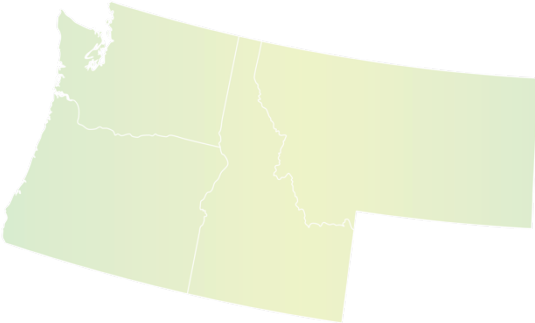


Very high efficiency DOAS: A High-Performance HVAC Approach for Better IAQ, Savings and Resilience

Jordan Pratt, PE, CEM
Senior Engineer, Energy 350

Who is NEEA?



What is BetterBricks?



>> Learn more at BetterBricks.com

Discussion Topics

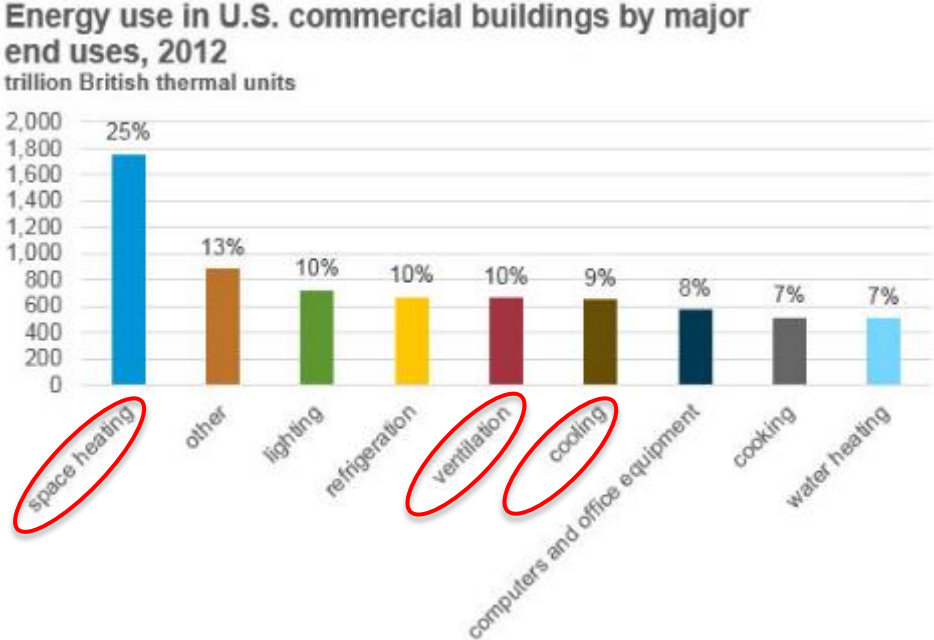
- **WHY** high-performance HVAC?
- **WHAT** is very high efficiency DOAS?
- **BENEFITS** of this approach
- **RESULTS** from Oregon projects



Why high-performance HVAC?

Why high-performance HVAC?

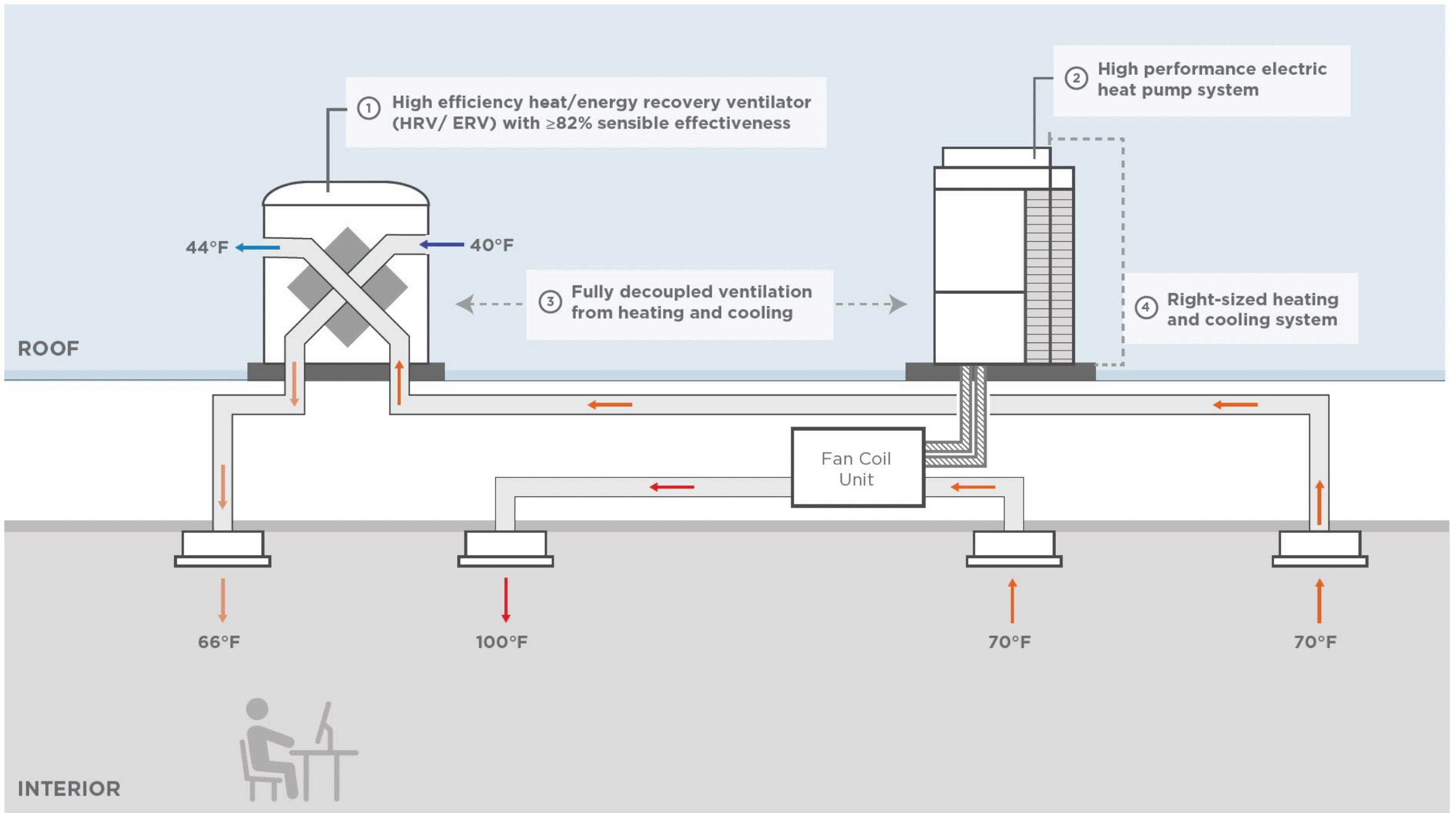
HVAC is Expensive & Energy Intensive



Source: U.S. Energy Information Administration, 2012 Commercial Buildings Energy Consumption Survey: Energy Usage Summary, Table 5 (March 2016)



What is very high efficiency DOAS?



High-Efficiency HRV/ERVs

Greenheck	ERVe-20-15L1	ERV	82% at 75% flow (AHRI database)
Greenheck	ERV-20-15L1	ERV	
Greenheck	ERV-45-15L1	ERV	
Greenheck	ERCH-20-15L1	ERV	
Greenheck	ERCH-45-15L1	ERV	
Oxygen8	Ventum H05	HRV	82.8% at 75% flow (AHRI software)
Oxygen8	Ventum H10	HRV	82.9% at 75% flow (AHRI software)
Oxygen8	Ventum H15	HRV	83% at 75% flow (AHRI test data)
Oxygen8	Ventum H20	HRV	
Oxygen8	Ventum H25	HRV	83.11% at 75% flow (AHRI software)
Oxygen8	Ventum H30	HRV	
Swegon	Gold RX 05	HRV	>84% (PHI database)
Swegon	Gold RX 07	HRV	
Swegon	Gold RX 08	HRV	
Swegon	Gold RX 11	HRV	
Swegon	Gold RX 12 MTE	ERV	>83% per (AHRIS software)

Swegon	Gold RX 14 MTE	ERV	>83% per (AHRIS software)
Swegon	Gold RX 20 MTE	ERV	
Swegon	Gold RX 25 MTE	ERV	
Swegon	Gold RX 30 MTE	ERV	
Swegon	Gold RX 35 MTE	ERV	
Swegon	Gold RX 40 MTE	ERV	
Swegon	Gold RX 50 MTE	ERV	
Swegon	Gold RX 60 MTE	ERV	
Swegon	Gold RX 70 MTE	ERV	
Swegon	Gold RX 80 MTE	ERV	
Tempeff	RGL 5500	HRV	82.5% at 75% flow (third-party testing provided at 20 and 16.7 deg F performance software confirmation at 35 deg F)
Tempeff	RGL 6500	HRV	
Tempeff	RG 1000	HRV	
Tempeff	RG 1500	HRV	
Tempeff	RG 2000	HRV	
Tempeff	RG 3000	HRV	
Tempeff	RG 4000	HRV	
Tempeff	RG 5500	HRV	
Tempeff	RGL 1500	HRV	

Tempeff	RGL 2000	HRV	82.5% at 75% flow (third-party testing provided at 20 and 16.7 deg F performance software confirmation at 35 deg F)
Tempeff	RGL 3000	HRV	
Tempeff	RGL 4000	HRV	
Tempeff	RGL 5500	HRV	
Tempeff	RGL 6500	HRV	
Ventacity	VS1000 RTh	HRV	PHI Certified RTh hHR= 82% Rte hHR= 82%* *Includes latent recovery
Ventacity	VS1000 RTe	ERV	
Ventacity	VS3000 RTh	HRV	
Ventacity	VS3000 RTe	ERV	
Ventacity	VS1200CMh	HRV	Ventacity test summary shows 83.3% at 75% flow. PHI Test data: 81.1% th eff at 54% flow.
Ventacity	VS900CMh	HRV	PHI Certified Ventacity test summary: 84.3% at 57% airflow PHI data: 81.6% at 55% airflow
Ventacity	VS250CMh	HRV	Ventacity test summary shows 81.7% at 76% flow. PHI data: >78%

As of February 2022; Source: [BetterBricks](#)

System Benefits

Why Upgrade Your HVAC?



Save energy & money

by reducing building energy use by an average of 36%, and HVAC energy use by an average of 65%.



Better indoor air quality

due to filtered 100% outside air being brought into the space, with little to no recirculation



Increased occupant comfort

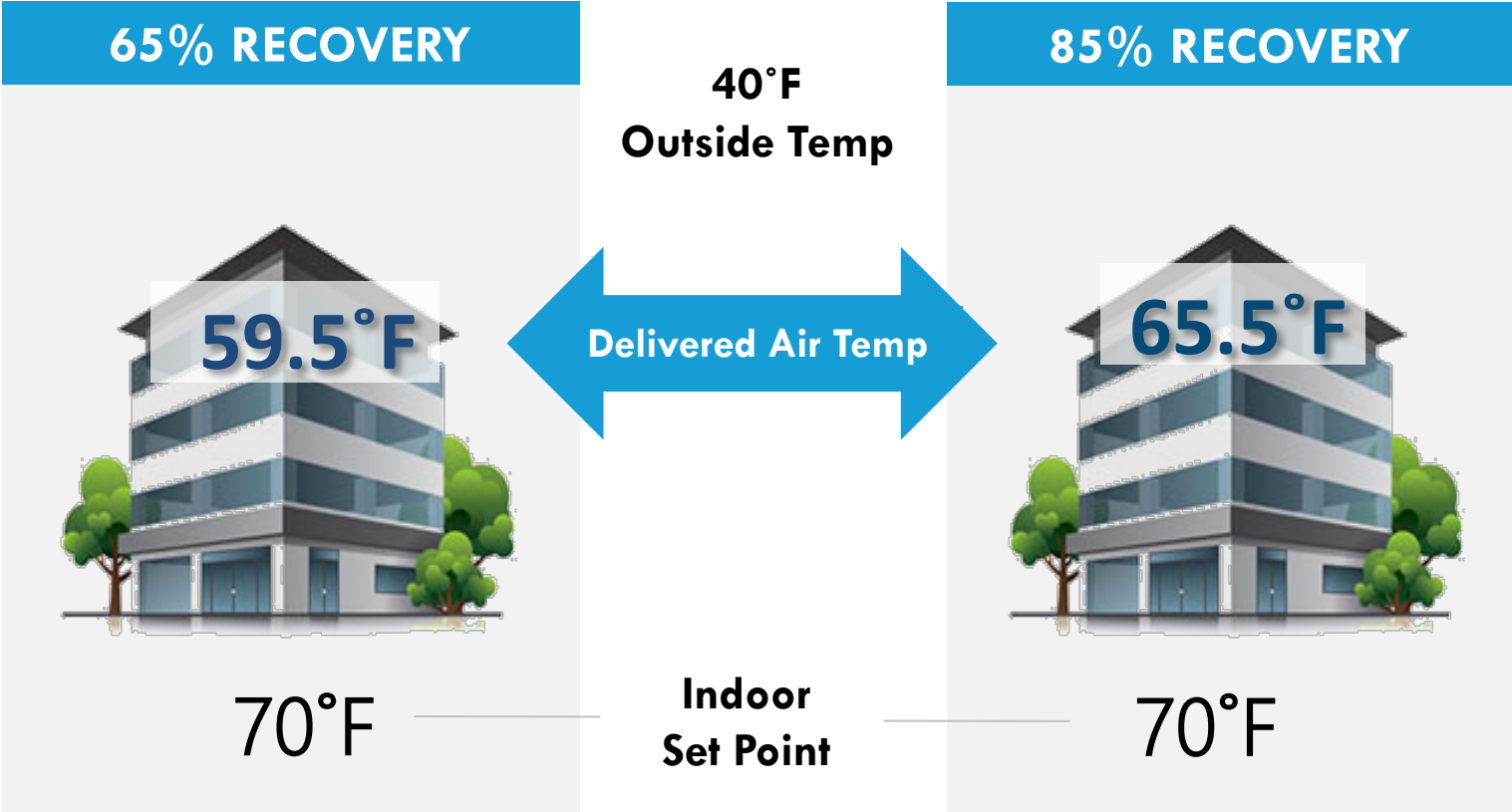
through improved temperature stability and the ability to create zones with unique temperature controls



Meets/Exceeds 2018 WSEC for

DOAS in many building types

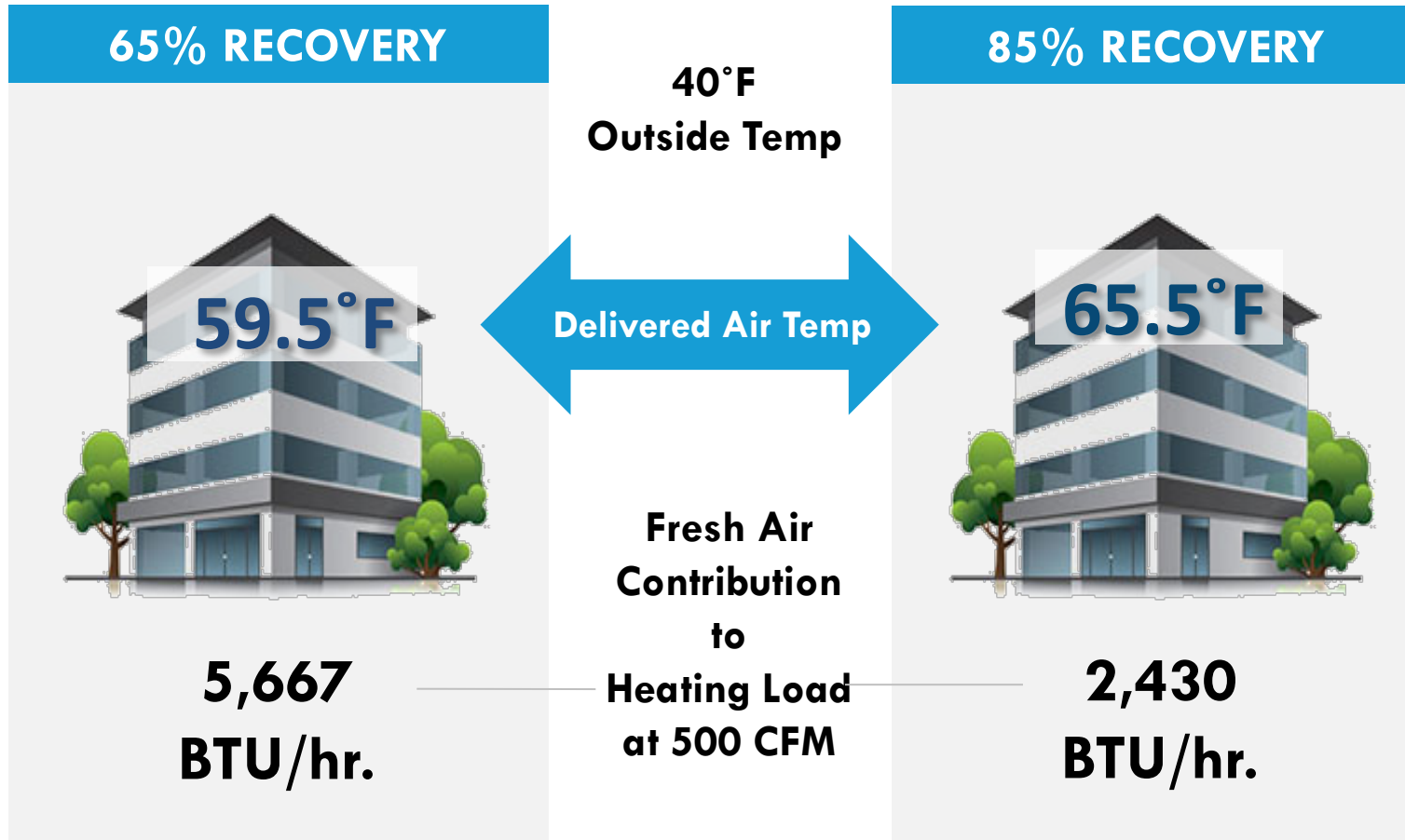
Efficiency = Comfort



Efficiency Matters:

- **Comfort is enhanced**
- **Energy efficiency is significantly improved**

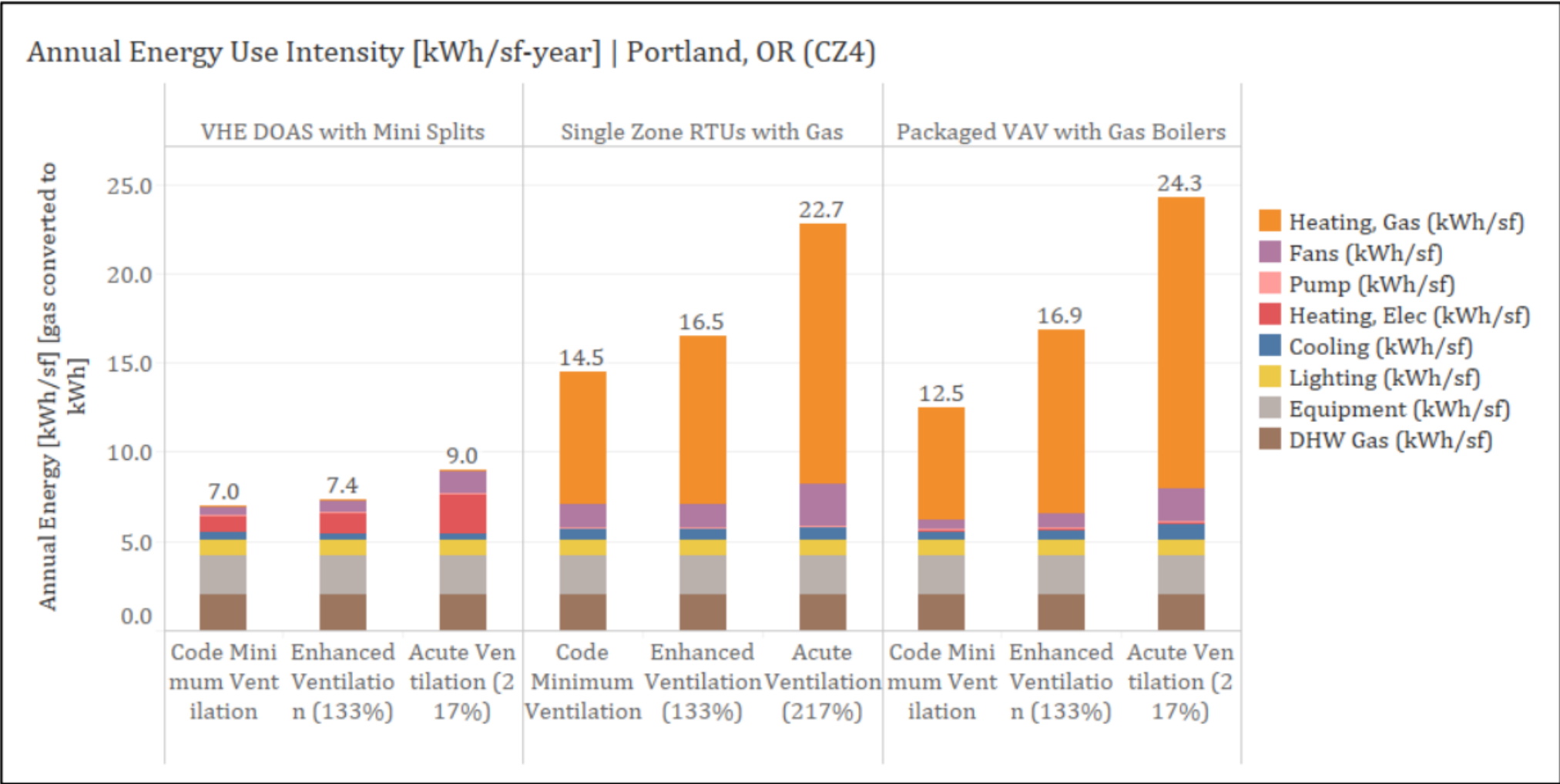
Efficiency = Significant Savings



Efficiency Matters:

- **20% increase in efficiency translates to more than 50% reduction in energy use**

Increased Ventilation and Energy Cost



Source: BetterBricks | Covid-19 Risk Reduction Strategies and HVAC System Energy Impact

Results from Oregon Projects

CASE STUDY:

New Day Preschool

LOCATION: Portland, OR

SQ. FT.: 2,900

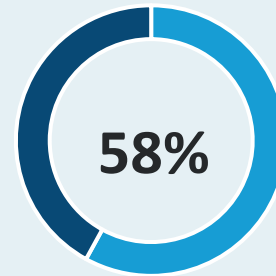
COST/SQ. FT.: \$22.80

EXISTING SYSTEM:

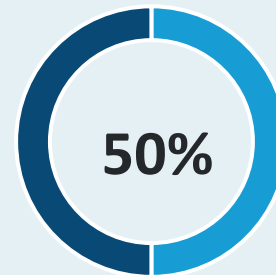
Constant volume 5-ton packaged heat pump RTU

NEW SYSTEM:

- (2) 1.5-ton ductless heat pumps
- (1) 2-ton ducted mini-split heat pump
- (1) 1000 cfm HRV



reduction in total HVAC energy use



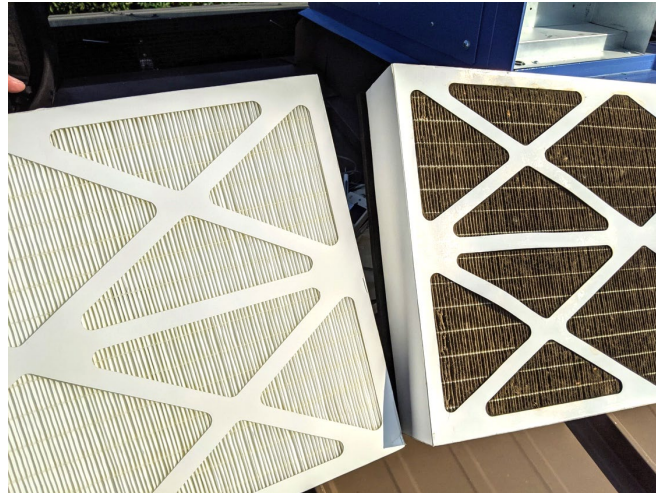
reduction in total building energy use

“The drastic difference in air quality is amazing! Before the renovation, our building was hot, stuffy and humid, and we had lots of odor issues in the classroom. Now the classroom air is fresh and odor-free. The air really does feel fresh and clean.”

With air quality such a major topic of discussion during the pandemic, it has been comforting to know we are having a constant exchange of fresh air in our buildings at all times.”

— New Day School administrator

New Day Preschool



“I think very high efficiency DOAS is a great choice for preschools to ensure high air quality at the developmental phase of a child’s growth when their bodies are developing, their lungs are growing, and fresh air is so vital to their health.”

Teachers and staff feel safer in a building with a high standard of air filtration and flow. Knowing that stagnant air is moved out of the building and the incoming air is fresh and filtered makes everyone feel much safer.”

— New Day School administrator

CASE STUDY:

Portland Office Building [7,659 sq. ft.]

EXISTING SYSTEM:

(2) Constant Volume Packaged Gas Rooftop Units

(25 tons heating, 16.5 tons cooling)

NEW SYSTEM:

(1) VRF Heat Pump System

(2) 1000 cfm HRVs

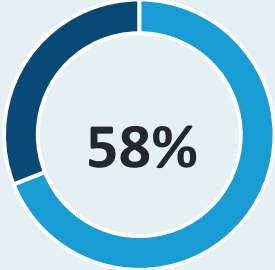
(11 tons heating, 10 tons cooling)

35.8

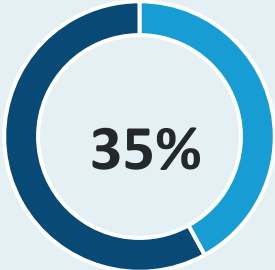
Existing HVAC EUI

23.3

New HVAC EUI



reduction in total HVAC energy use



reduction in total building energy use



*Preliminary savings results are based on 10 months of metered HVAC data and annualized to a typical weather year.

Right-Sizing Example

Existing System



Conversion System



39% Cooling Capacity Reduction

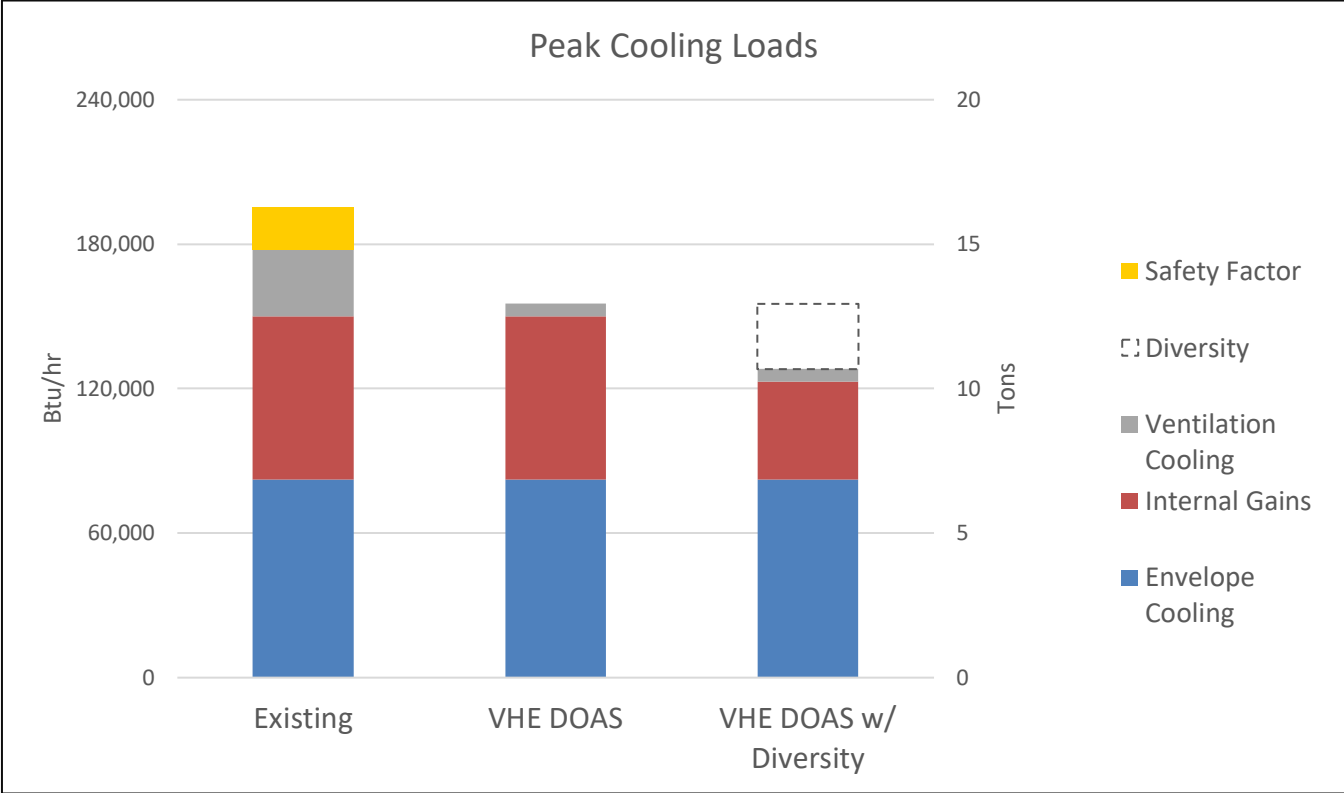
54% Heating Capacity Reduction

	Cooling Capacity	Heating Capacity	Zones
(2) CAV Packaged Gas RTUs	16 tons	293 MBH	2

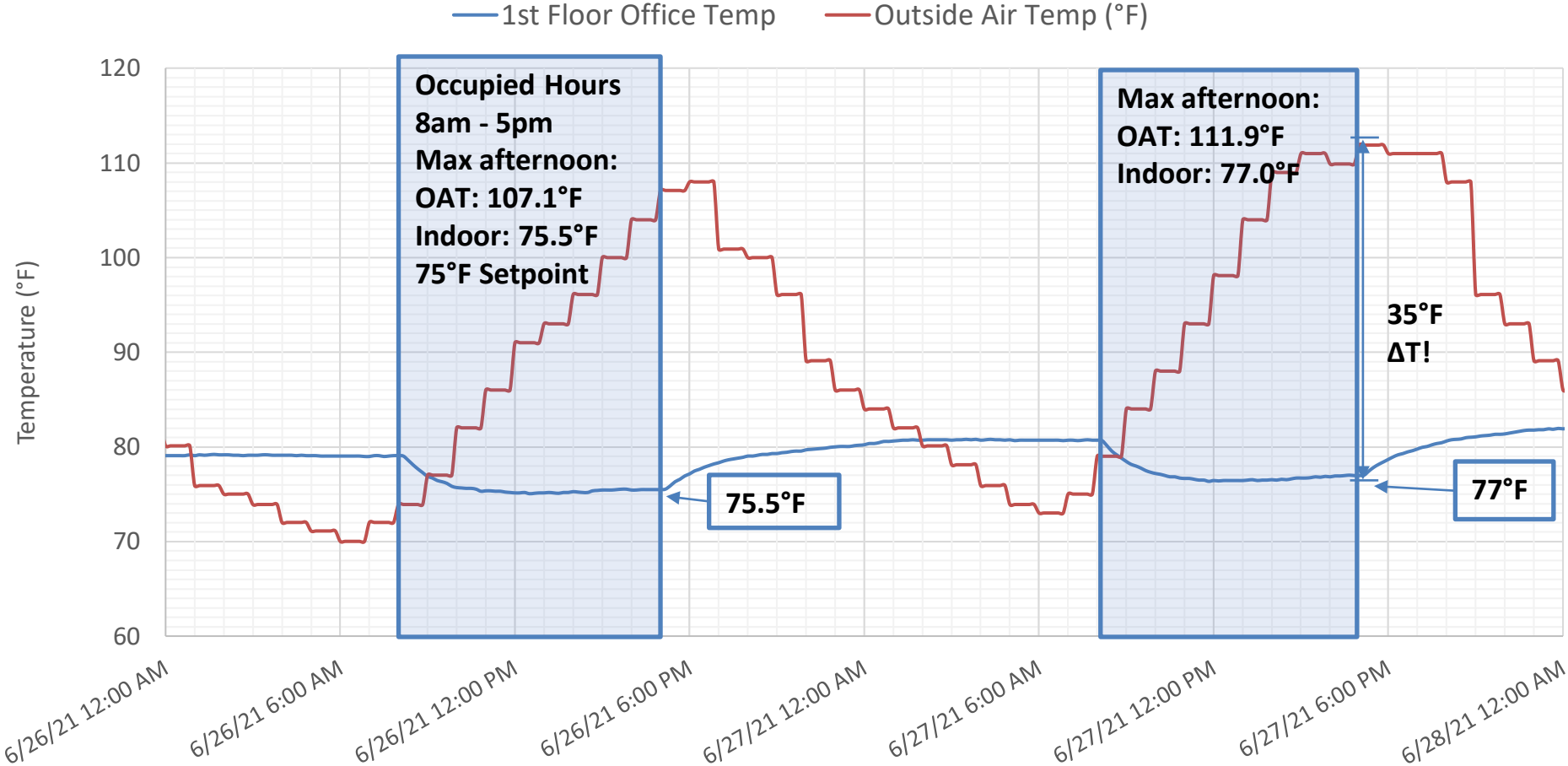
	Cooling Capacity	Heating Capacity	Zones
(2) 1000 cfm HRVs	16 tons	293 MBH	2
VRF Heat Pump	10 tons	135 MBH	7

Peak Cooling Loads

Input	Value	Unit
Conditioned Floor Area	7,659ft ²	
Window Area	739ft ²	
Window Thermal Resistance	R-2.2°F-ft ² -h/btu	
Wall Thermal Resistance	R-1.8°F-ft ² -h/btu	
Roof Thermal Resistance	R-36°F-ft ² -h/btu	
Peak Occupancy	94people	
Average Infiltration	0.032cfm/ft ²	
Lighting Power Density	0.79watts/ft ²	
Equipment Power Density	1.21watts/ft ²	
Average Ventilation	0.19cfm/ft ²	
Design Cooling (0.4%)	91.2°F	
Design Heating (99.6%)	25.0°F	



Hot Weather Resilience



CASE STUDY:

Portland Law Office Building [12,000 sq. ft.]

EXISTING SYSTEM:

- (9) RTUs
- (43 tons heating, 35 tons cooling)

NEW SYSTEM:

- (1) VRF System
- (4) 1000 cfm HRVs
- (18 tons heating, 16 tons cooling)

51.4

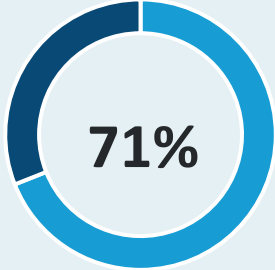
Existing EUI

19.1

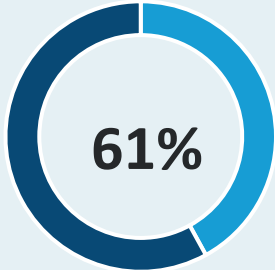
New System EUI

Total Project Cost:

\$15.61/sf



reduction in total HVAC energy use



reduction in total building energy use



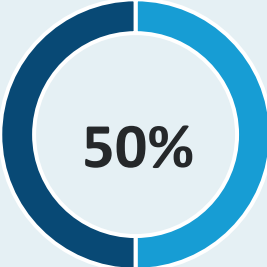
CASE STUDY:

Monument Grade School

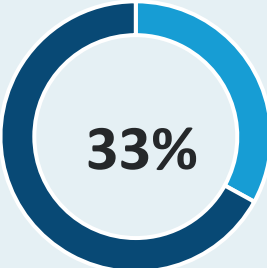
LOCATION: Monument, OR
BUILT: 1965 | **sq. ft.:** 7,200
COST/SQ. FT.: \$13.86 (before incentives)

EXISTING SYSTEM:
5x 2.5-ton unitary heat pumps,
1-3 space heaters per classroom

NEW SYSTEM:
5x 2-ton ductless heat pumps
1x 1.5-ton ductless heat pump
1x Ventacity Systems 1000RT HRV



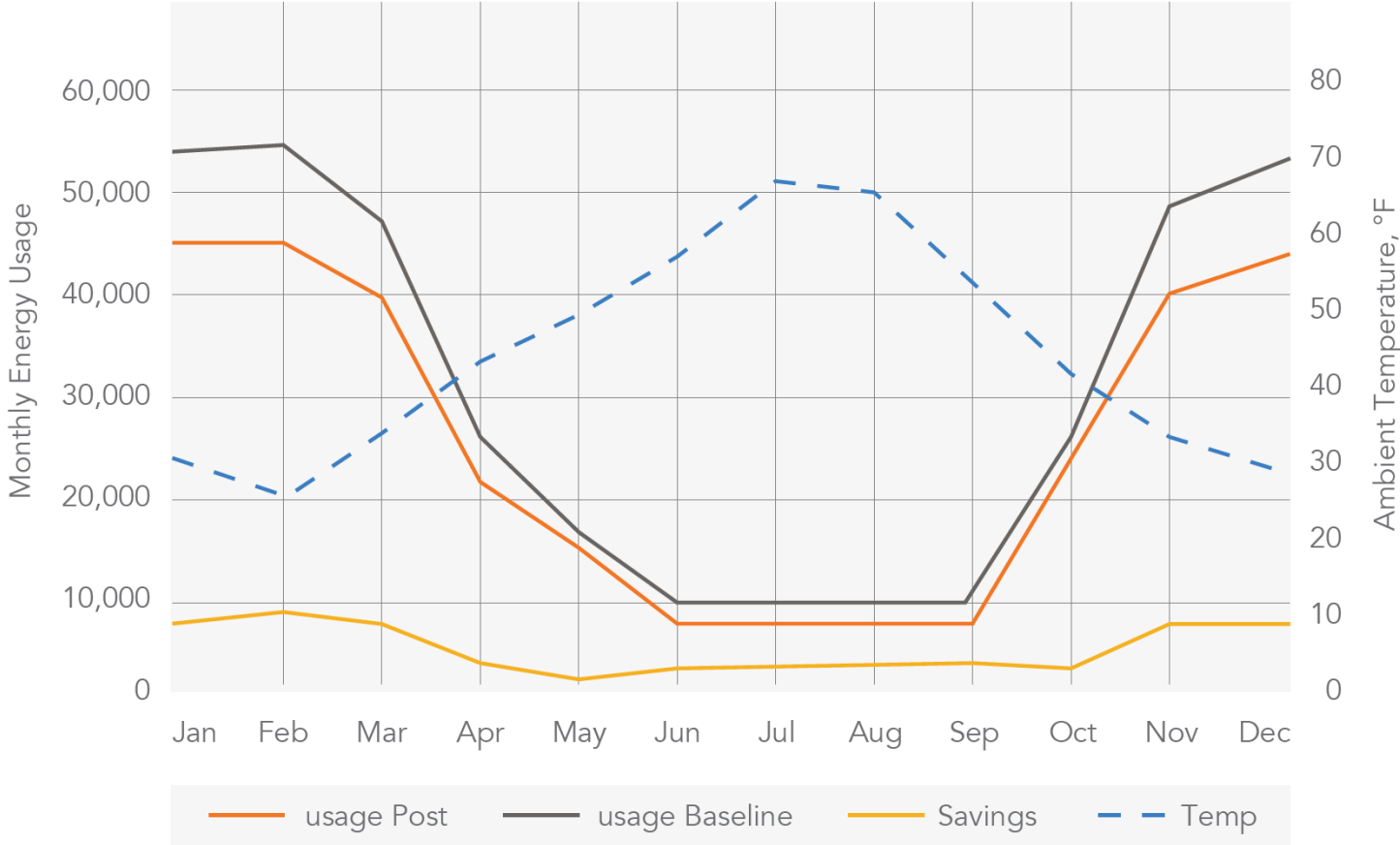
reduction in total HVAC energy use



reduction in total building energy use



Normalized Use & Savings



*In the 12 months following the installation, data shows the school has reduced their energy use by almost 60,000 kWh— **60% HVAC energy use reduction**—when compared to the previous system and when normalizing for weather.*

Ideal Building Types

- Schools, office, government, retail
- Small-to-medium sized buildings
- New construction
- Major renovations/retrofits



Learn More

- Case studies
 - Pilot report details and findings
 - Design requirements and guidelines
 - Qualifying ERV/HRV manufacturers and products
 - Research, including economic and indoor air quality analyses
- ▶ betterbricks.com/resources/what-is-a-very-high-efficiency-dedicated-outside-air-system

Thank You

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Appendix Slides
