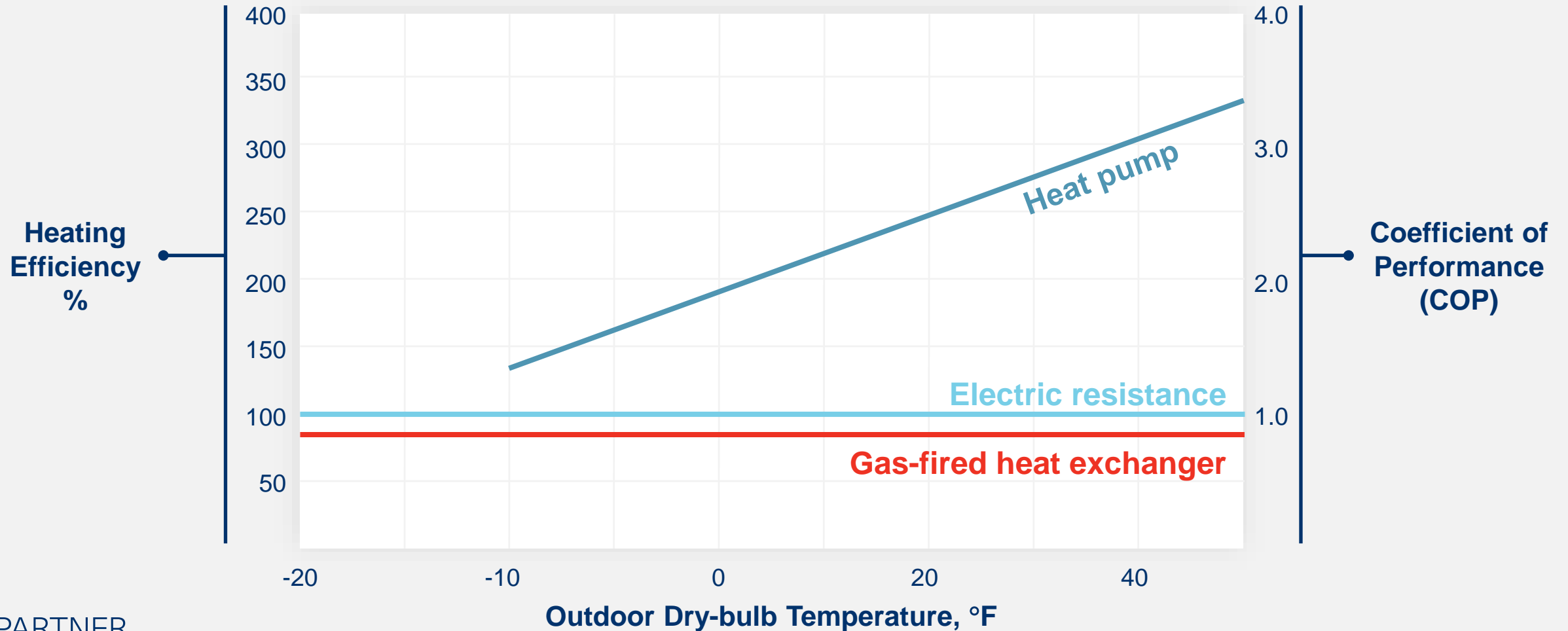


- Opportunity expanding into larger tonnage rooftop units
- Introduce flexibility for our customers to have choices
- Application complexities to consider...

Payback



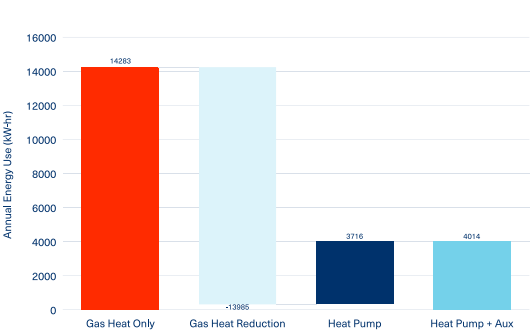
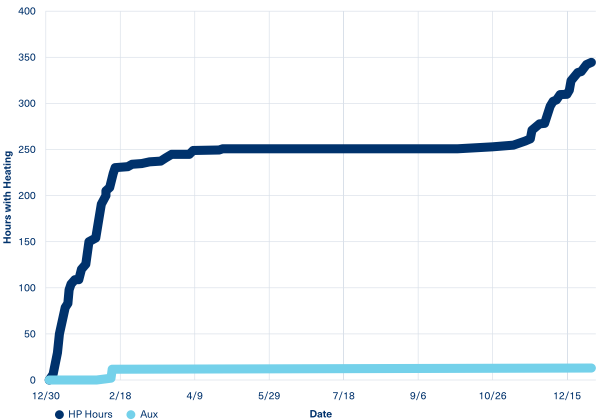
Heating System Efficiency



Decarbonization Examples

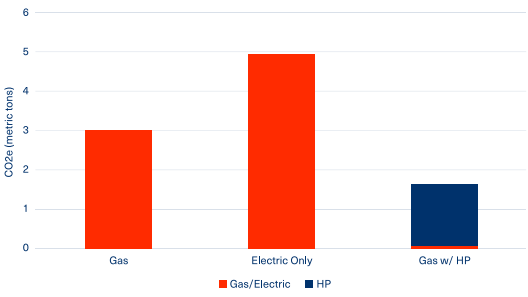


Dallas, TX



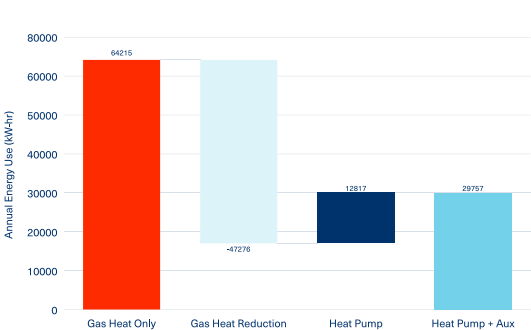
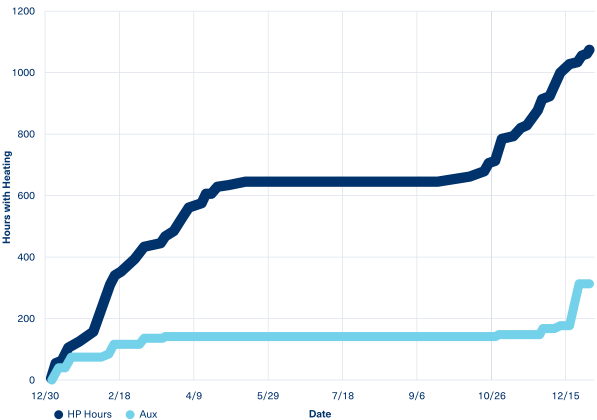
Annual Cost Analysis	Gas Heat Only	Electric Heat Only	Heat Pump/Hybrid		Hybrid Savings	
			HP		vs Gas	
\$	486	\$ 1,007		\$ 323		\$ 153
			Aux	\$ 10		
			Total	\$ 333	vs Elec	\$ 674

Annual CO2e Emissions by Heat Type



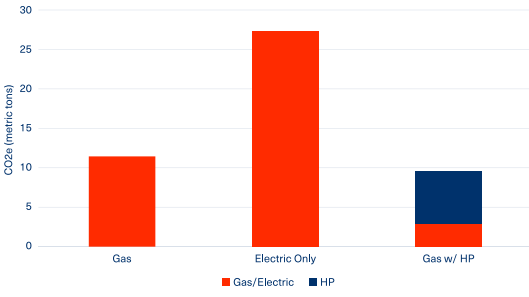
Annual Emissions Analysis	Gas Heat Only (metric tons)	Electric Heat Only (metric tons)	Heat Pump/Hybrid (metric tons)		Hybrid Savings (metric tons)	
			HP		vs Gas	
	3.0	5.0		1.6		1.3
			Aux	0.1		
			Total	1.7	vs Elec	3.3

Denver, CO



Annual Cost Analysis	Gas Heat Only	Electric Heat Only	Heat Pump/Hybrid		Hybrid Savings	
			HP		vs Gas	
\$	2,360	\$ 5,878		\$ 1,448		\$ 289
			Aux	\$ 623		
			Total	\$ 2,071	vs Elec	\$ 3,807

Annual CO2e Emissions by Heat Type

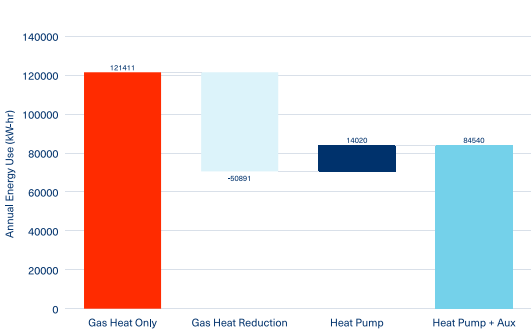
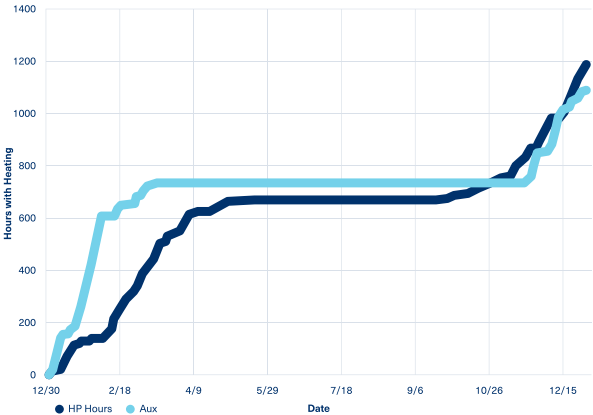


Annual Emissions Analysis	Gas Heat Only (metric tons)	Electric Heat Only (metric tons)	Heat Pump/Hybrid (metric tons)		Hybrid Savings (metric tons)	
			HP		vs Gas	
	11.6	27.5		6.8		1.8
			Aux	3.1		
			Total	9.8	vs Elec	17.7

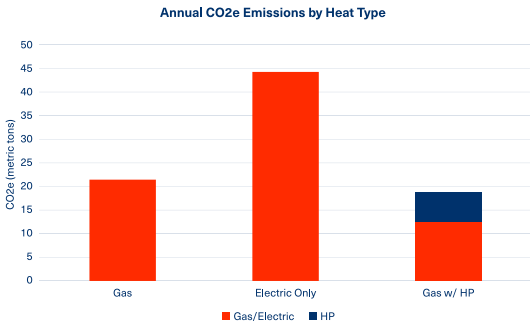
Decarbonization Examples



Minneapolis, MN

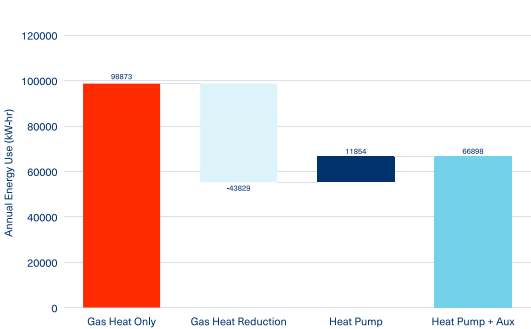
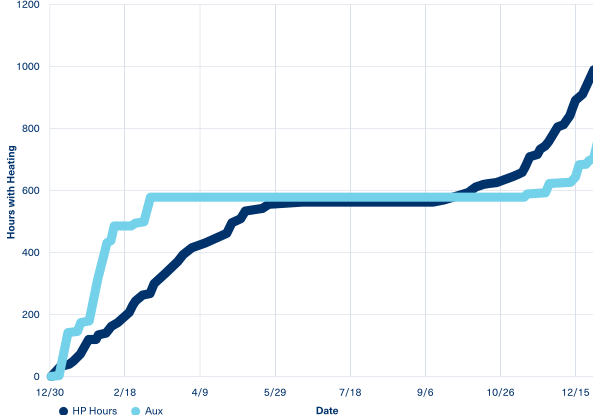


Annual Cost Analysis	Gas Heat Only	Electric Heat Only	Heat Pump/Hybrid		Hybrid Savings	
			HP		vs Gas	
\$	6,825	\$ 12,588	\$ 1,795		\$ 1,066	
			Aux		vs Elec	
			\$ 3,964		\$ 6,829	
			Total	\$ 5,759		

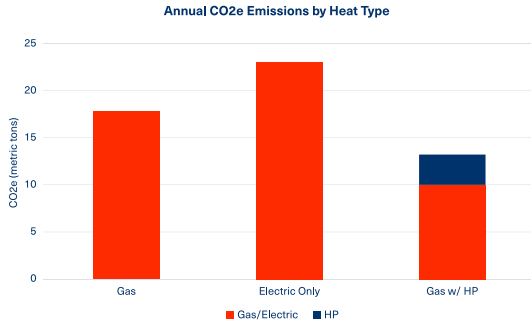


Annual Emissions Analysis	Gas Heat Only (metric tons)	Electric Heat Only (metric tons)	Heat Pump/Hybrid (metric tons)		Hybrid Savings (metric tons)	
			HP		vs Gas	
	21.9	44.7	6.4		2.8	
			Aux		vs Elec	
			12.7		25.6	
			Total	19.1		

Billings, MT



Annual Cost Analysis	Gas Heat Only	Electric Heat Only	Heat Pump/Hybrid		Hybrid Savings	
			HP		vs Gas	
\$	4,903	\$ 9,851	\$ 1,458		\$ 715	
			Aux		vs Elec	
			\$ 2,730		\$ 5,663	
			Total	\$ 4,188		



Annual Emissions Analysis	Gas Heat Only (metric tons)	Electric Heat Only (metric tons)	Heat Pump/Hybrid (metric tons)		Hybrid Savings (metric tons)	
			HP		vs Gas	
	17.9	23.2	3.4		4.5	
			Aux		vs Elec	
			9.9		9.8	
			Total	13.4		

Application Considerations



What's the difference?



Heat Pump

- All electric (cooling & heating)
- Optional auxiliary electric heat internal to unit



Dual Fuel/Hybrid

- All electric cooling
- Heating through refrigeration cycle and gas auxiliary heat



Both: Heat Pump and Electric Heat

- Cooling mode **exactly the same**
- Four-way reversing valve for heat
 - Switchover point input needed for auxiliary heat
- External heat in VAV boxes available

Heat Pumps and Dual Fuel Options Available Now in R-454B



Precedent® Models — Heat Pumps



	Hybrid Dual Fuel Heat Pumps	Heat Pumps
Models	DSK/DHK	WSK/WHK
Capacities	3-25 Tons	3-25 Tons
Fuel Type	Electric Heat Pump + Gas	Electric Heat Pump + Optional Aux Electric Resistance
Efficiencies	Standard & High Efficiency	Standard & High Efficiency
Unit Controller	Symbio® 700 with Service & Installation App	Symbio® 700 with Service & Installation App
Warranty	3 Year Parts, 5 Year Compressor	3 Year Parts, 5 Year Compressor
Humidity Control (HGRH) Option	Yes	Yes
Stable Temperature Control (Modulating Gas Heat) Option	10:1 Natural Gas, 6:1 LP	10:1 Natural Gas, 6:1 LP
Refrigerant	R-454B	R-454B
Supply Air Options	Multi-Speed, Single Zone VAV & Multiple-Zone VAV	Multi-Speed, Single Zone VAV & Multiple-Zone VAV

Auxiliary Heat Types



The Trane Way

Heat Pump with Auxiliary Electric Heat



- Electric heat operates as **supplemental to** heat pump heating

Heat Pump with Auxiliary Gas Heat



- Gas heat operates **mutually exclusive with** heat pump heating



✓ User Determined Heat Pump Heating Lockout Setpoint

- Defaulted temperature (0 °F)
- When outdoor air temperature falls below the heat pump heating lockout setpoint, heat pump operation is disabled, control will transition to auxiliary heat (if installed)

✓ Heating Lockout Point Can Be Selected Based On:

- Balance point
- Comfort level
- Local utility rates

Replacement Scenarios



Electric Heat to Heat Pump with Electric Resistance Auxiliary

- Electrical connections are in the same locations
- Likely no need to upgrade the electrical supply

EASY

Easy replacement opportunity



Gas Heat to Dual Fuel

- Gas and electrical connections are in the same locations
- Likely no need to upgrade the electrical supply

EASY

“Easy as replacing a Trane gas heat with a new gas heat unit”



Gas Heat to Heat Pump

- Need for relocating the current gas supply
- May require an upgraded electrical supply if auxiliary heat is needed

MORE DIFFICULT

More difficult replacement opportunity

Note: In all cases, be cognizant of weight

Reliability & Maintenance



Reliability

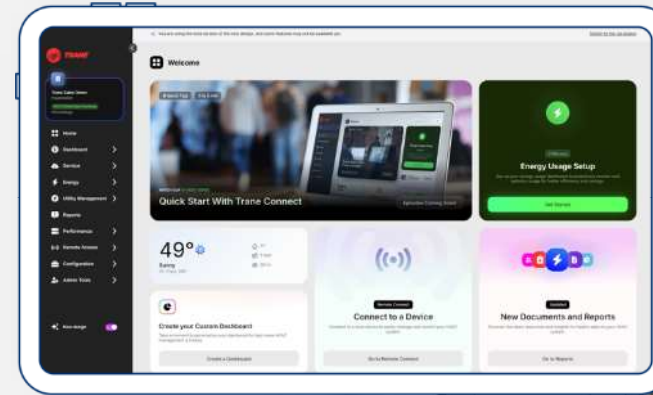
- No proven reliability issues in HPs as compared to non
 - Trane is constantly analyzing the quality data
- Compressors benefit from longer run time, especially at design points
 - Good oil return
- Compressors are designed for both heating and cooling operation
- Symbio improves reliability & enables connectivity



Trane Unitary has had heat pumps for over 40 years and dual fuel for almost 10!

Maintenance

- No difference to planned maintenance schedule
- Plan maintenance for shoulder seasons
- Check on units remotely via **Trane Connect with internet access**



Defrost Considerations



Two common schemes for heat pump outdoor coil defrosting:

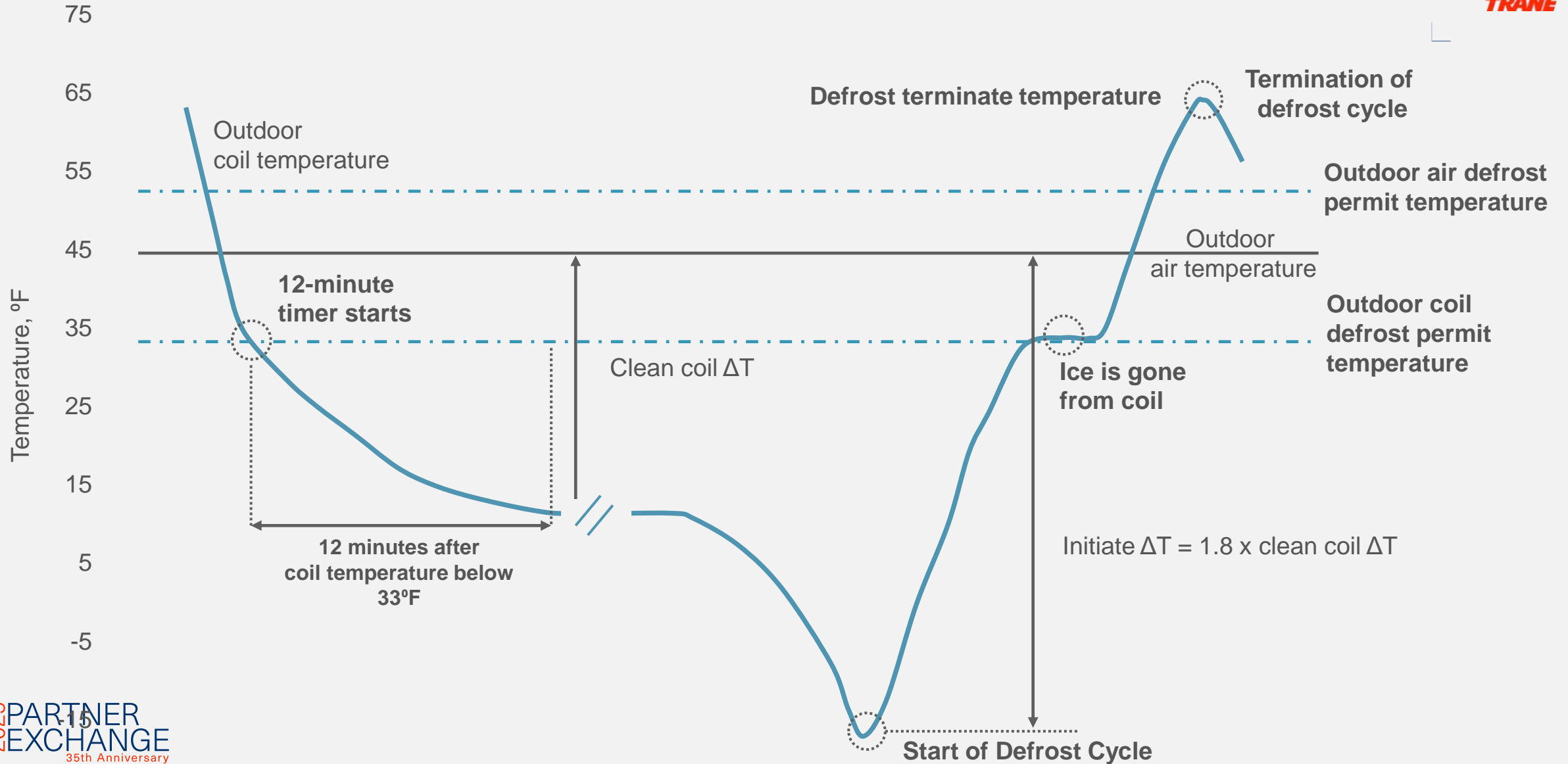
- **Demand Defrost:** More efficient, initiates defrost cycles only when necessary
- **Time Temperature Defrost:** Initiates defrost cycles based on operating time below the threshold temperature

Demand Defrost Cycle

- Occurs below 52 °F OAT and Outdoor Coil below 33 °F
- Automatic defrost mode
- Controlled to reduce performance impact
 - **Auxiliary heat recommended, automatically engages during defrost cycle**



Heat Pump Terminology | Demand and Timed Defrost



Heat Pump Terminology | Coil Frosting



Coil Frosting



Coil Defrost



Heat Pump Sizing | Determining the RIGHT Size



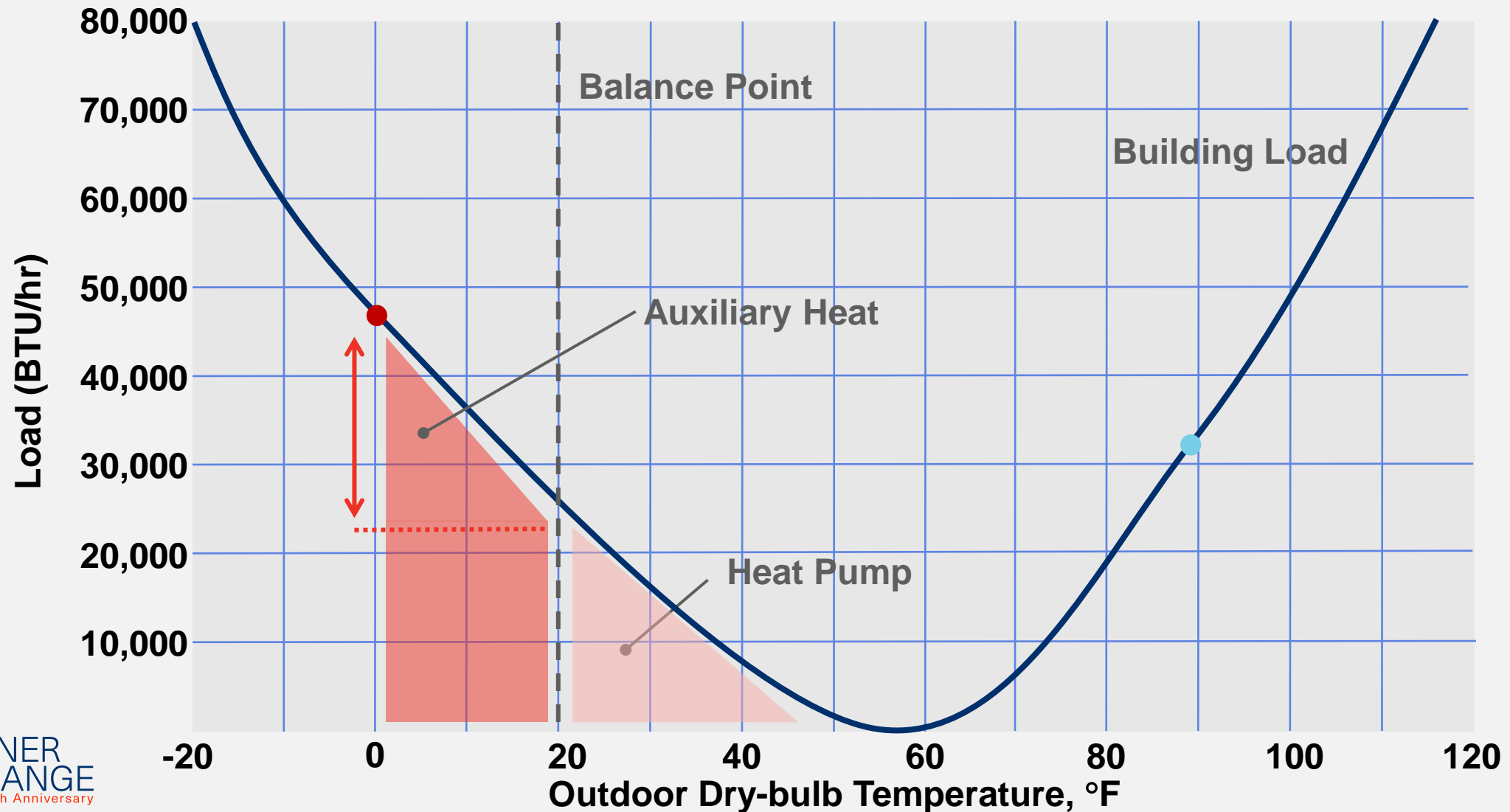
- 1 **Perform** a load analysis
- 2 **Determine** cooling and heating load at design day conditions
- 3 **Select** unit based on cooling load
- 4 **Decide** if heating capacity is large enough
- 5 Is **auxiliary heat** required?



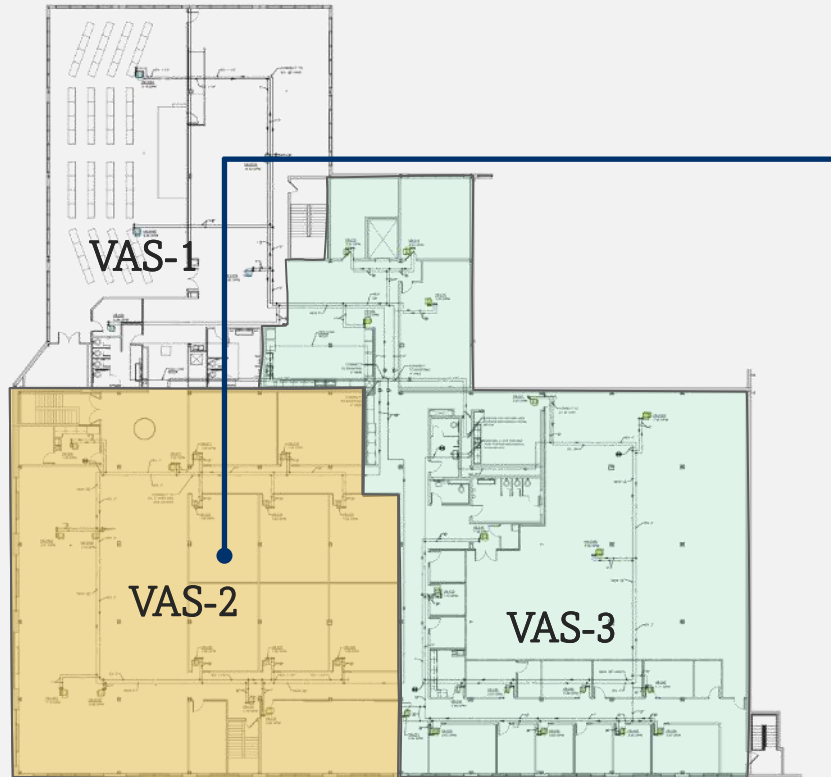
Climate conditions determine the need

Single Zone Applications

Do I need auxiliary heat?



Multiple Zone VAV System Heating



Two Story 79,338 ft² La Crosse, WI

- First Floor — manufacturing space, technical training, office space
- Second Floor — offices, breakout rooms, lecture hall, student lounge

VAS-2: 16 Zones 10470CFM Design Air Flow

- Many conference rooms/variable occupancy rooms
- Northwest Corner



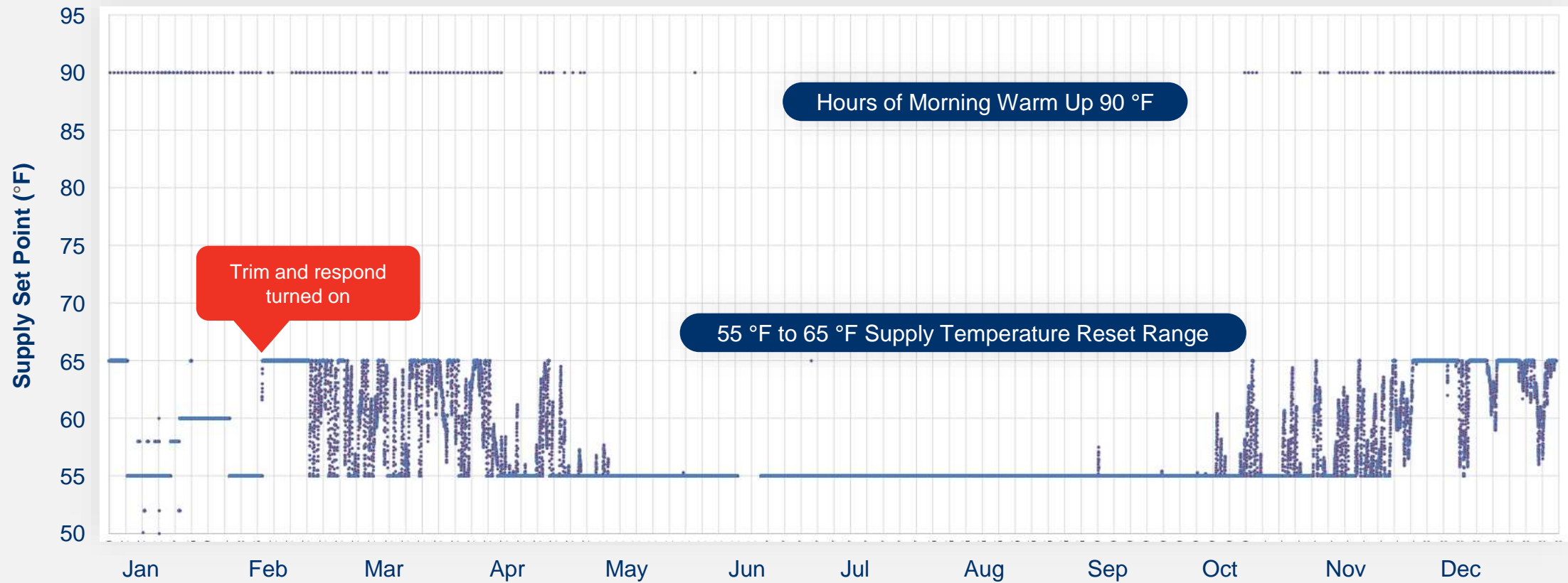
How much heat is needed from boxes vs. rooftop unit?

How much of this heat is “reheat?”

Multiple Zone VAV System Heating



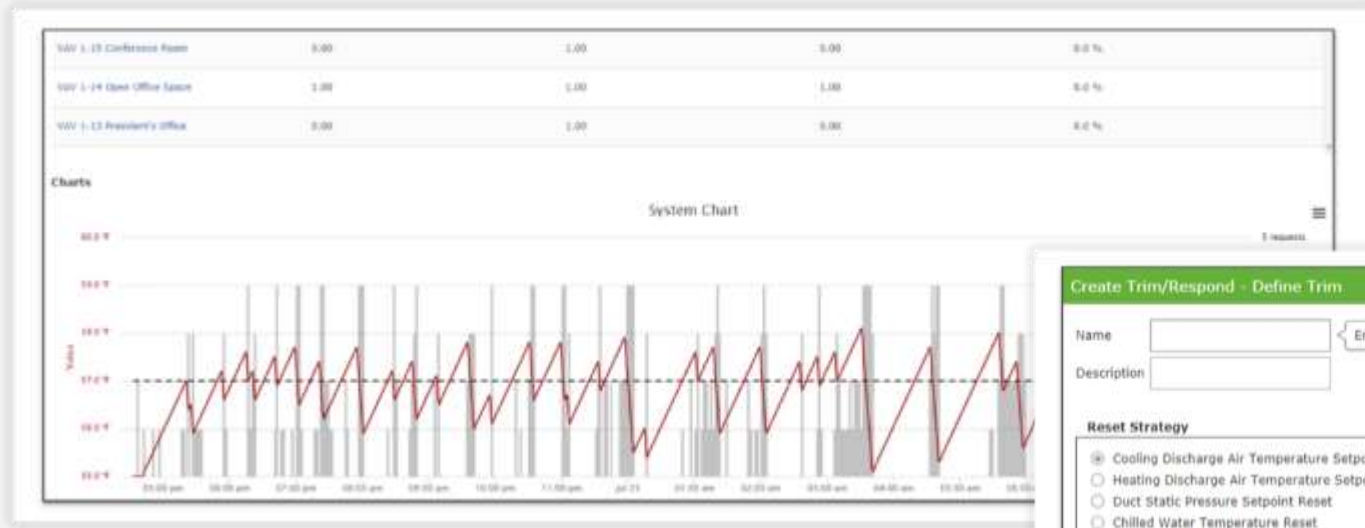
Supply Air Setpoint vs. Operating Hour



Trim and Respond

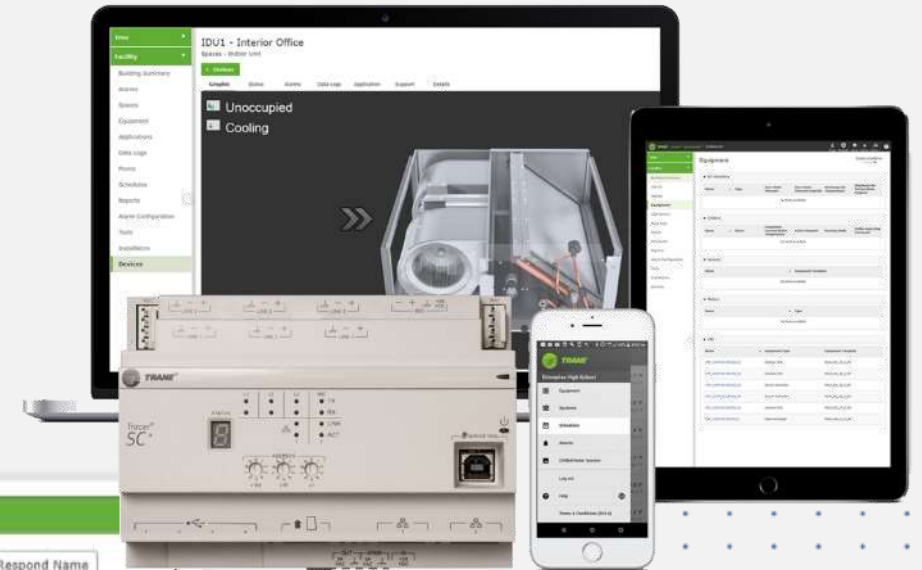


- Trim and respond is a feedback loop control method
- Intended to be a hunting loop with no “sweet spot”
 - Seeking balance between comfort and energy efficiency



The screenshot shows the 'Create Trim/Respond - Define Trim' form. It includes fields for 'Name' and 'Description', with a placeholder 'Enter Trim/Respond Name' for the name. Below these fields is a 'Reset Strategy' section with a list of radio button options:

- ☒ Cooling Discharge Air Temperature Setpoint Reset
- ☐ Heating Discharge Air Temperature Setpoint Reset
- ☐ Duct Static Pressure Setpoint Reset
- ☐ Chilled Water Temperature Reset
- ☐ Chilled Water Plant Enable
- ☐ Chilled Water Pump Pressure Reset
- ☐ Hot Water Temperature Reset
- ☐ Hot Water Plant Enable
- ☐ Hot Water Pump Pressure Reset
- ☐ Custom Reset



Multiple Zone VAV System Heating La Crosse, WI

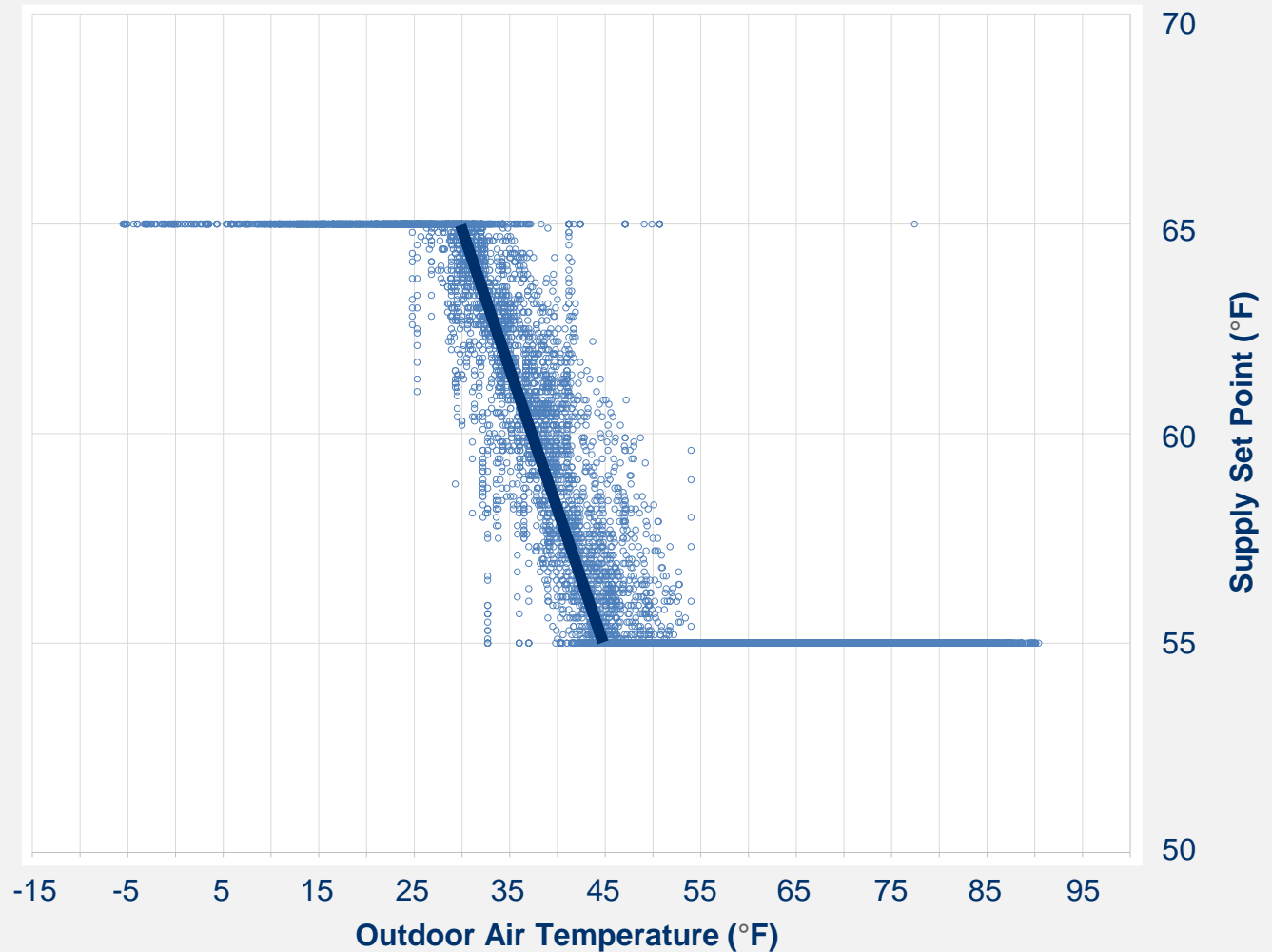
Supply Temperature Reset at the Air Handler — Annual logged data at 15-minute intervals



Typical of most buildings

- Primarily Cooling $>45^{\circ}\text{F}$
- Primarily Heating $<35^{\circ}\text{F}$
- Transition $35\text{-}45^{\circ}\text{F}$

Trim and respond is more precise at meeting building needs by looking at the zones vs. OA temp



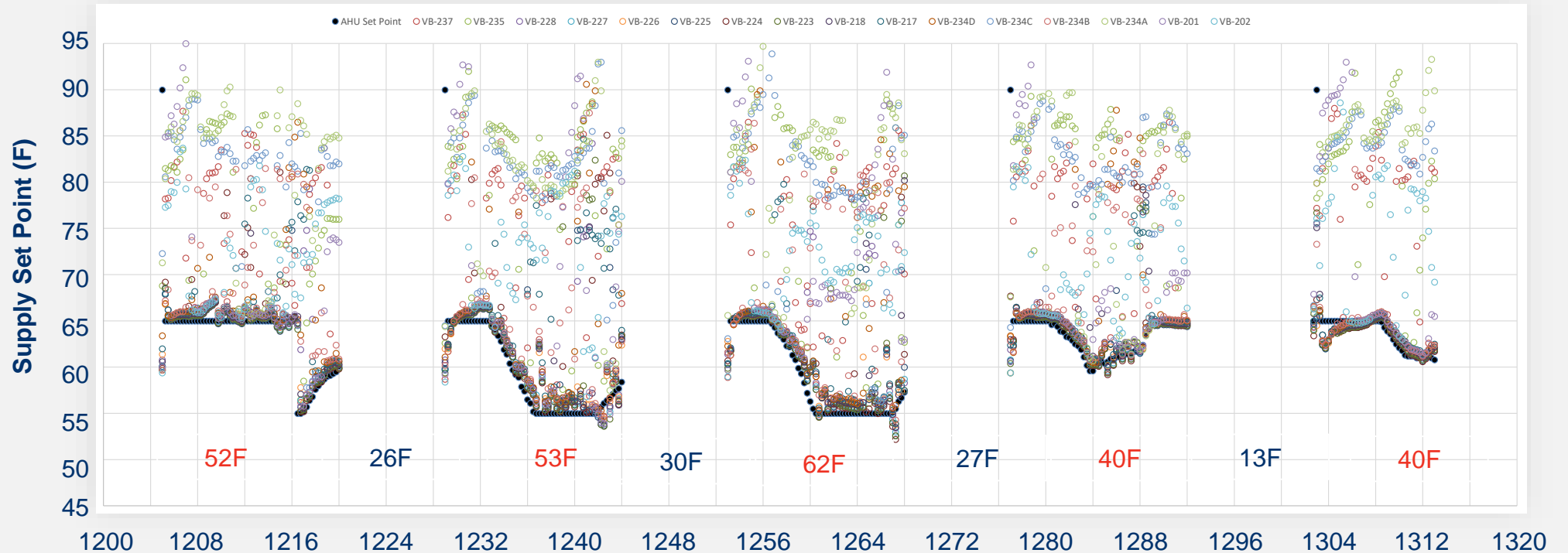
Multiple Zone VAV System Heating



AHU Supply Temperature vs. VAV Boxes — 5-day sample data at 15-minute intervals

- Unit starts up with warm up set point of 90 °F, however system does not need it and resets to 65 °F
- Majority of zones need little heat, when colder supply is needed temperature is reset down

Sample of AHU Supply Air Temperature vs. Zone Supply Temperature: Feb 20-24



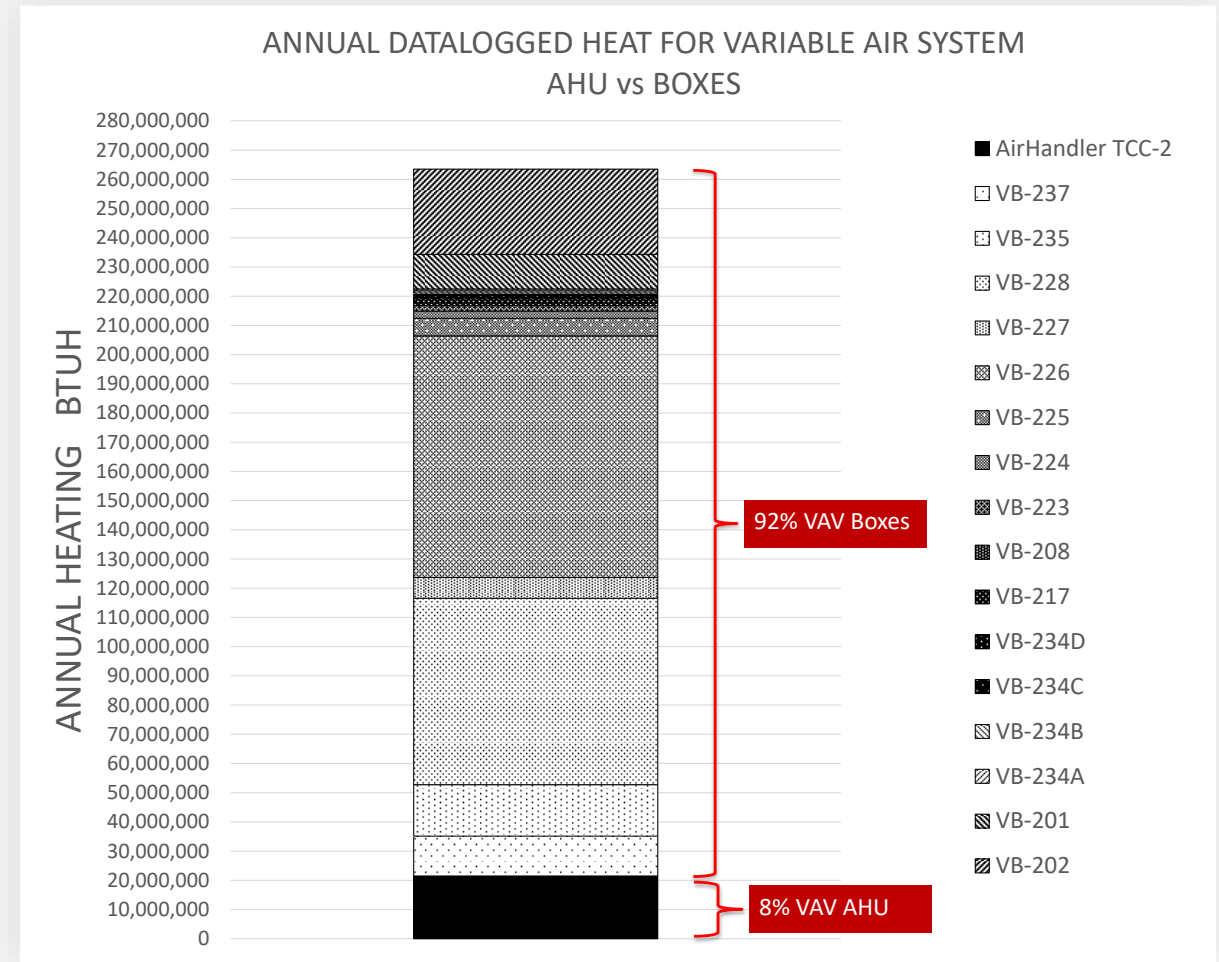
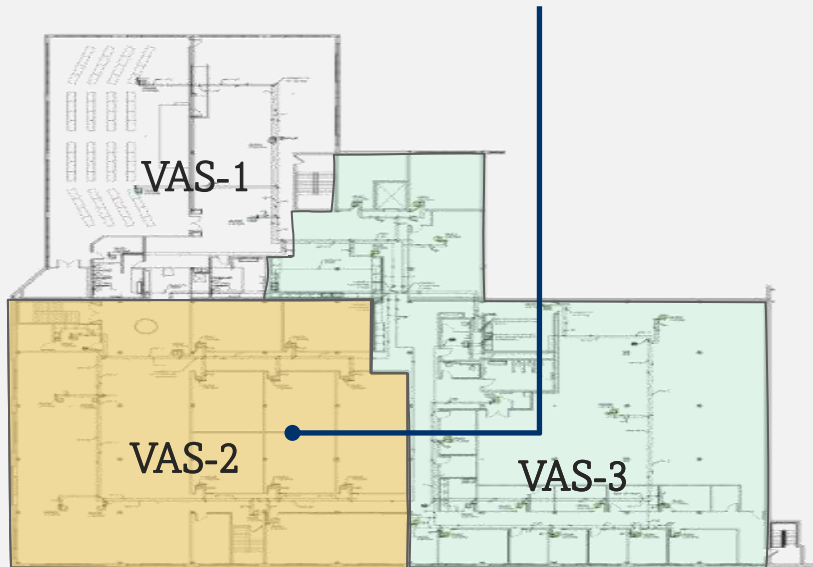
Discharge air temp should be no higher than 65 °F — zone diversity drives this

Multiple Zone VAV System Heating



Installed heating capacity does not reflect where heating occurs

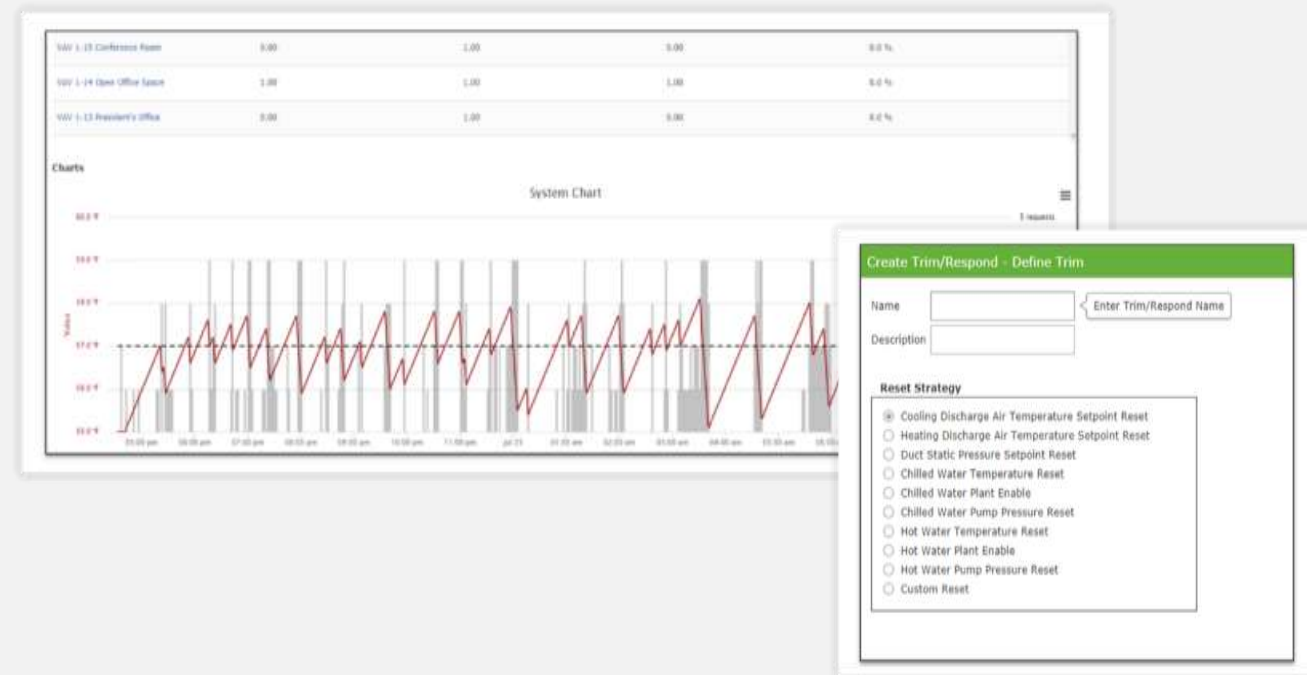
- Majority of the heat is from VAV boxes
- Installed capacity for 10,470cfm system
 - AHU = 450MBH
 - Total for 16 VAV Boxes = 350MBH



Multiple Zone VAV Application Considerations



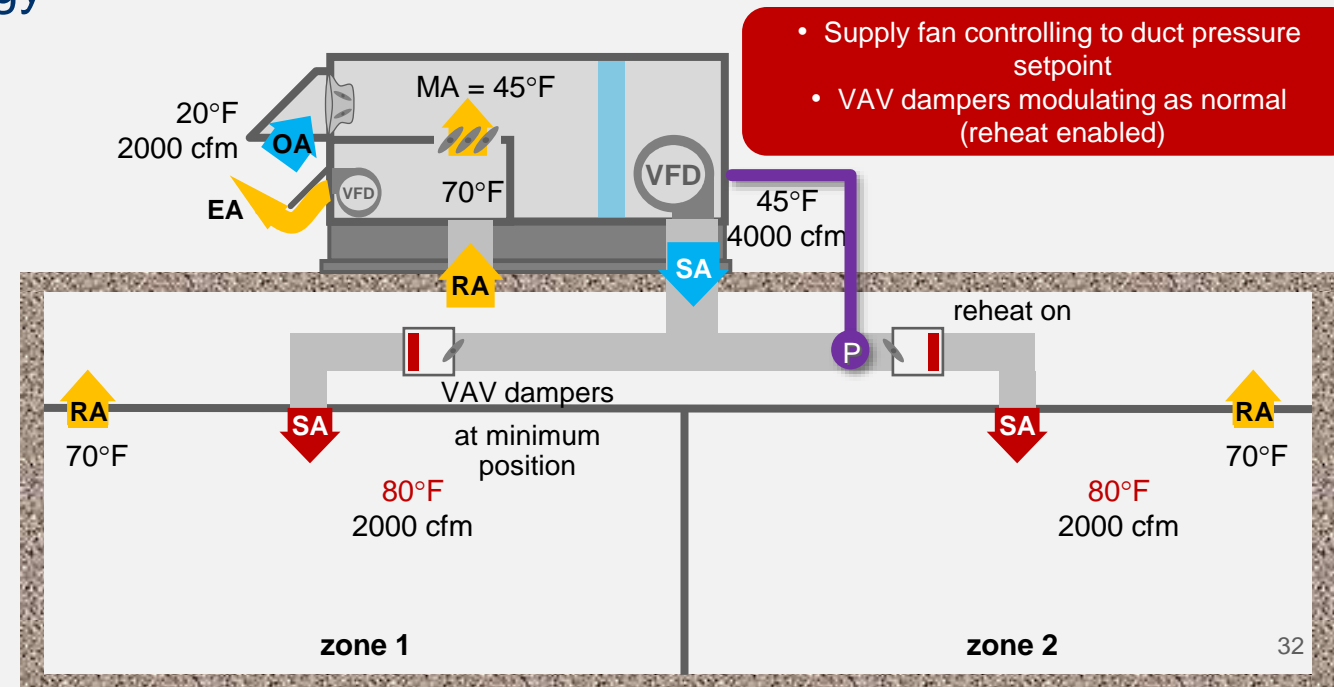
- Unit is sized for cooling
- Auxiliary heating or dual fuel should be sized for back up heat
- Guideline 36 — discharge air reset should be employed to reduce VAV box reheat
 - Reset points between 55-65 °F
 - Trim and Respond is a standard application in Tracer[®] SC+
- Heat pump is capable of supply air tempering during occupied operation



Heat pump applications with electric heat in boxes



- ~40% of IntelliPak® are cooling only
- ~40%-70% of VAV boxes are electric and growing
- Using a heat pump RTU can offload electric box demand and shift to more efficient RTU
 - Using HP for Morning warm up and occupied heating needs
- Using trim and respond reduces overall energy use
- Quick replacement opportunity
 - No difference in electrical requirements
 - More efficient
- New design considerations
 - Reduce electric heat in boxes
 - No additional electrical requirements



A2L System Mitigation for VAV Air Systems

For Equipment with R-454B Refrigerant



Leak Detection Systems and VAV System Mitigation



- **Per UL 60335-2-40** leak detection is required in ducted HVAC systems that have more than 3.91lbs of R-454B refrigerant charge in a circuit
- **Leak detection systems**
 - Factory installed in the unit
 - Must act quickly (<15 seconds) and at low levels (25%) of lower flammability limit
 - Signal mitigation efforts in unit controls
- **Trane factory installed LDS benefits**
 - Reduces the risk of improper installation in the field
 - Bypasses the added cost in the field for installation
 - Capable of integrating into BAS

Table 1. Example office building served by the rooftop VAV system

Occupied Space	Volume of Space, ft ³	V _{eff} , ft ³
Office 2	2695	61,072
Conf Room 1	3144	
Conf Room 2	3327	
Data Center	3593	
Conf Room 3	3826	
Office 3	3992	
Office 1	5389	
Lounge	7319	
Reception	8383	
Corridor 1	2146	
Corridor 2	2146	
Work Space	6387	
Ceiling Plenum	8725	

Systems with air circulation

If the system has either continuous air circulation (except during short periods for maintenance or repair) or air circulation that is initiated by a refrigerant detector that conforms to Section 7.6.2.4, the EDVC is as follows (per Section 7.6.1).

$$EDVC = LFL \times V_{eff} \times CF$$

where,

EDVC = effective dispersal volume, lb (kg)

V_{eff} = effective dispersal volume, ft³ (m³)

LFL = lower flammability limit of refrigerant, lb/ft³ (kg/m³)

CF = concentration factor = 1.0 for institutional; 1.0 for a

F_{occ} = occupancy adjustment factor (0.5 for institutional; 1.0 for a

Refrigerant Leak Detection Systems

The new Trane standard for Unitary Products



Trane is going the extra mile to help you meet new safety requirements for equipment containing A2L refrigerants with low flammability. Our factory-installed leak detection systems eliminate any uncertainty regarding when monitoring is required and how to implement it.

Trane is making refrigerant leak detection systems standard on commercial unitary products with more than 3.91 lbs. of refrigerant charge per circuit, including:



Safety is our priority. On units that require leak detection, Trane will provide the multi-level support you need to feel confident about using next-generation refrigerants.

- Factory-installed leak detection systems with one or more sensors
- Automatic activation of emergency vents
- Provides BAS permits to allow for detection and mitigation reconfiguration

Keeping you in compliance. According to safety standard UL 60335-2-40, ducted HVAC systems that have more than 3.91 lbs. of A2L refrigerant charge will be required to include one or more refrigerant detection sensors.

Mitigation Tactics

Standard leak detection systems monitor for leaks and activate the following mitigation steps when necessary:

1. Supply fans activated to deliver production airflow
2. Compressors turned off and disabled
3. Zone dampers fully opened (such as VAV boxes)
4. Additional mechanical ventilation activated (if required)
5. Mitigation will continue until refrigerant has not been detected for at least five minutes

This means worry-free design, installation and operation

Learn more by watching the Engineering Newsletter Live:

[Trane Education Center — ASHRAE Standard 15-2022 \(2023\)](#)

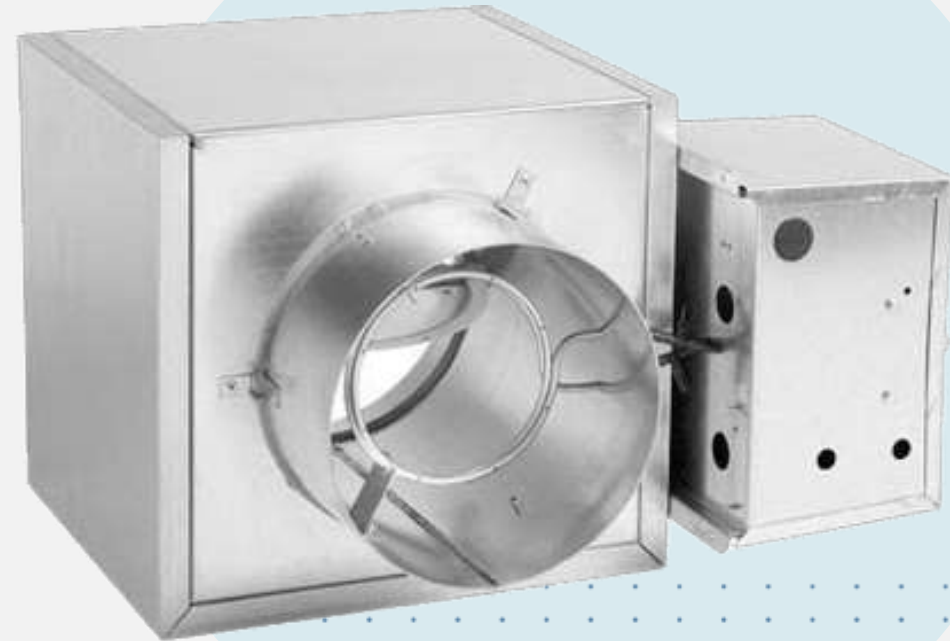
[REFR-SLB008-EN](#)

System Control — Occupied

Tracer® SC+/Synchrony®



- All VAV boxes normally open during occupied operation
- Upon alarm detection:
 - The VAS application overrides all VAV boxes **fully open**
 - VAS disables **electric** heat in all VAV boxes
- Alarm condition is cleared:
 - VAS releases the flow/position overrides
 - VAS releases the electric heat overrides



System Control — Unoccupied

Tracer® SC+/Synchrony®



- All VAV boxes are normally closed in the unoccupied mode
- Before the alarm:
 - VAS overrides the *designated* VAV boxes **fully open**
 - Coordination with VAV box **calibration** is handled by the VAS application
- Upon alarm detection:
 - VAS overrides all remaining VAV boxes **fully open**
 - VAS disables **electric** heat in all VAV boxes
- Alarm condition is cleared:
 - VAS releases the flow/position overrides for the *remaining* boxes
 - Boxes selected for unoccupied override remain overridden open by VAS
 - VAS releases the electric heat overrides in all VAV boxes

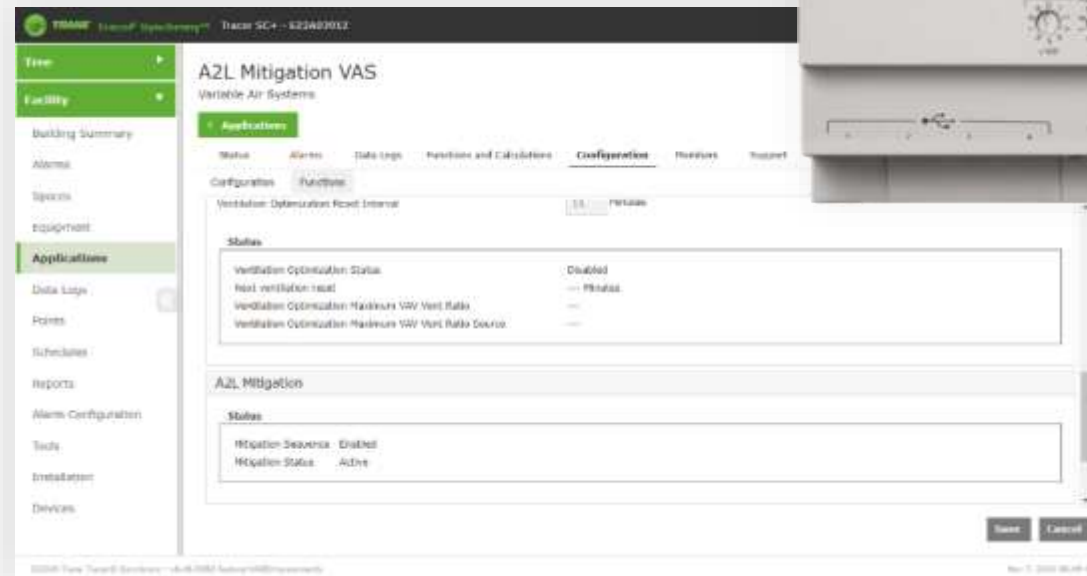
Name	Use in Temperature Calculation	Use in Duct Press. Optimization	Use in Ventilation Optimization	Send Max Heat	Send Source Temperature	Is Common Space	A21 Unoccupied Override
Engineering	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Finance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Manufacturing	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Training	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Tracer® SC+/Synchrony®

VAS Application Support



- A2L mitigation sequences were added to VAS in version 6.1 (December 2024)
 - Upgrade Tracer® SC+ to V6.1 for inherent application support
 - In lieu of upgrading, custom programming is necessary
- Best practice — upgrade legacy installations
- Alternately, refer to the PPS Configurator Vault
 - White paper
 - Tracer® SC/SC+ TGP2 programming
 - VAV Box TGP2 programming



Installation & Replacement Scenarios — MZVAV

Trane and non-Trane DX Equipment



			Building Management System				
			Tracer® SC+		Tracer® SC	Tracker/CCP	Non Trane BAS By Others
			V6.0 or earlier	V6.1 or earlier			
DX Equipment	R-410A	Trane	Unaffected	Unaffected	Unaffected	Unaffected	Unaffected
		By Others	Unaffected	Unaffected	Unaffected	Unaffected	Unaffected
	R-454B	Trane	Programming Required	Automated in VAS	Programming Required	Upgrade to Tracer® SC+	Programming Required by Others
		By Others	Programming Required (with mapping)	Automated in VAS (with mapping)	Programming Required (with mapping)	Upgrade to Tracer® SC+ (with mapping)	Programming Required by Others

Key Takeaways

- 1 Electrification of heating can substantially **decarbonize** buildings
- 2 Heat pumps can be significantly more **efficient** than electric resistance heating
- 3 Single zone and multiple zone heat pump applications differ
- 4 Additional considerations are needed for heat pump applications
- 5 Electrified heating solutions are **available for nearly every application**





Breakout Workshops

Thank you!

If you would like to receive PDH credit for this session, please be sure to provide your feedback in the applicable session survey.
(Also available via the event App!)

**Surveys close 6/4/25*





2025 PARTNER EXCHANGE

35th Anniversary

WAVES of **INNOVATION**
TOGETHER WE RISE

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