ENERGY-EFFICIENT SYSTEM PROVIDING SUPERIOR IAQ

3FFICIENCY: PINNACLE, NEUTON AND CHILLED BEAMS

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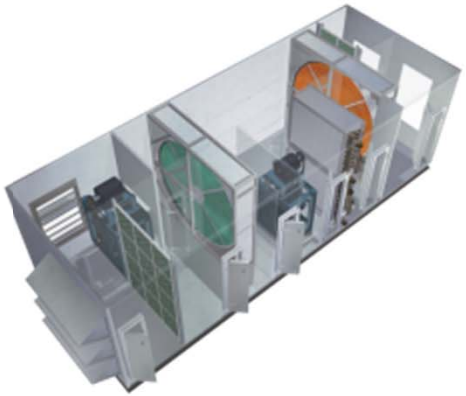
A FläktGroup Brand

3fficiency™
PINNACLE + NEUTON + CHILLED BEAMS

3fficiency system components

3fficiency™
PINNACLE + NEUTON + CHILLED BEAMS

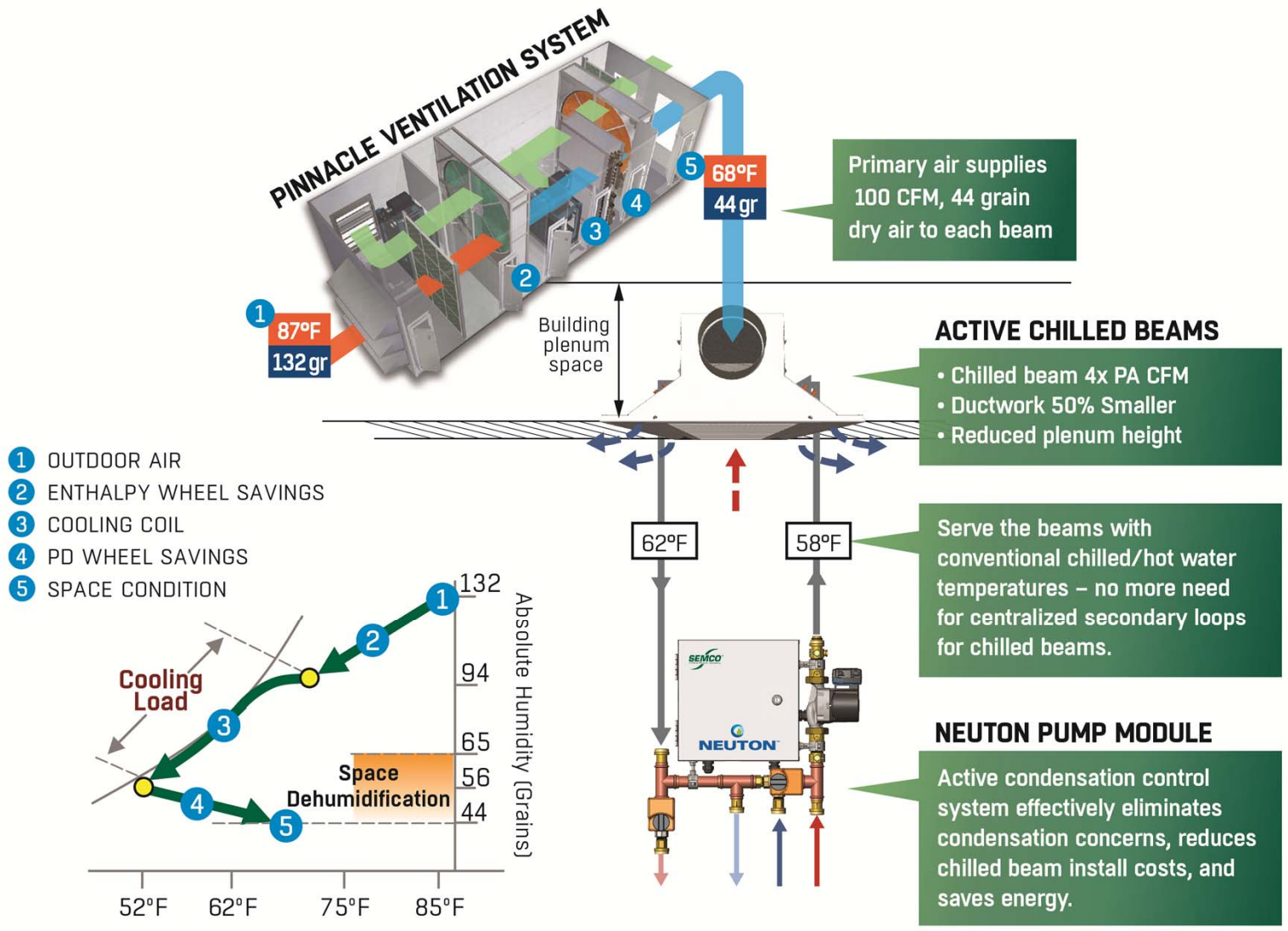


3fficiency™ is the “Pinnacle” of chilled beam systems. The 3 components included in the system package are:

- Pinnacle™ Dedicated Outside Air System (DOAS),
- NEUTON™ Chilled Beam Pump Module, and
- SEMCO Active Chilled Beam line.

The NEUTON pump module manages the water system to allow for a building level occupant control that is superior to all other systems.

3fficiency system



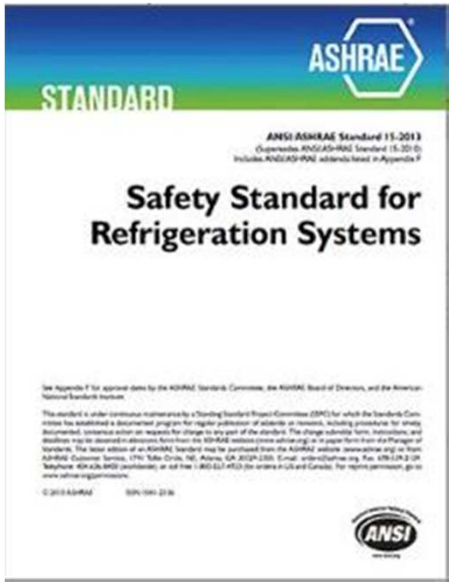
System Configuration

Feature set includes:

1. The outside air portion of the system will be treated by a Pinnacle
2. Each zone has a combination of:
    a. A chilled beam
    b. Diffuser
    c. Return grill
    d. Temp and humidity sensor
    e. Opt 2 way valve (if multiple zones are required)
3. Each 1-5 zones will have a NEUTON (See Figure 1)
4. Controls are all native Bacnet

Direct Replacement for VRF

- 3fficiency can directly replace Variable Refrigerant Flow (VRF)
- Provides even more savings through the use of a water to water chiller and using the condenser water as the hot water for the system
- No more concerns with ASHRAE 15, refrigerant leaks, or large electrical wire runs
- A whole building **Variable WATER Flow System!**



Did you know most HCFC refrigerants and blends containing HCFCs will be phased out by **2020** because of ozone depletion?

This HVAC obstacle can be avoided by using chilled beams which employ water rather than refrigerants.

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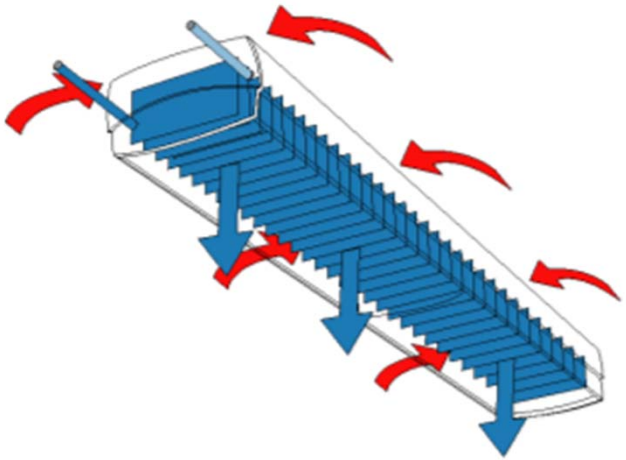
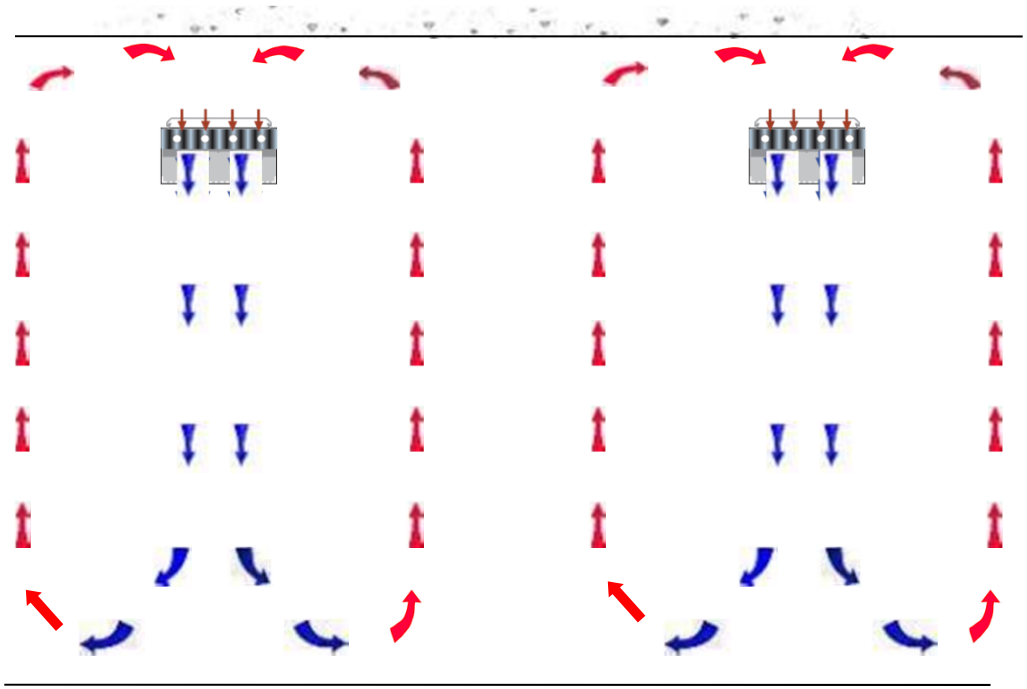
CHILLED BEAMS
Active and Passive

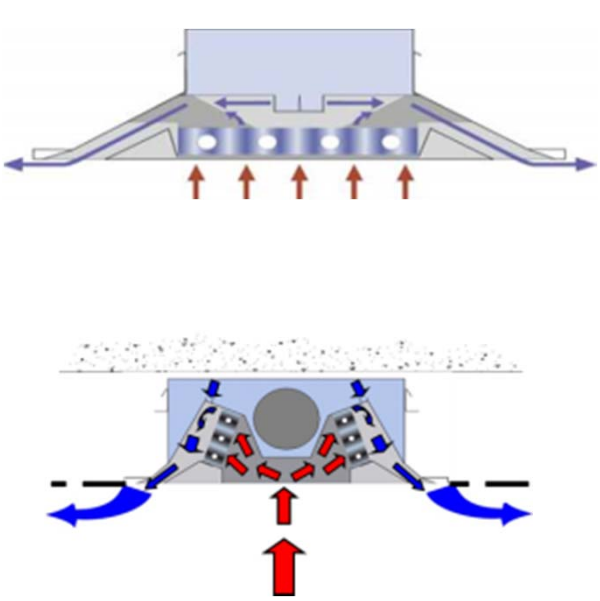
Passive Chilled Beams

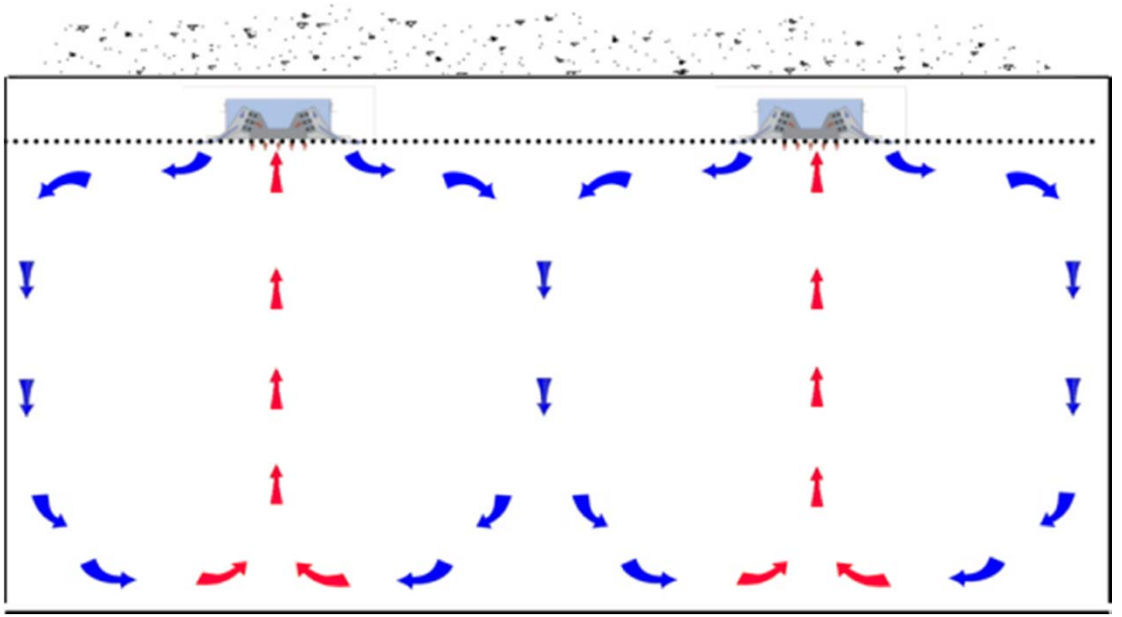




- **The << engine >> is the gravity** and the density difference between the cold air and the warm air
- Only **cooling mode**
- **The air diffusion isn't controlled** and there are risks of draft below the chilled beam
- Passive chilled beams are used only for an additional source of cooling for a specific need.

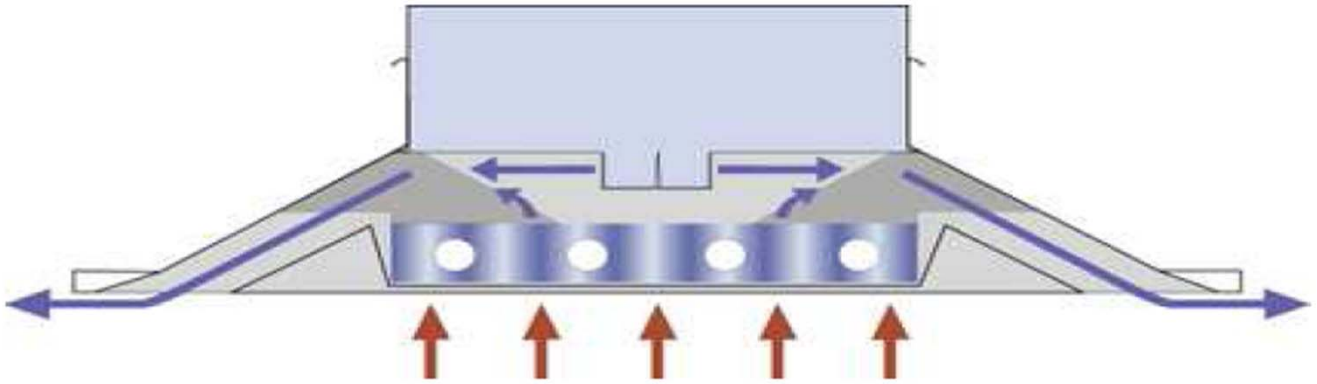
Active Chilled Beams



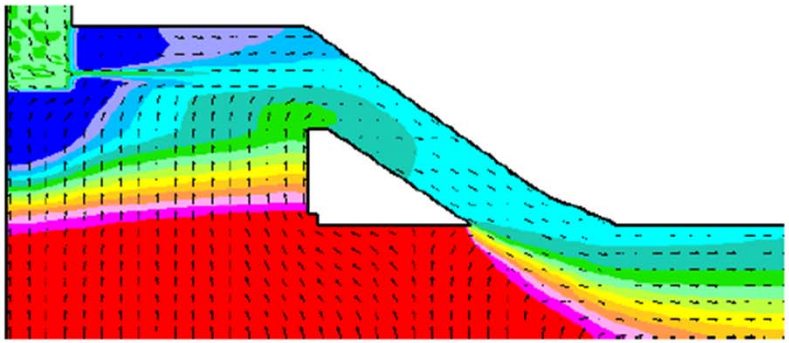


- **The « engine » is the induction** created by the adjustable slots.
- **Cooling and heating mode**.
- The fresh air is supplied through the chilled beam.
- Mixing air diffusion into the room so **the air velocity is controlled**.
- Active chilled beams provide heating, cooling and ventilation with high comfort.

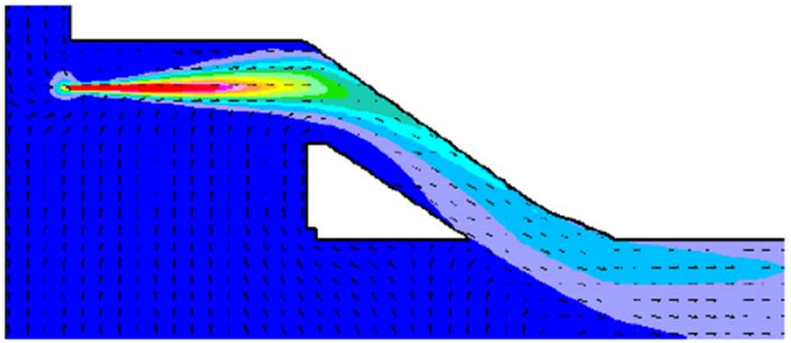
Active Chilled Beams



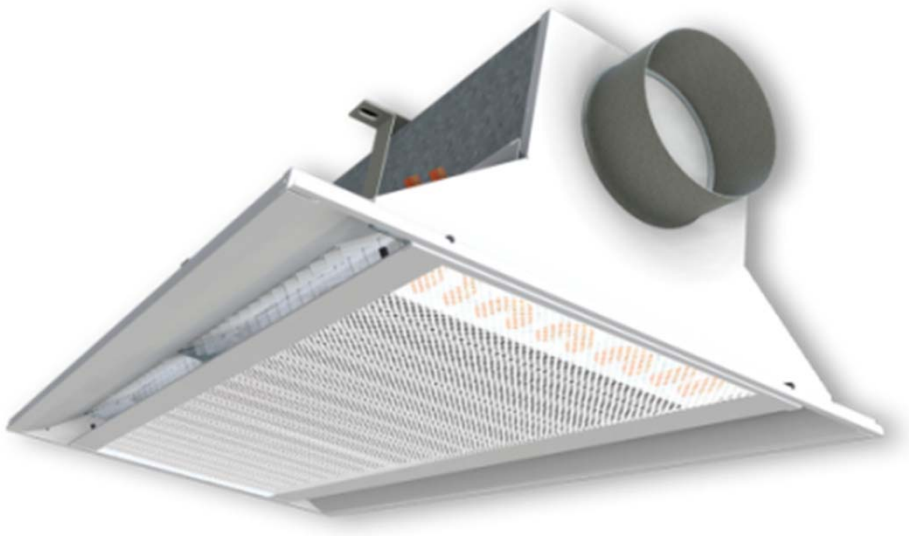
Temperature profile



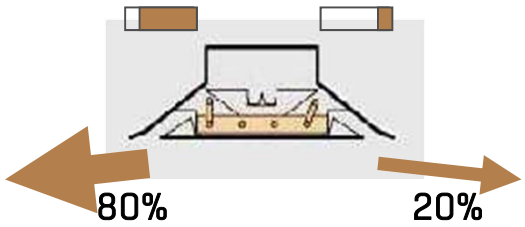
Velocity profile

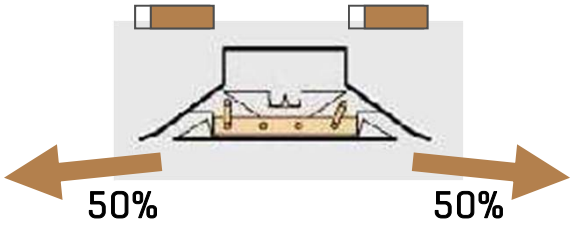


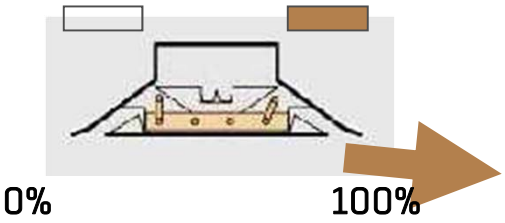
Comfort Control



- Adjustable induction on site
- Different air distribution available:
  - One way distribution
  - Two way distribution
  - Asymmetric air diffusion
- Chilled beam capacity can be increased or decreased by slot adjustment
- No tools required



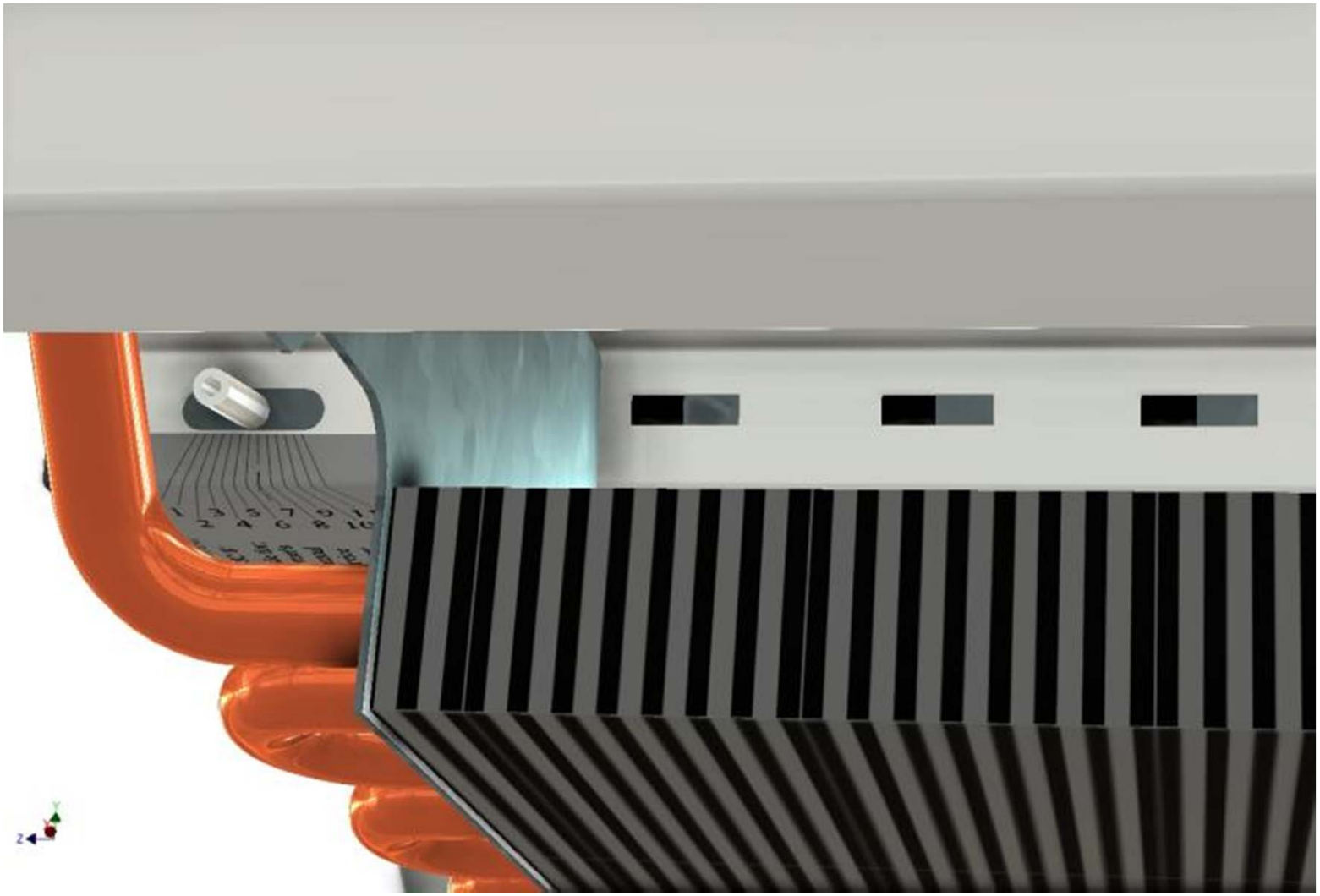




IQHC Air Slider Label

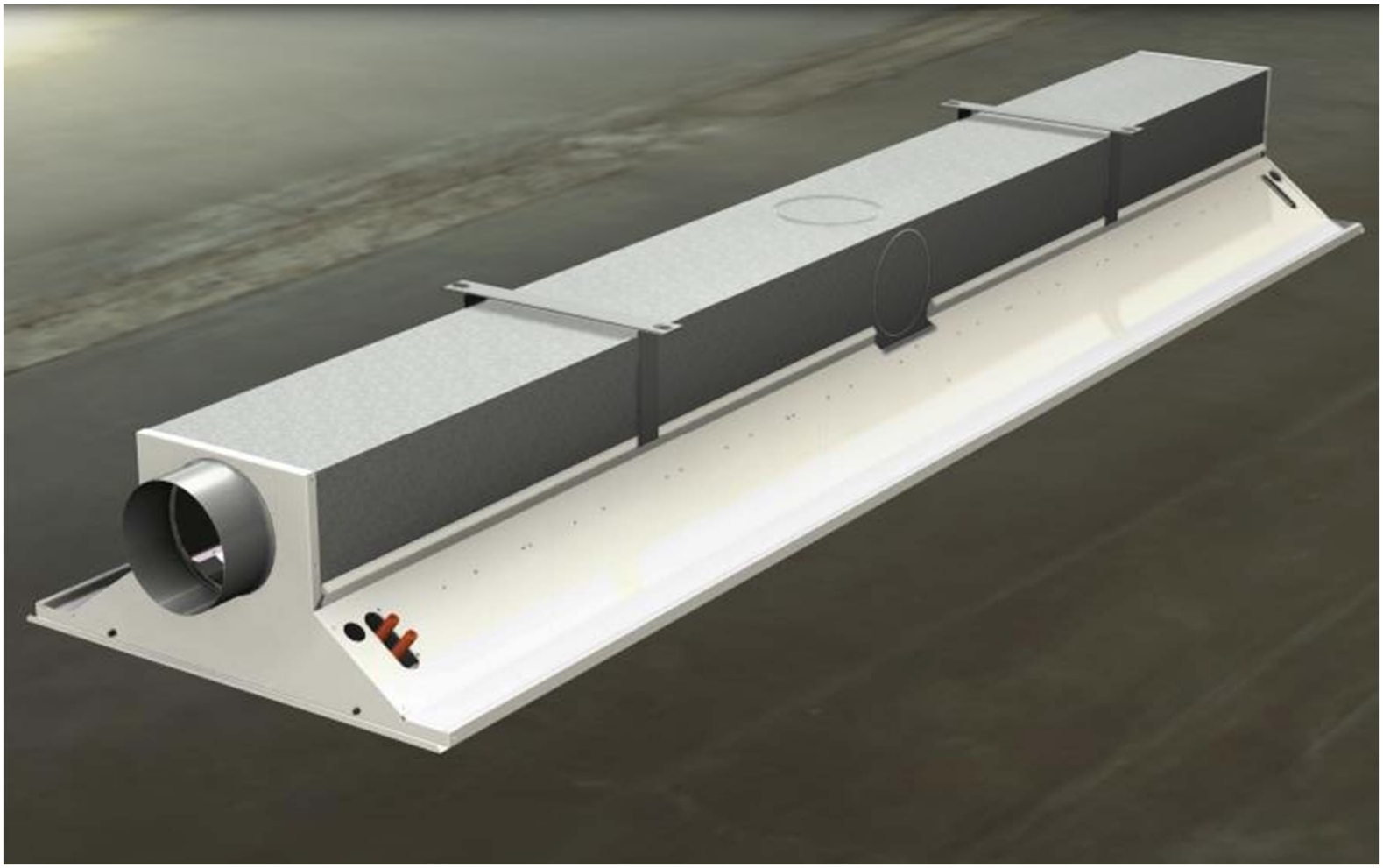
IQHC Air Slider Open

IQHC Air Slider Half Open



IQHC Air Slider Closed

Universal Beams



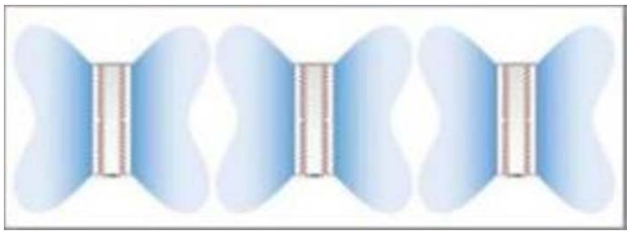
Flow Pattern Control System

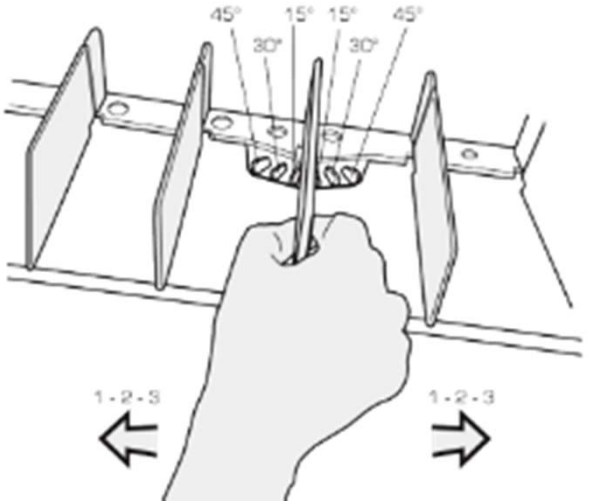
- Plastic blades to adjust air diffusion & throw length
  Angles: 0°- 15°- 30°- 45°
- Modules of 2 feet to get different flow pattern
- Manual adjustment from room to room, no tools required

Flexibility in building design

Increased comfort level

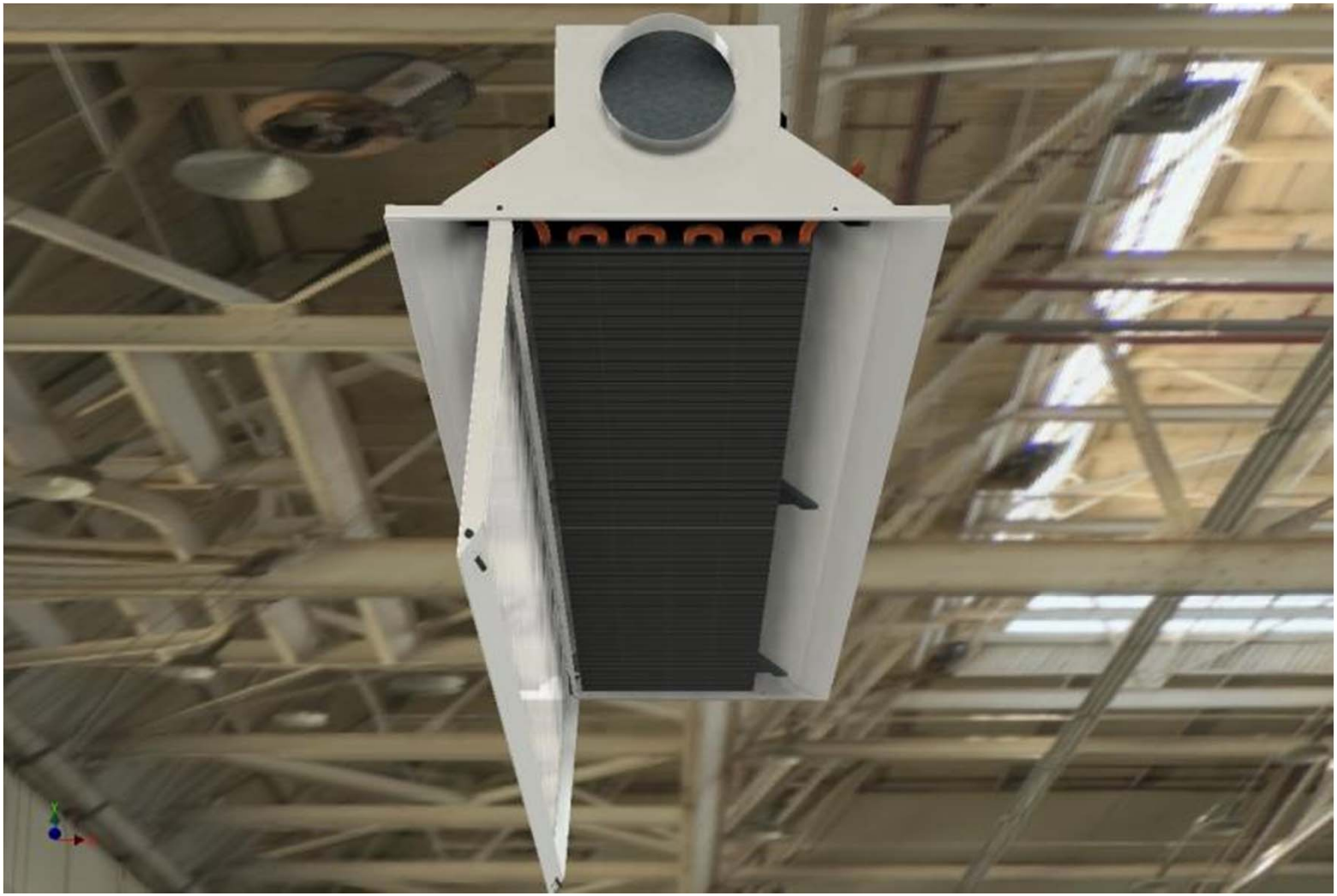
No tools required





Bottom Closed

Bottom Open



Accessories for Installation

Fastening Brackets for both types of installation:

- Free hanging installation
- False ceiling installation

Easier installation

Faster installation

→ Installation cost reduction

Attachment QFAZ-18

Attachment CB-IQHC-24

Chilled Beams Benefits

Experience

- Applied in Europe for more than 3 decades
- Applied in the US more than 10 years
- SEMCO manufactured in the United States for more than 5 years

Indoor Air Quality

- Increased ventilation to each space (all applications)
- Better air distribution (circulation) within the space
- Lower sound levels than almost all HVAC systems

Energy Savings

- Reduced fan horsepower
- Load matching (only use space cooling if required)
- Higher temperature chilled water (increased chiller efficiency)

First Cost Savings

- Reduced duct size
- Reduced interstitial space
- Smaller air handlers, plant rooms

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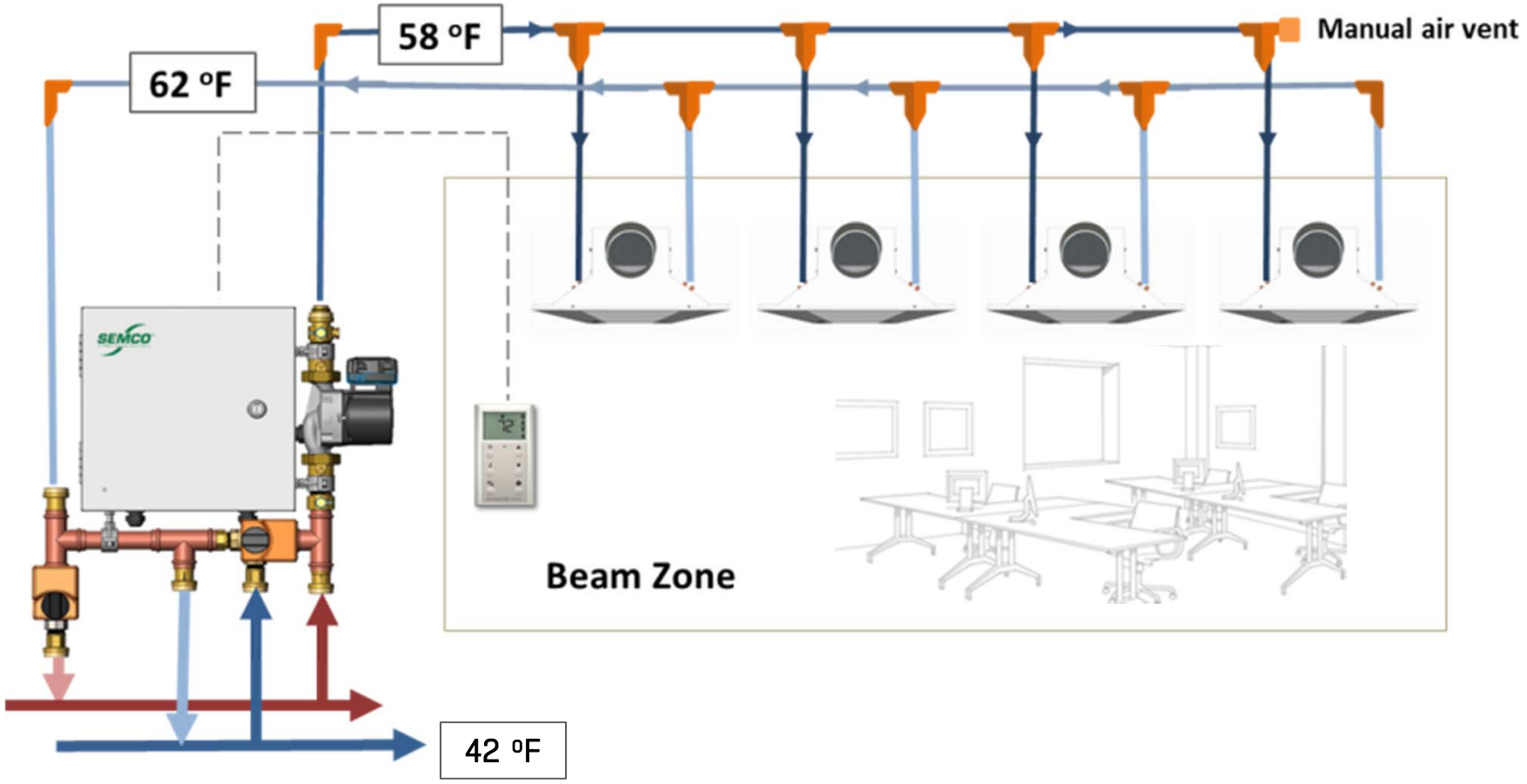
NEUTON
Controlled Chilled Beam Pump Module

U.S. patent number 9,625,222

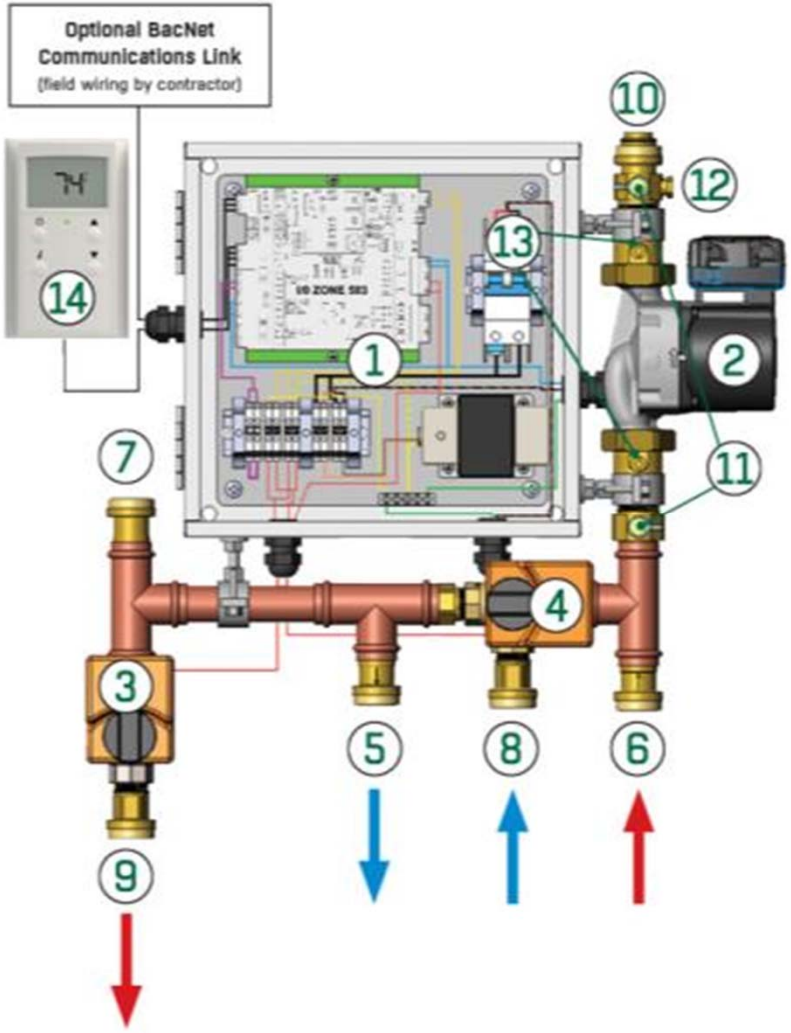
Concept



Component Parts

1) Integrated electrical, DDC controls panel
2) Electronically Commutated Motor (ECM) high efficiency, variable speed pump
3) Hot water control valve
4) Chilled water control valve
5) Chilled water return
6) Hot water supply
7) Zone loop return connection
8) Chilled water supply
9) Hot water return
10) Zone supply water connection
11) Pete's plugs for pressure and flow measurement
12) Zone supply water thermistor
13) Pump Isolation Valves
14) ZS Pro Sensor Zone Controller

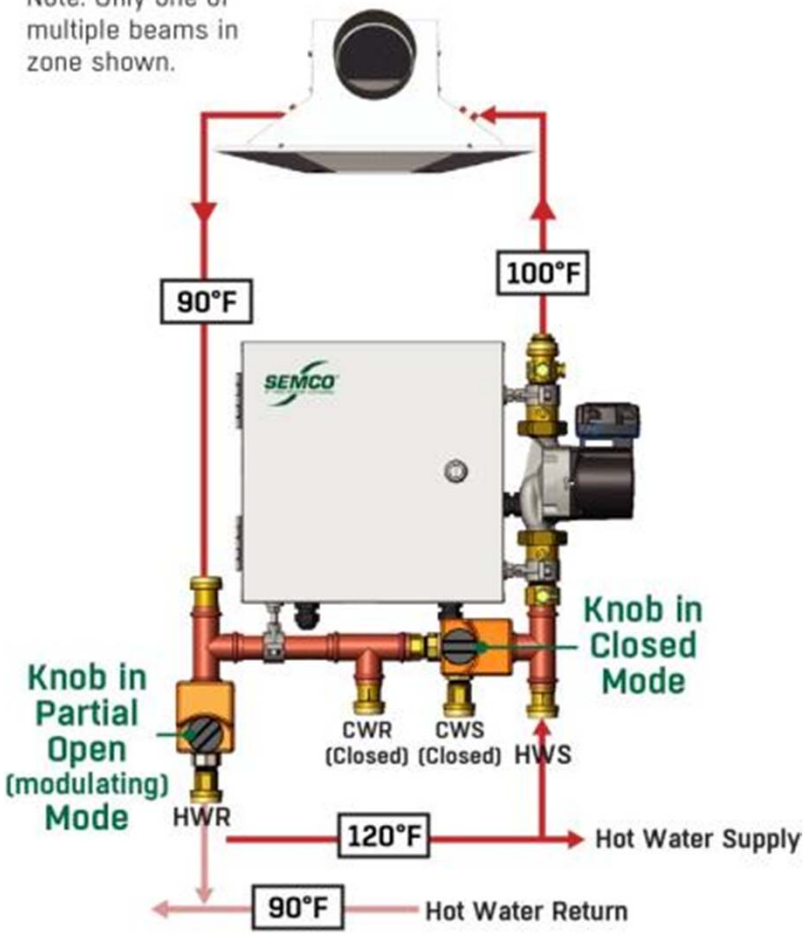
NEUTON Chilled Beam Pump Module



How It Works: (4 pipe primary loop)

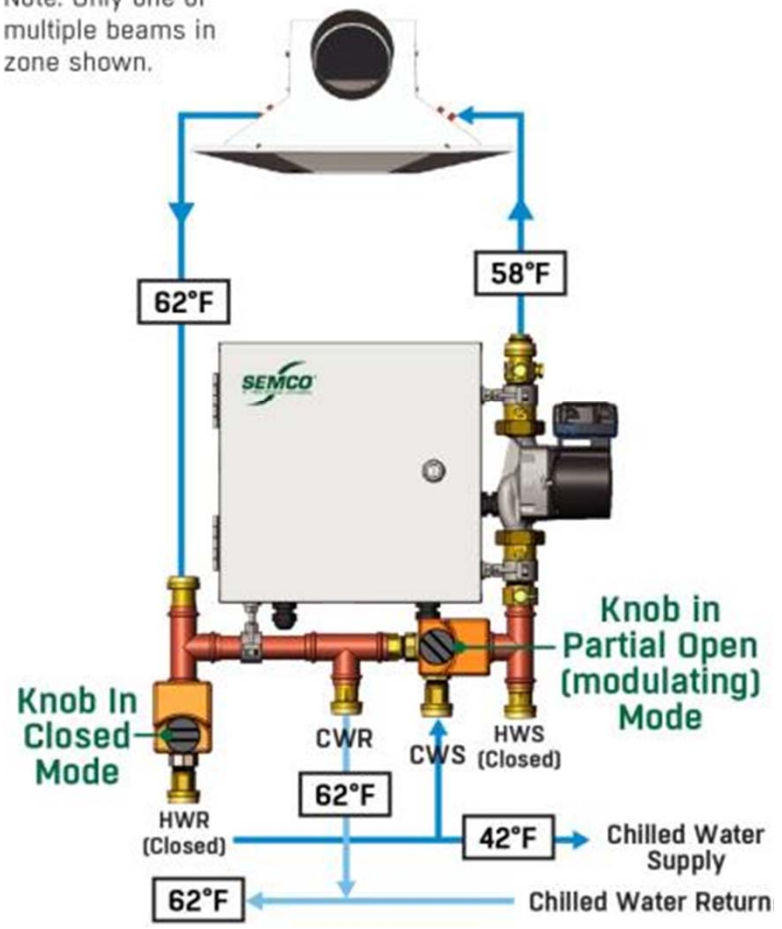
Heating Mode
(4 pipe primary loop shown)

Note: Only one of multiple beams in zone shown.



Cooling Mode
(4 pipe primary loop shown)

Note: Only one of multiple beams in zone shown.



NEUTON Benefits

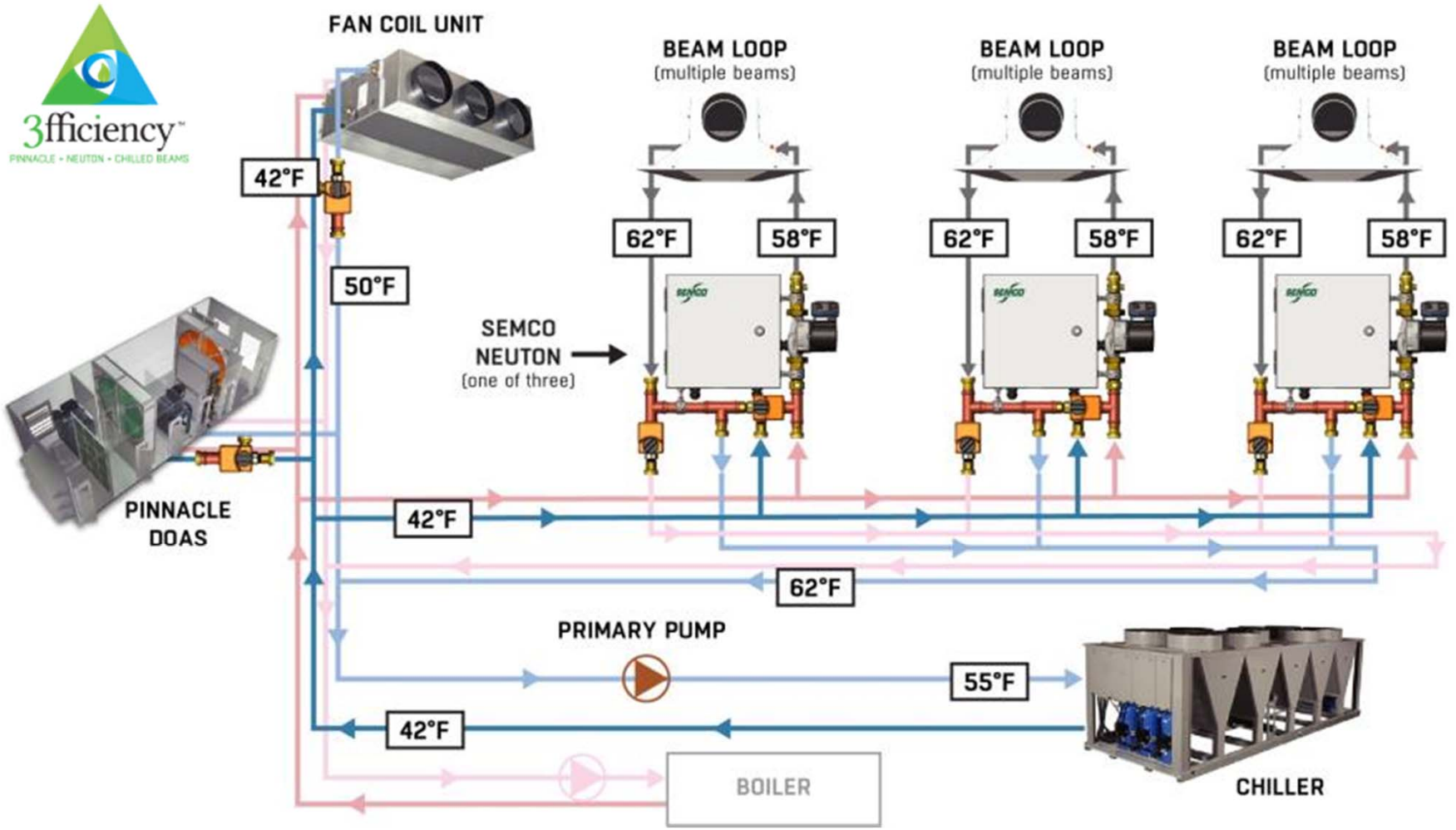
New Construction:

- Reduction of installation cost by 30% and more
- Use of conventional water (chilled/hot)
- Simplifies installation, and includes zone level controls
- Active condensation control
- Reduces pump energy and addresses load matching
- Improves response to occupied/unoccupied conditions
- PATENTED DESIGN: U.S. patent number 9,625,222

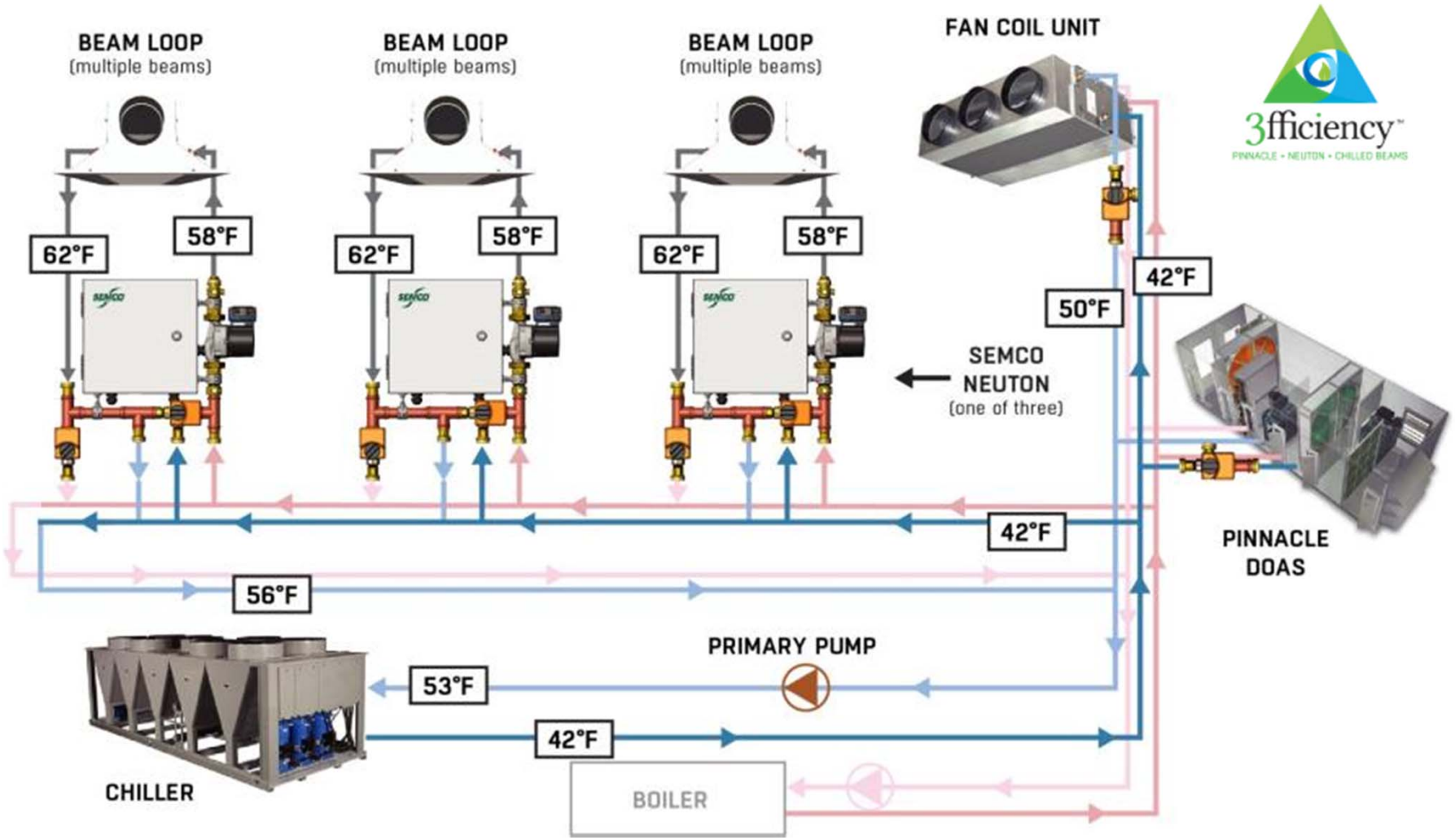
Existing Construction:

- Re-utilize existing hot water / chilled water systems piping and central plant
- Alleviates concern regarding vapor barrier (or lack thereof)
- True energy savings compared to VRF option
  - Similar design
  - Reduces refrigerant

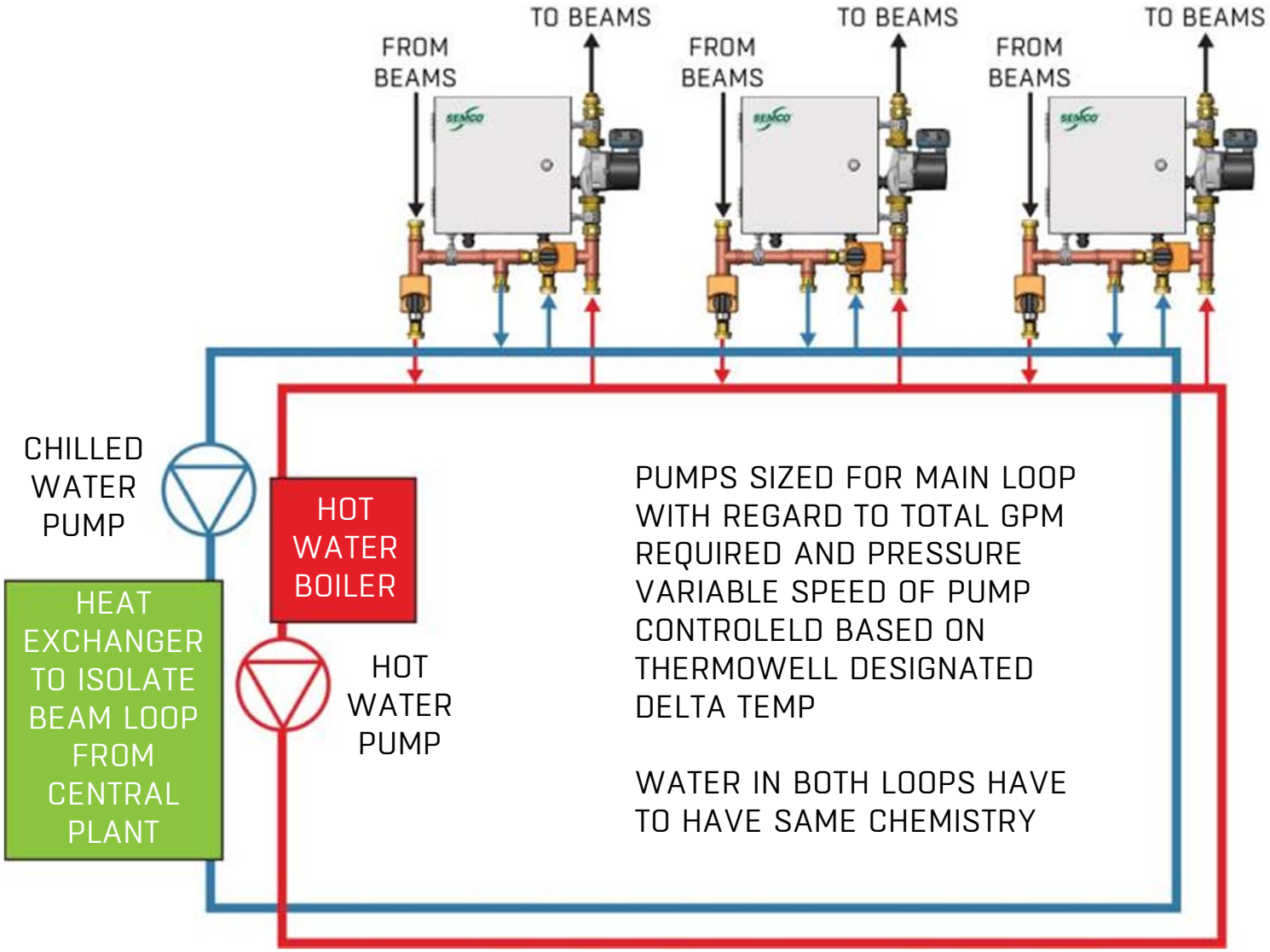
Traditional 4 Pipe Approach



Unconventional 2 Pipe Approach



Main Loop View



Greatly simplify Design and Installation Process

Factory wired/tested

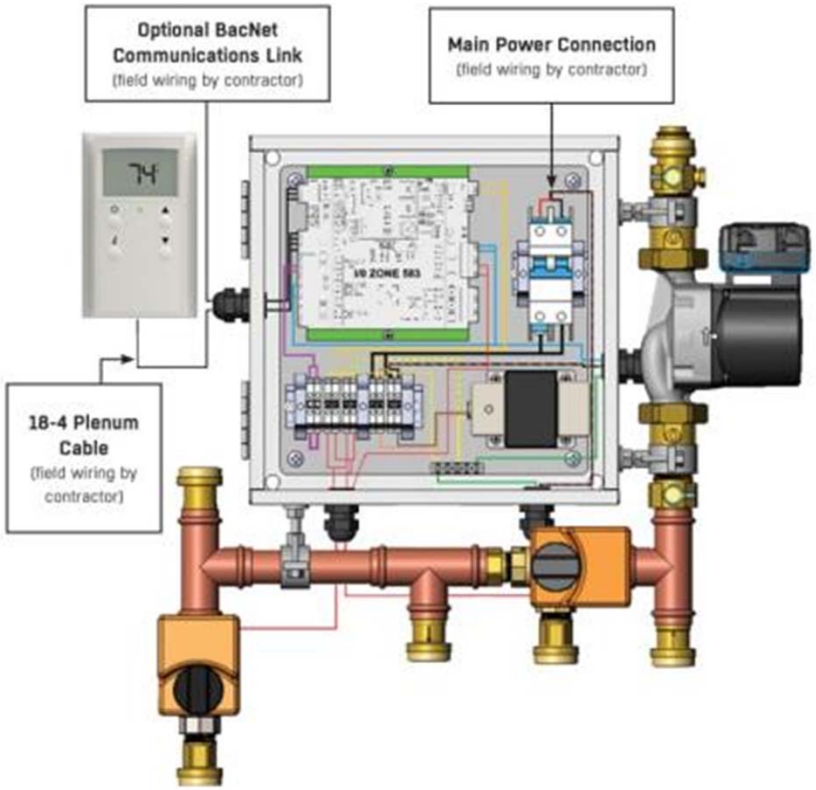
- Zone Pump
- Water temp sensor
- Control Valve
- Electrical/controls

Electrical Field connections require

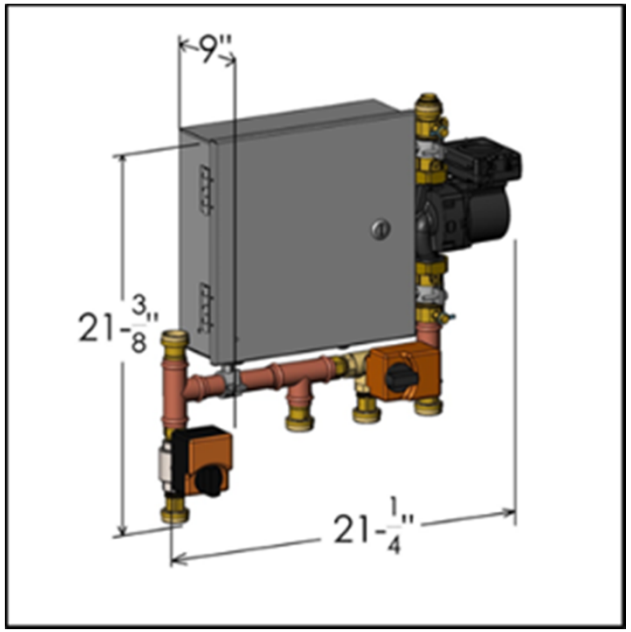
- Smart sensor
- Main power (208/230 – 1 Ph)
- BAS (if applicable)

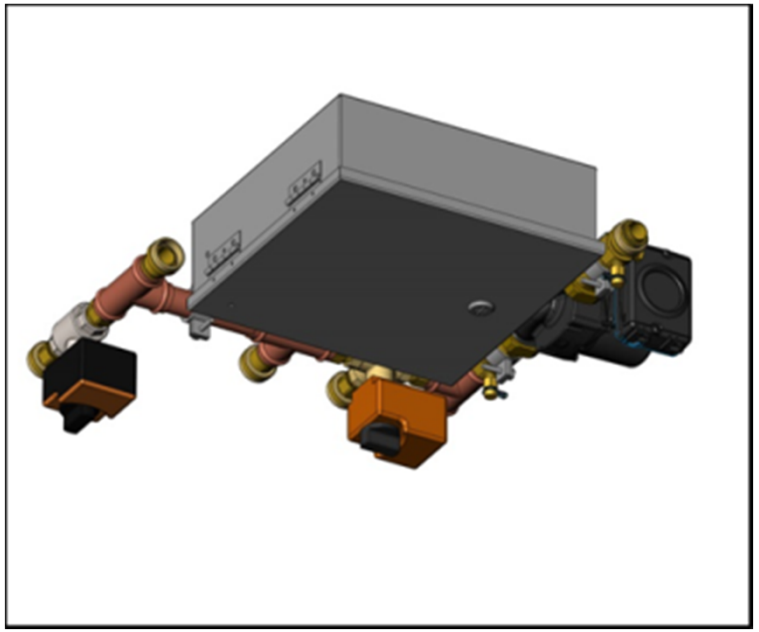
Water connections

- 6 pipe connections
- Swivel half-union adapters
- Designed for std 1” male fitting



Vertical or Horizontal Mounting Accommodated





Notes:

- NEUTON can be mounted in several positions as long as the pump shaft remains horizontal (as shown above)
- Adequate space must be allocated of opening the hinged panel door and accessing the DDC control board and other components

Room Smart Sensor

Features

- Full digital display
- Communicates with NEUTON via BACnet

Wall sensor includes:

- Temperature
- Relative Humidity
- CO2 (optional)

Reduced First Cost Comparison

Summary of Zone Performance/Cost Analysis: Current State-of-the-Art 4-Pipe Approach vs. NEUTON and 2-Pipe Approach

Estimated Installed Cost	SOA 4 Pipe Coils	NEUTON 4 Pipe Coils	NEUTON 2 Pipe Coils
Primary Loop	$65,000	$23,840	$10,450
Zone Loops, Beams, Controls, NEUTON	$68,230	$77,300	$77,300
Total Installed Cost [1]	**$133,230**	**$101,140**	**$87,750**
Reduction from SOA Baseline (percentage)	0%	24%	34%
Reduction from SOA Baseline ($/sq.ft.)	$0 / sq.ft.	$2.10 / sq.ft.	$3.00 / sq.ft.

Note 1: Includes all installed components except ductwork and Pinnacle DOAS equipment and installation

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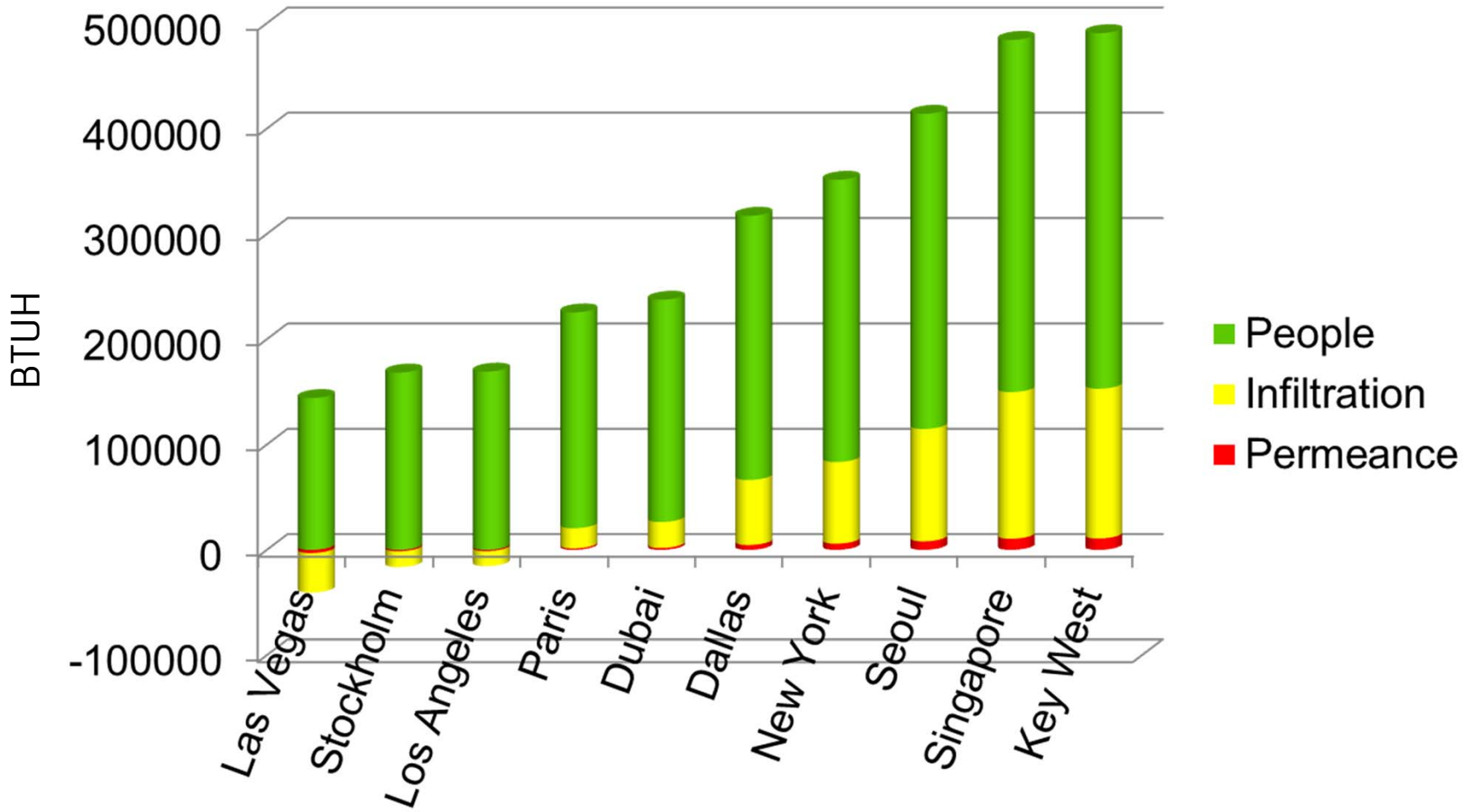
SYSTEM INTEGRATION
PINNACLE – NEUTON - CHILLED BEAMS

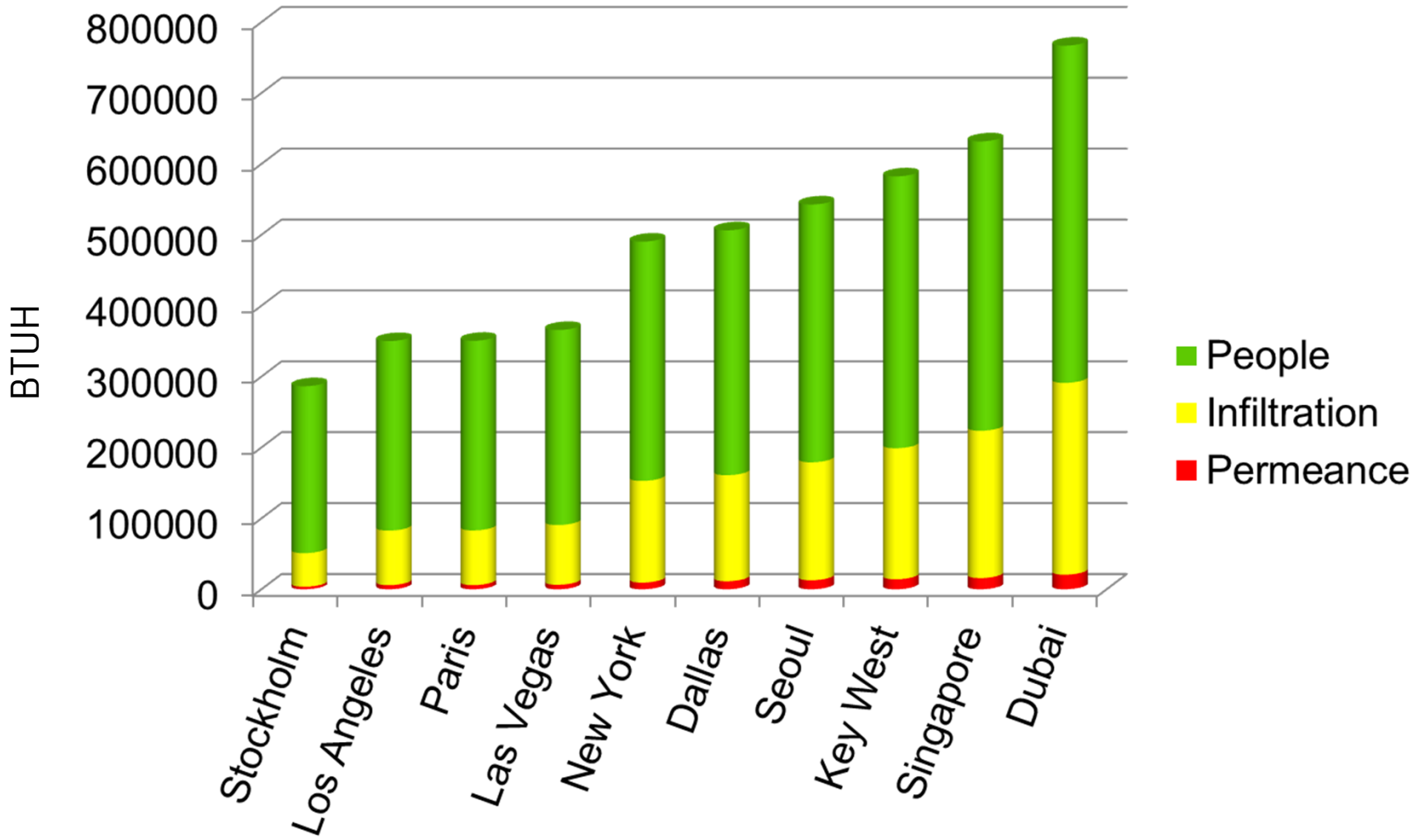
Space Humidity Remains Regardless of Location

Based on 0.04% ASHRAE Peak Dry Bulb Design



Space Humidity Remains Regardless of Location

Based on 0.04% ASHRAE Peak Dewpoint Design



What Determines Minimum Primary Airflow?

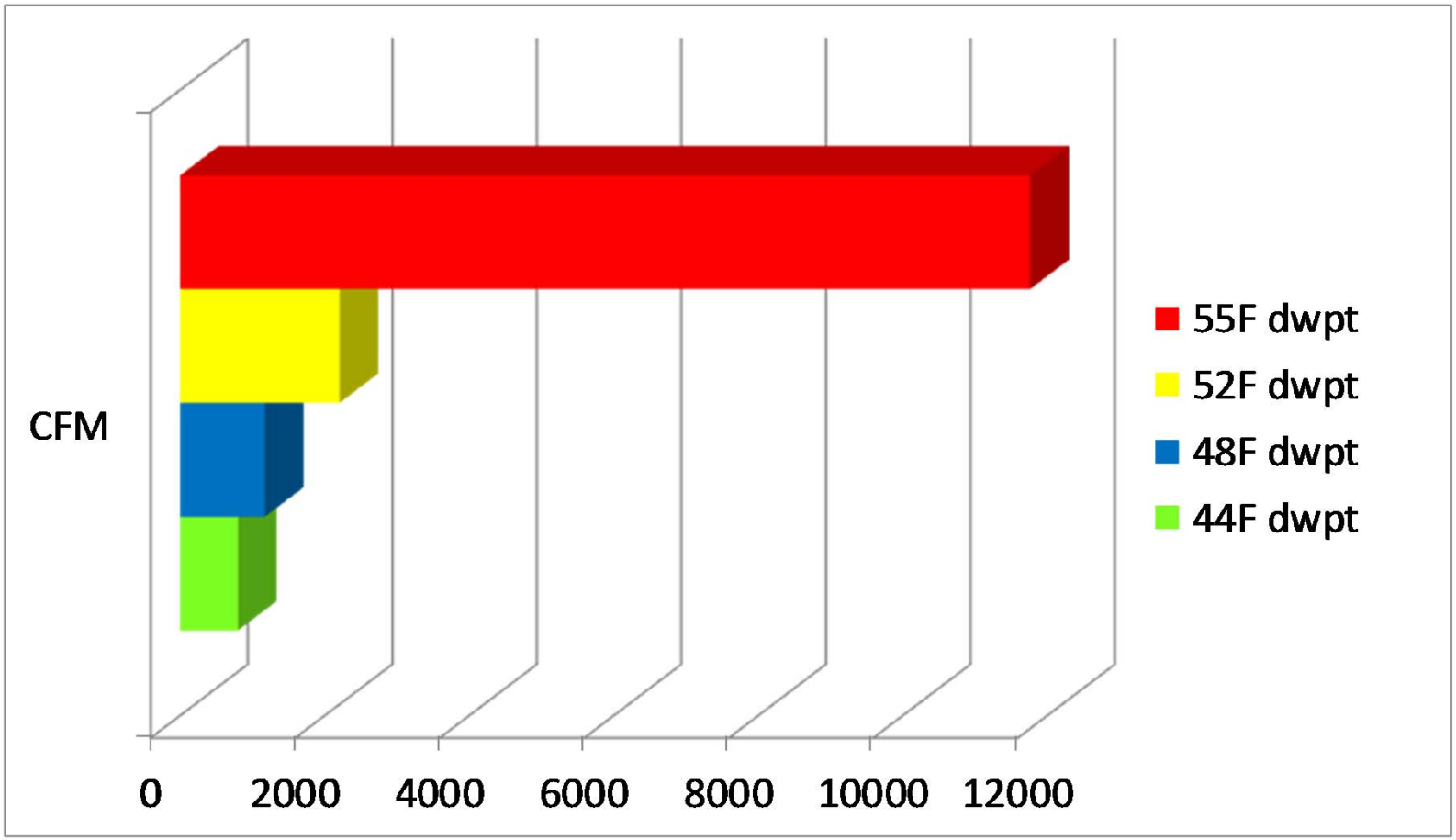
1. ASHRAE 62 minimum ventilation requirement
2. Minimum to satisfy space latent load
3. Minimum to satisfy space sensible load
4. Make-up air requirement

*Laboratory, Kitchen Exhaust Make-up, Etc.

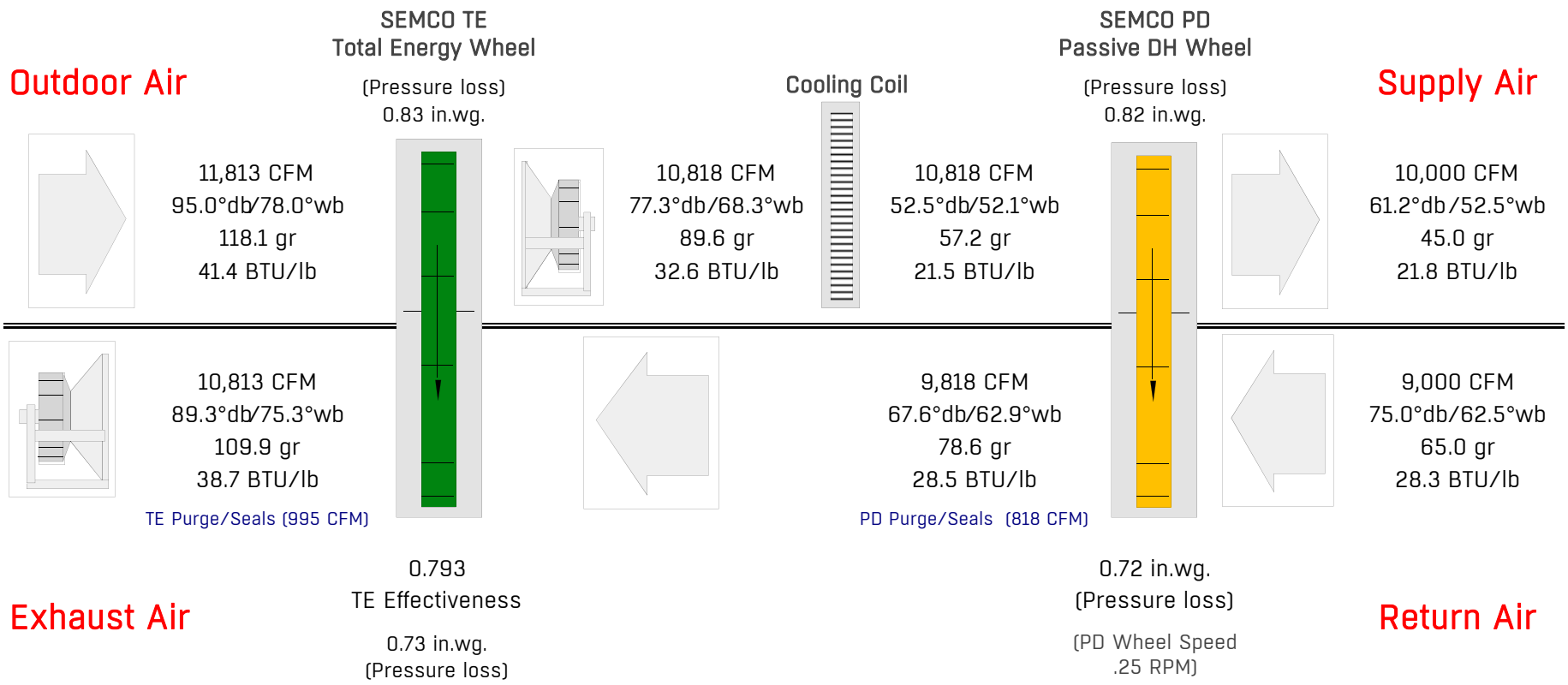
How Supply Dewpoint Effects Primary Airflow

Maintaining 50% space relative humidity at 75F db

Based on 3 ton space latent load



Pinnacle Dual Wheel DOAS - Review

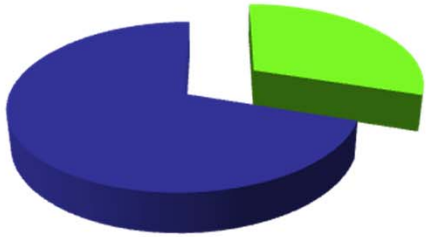


Summarizing Primary Air and Humidity Concern

- Traditional beam system approach utilizes higher dewpoint/colder air
- Primary benefit of chilled beam system is horsepower reduction
- To maximize energy benefit, minimize primary air
- Lower the airflow, the lower the dewpoint required.
- Application type impacts approach – 3fficiency system can be adjusted to suit the application and amount of outdoor air required

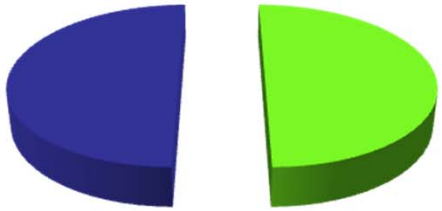
Occupancy Impacts Primary Air

VAV Office (low Occupancy)



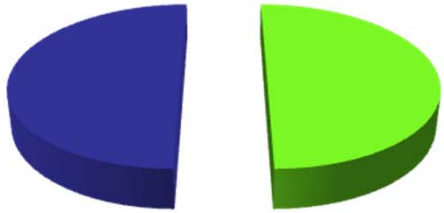
Outdoor Air
Recirc Air

VAV School (High Occupancy)



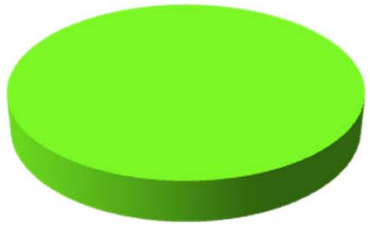
Chilled Beams require ½ the airflow of a traditional VAV system design

PVS/CB Office (low Occupancy)

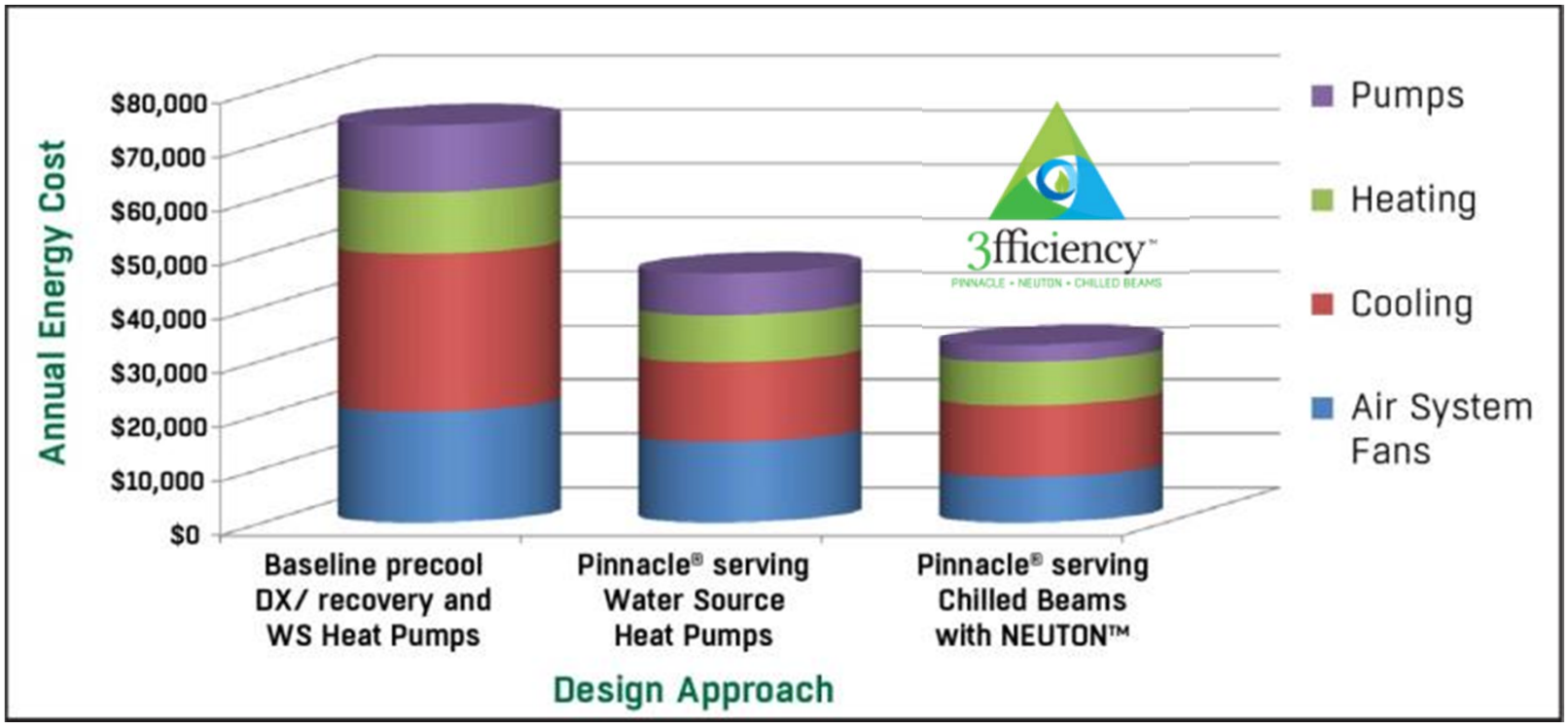


Outdoor Air
Recirc Air

PVS/CB School (High Occupancy)



Energy Modeling: Systems Compared



Energy modeling completed for an actual High School project comparing three design approaches which highlights the significant fan and pump energy savings offered by the 3fficiency system.

System Integration Summary

1. Geography doesn't eliminate humidity concerns

2. Lower dewpoints requires lower primary airflow requirement

3. A Pinnacle unit uses the lowest dewpoint with the least energy

4. Primary Air is determined by
    1. ASHRAE 62
    2. Minimum Dehumidification
    3. Minimum Sensible
    4. Make up air requirement

5. Adjustable nozzles makes test and balance easier

6. A chilled beam system can save more than 50% of the building's HVAC energy

7. 3fficiency uses an average of 70% less pump energy to achieve better comfort than traditional equipment

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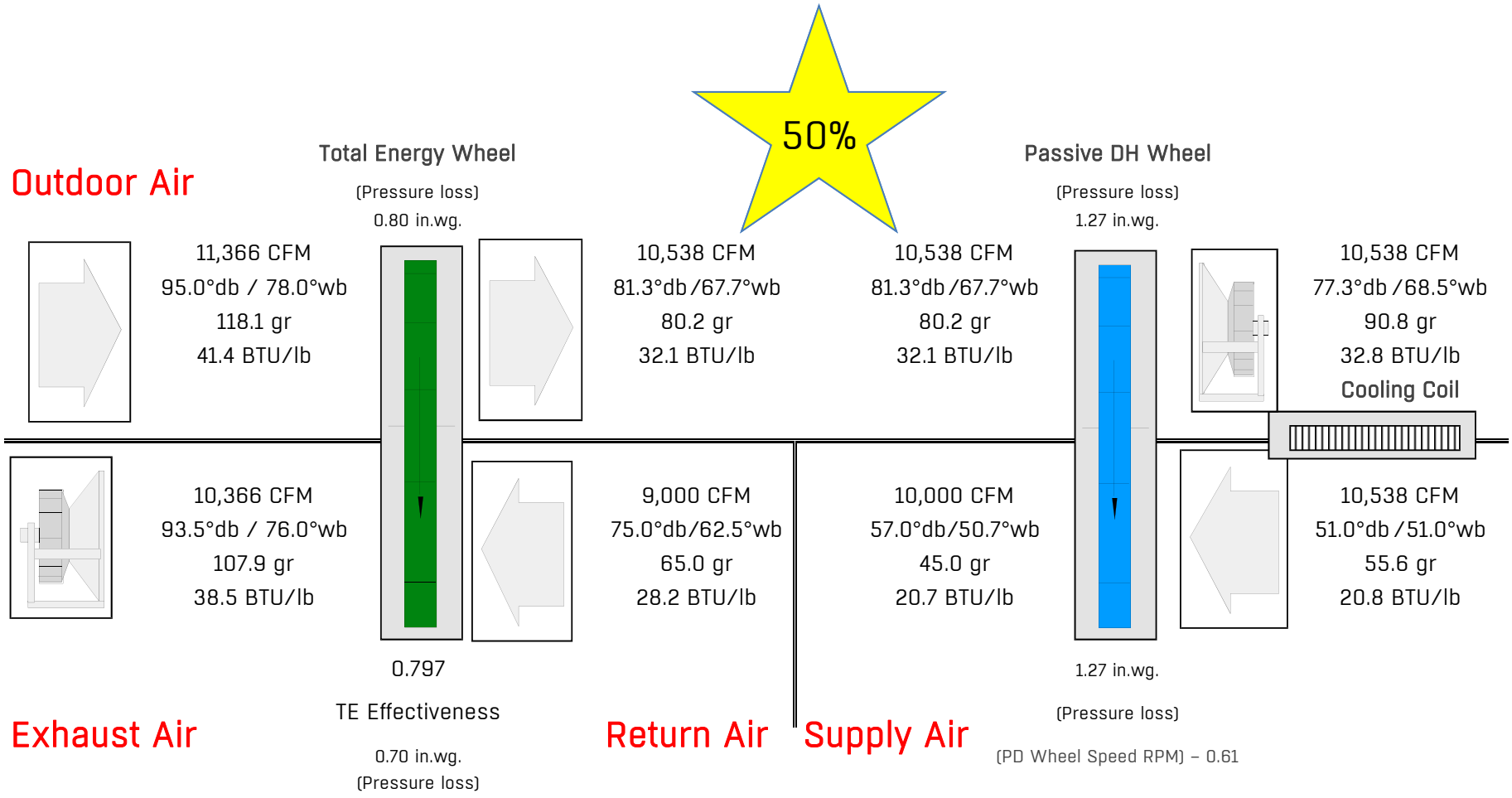
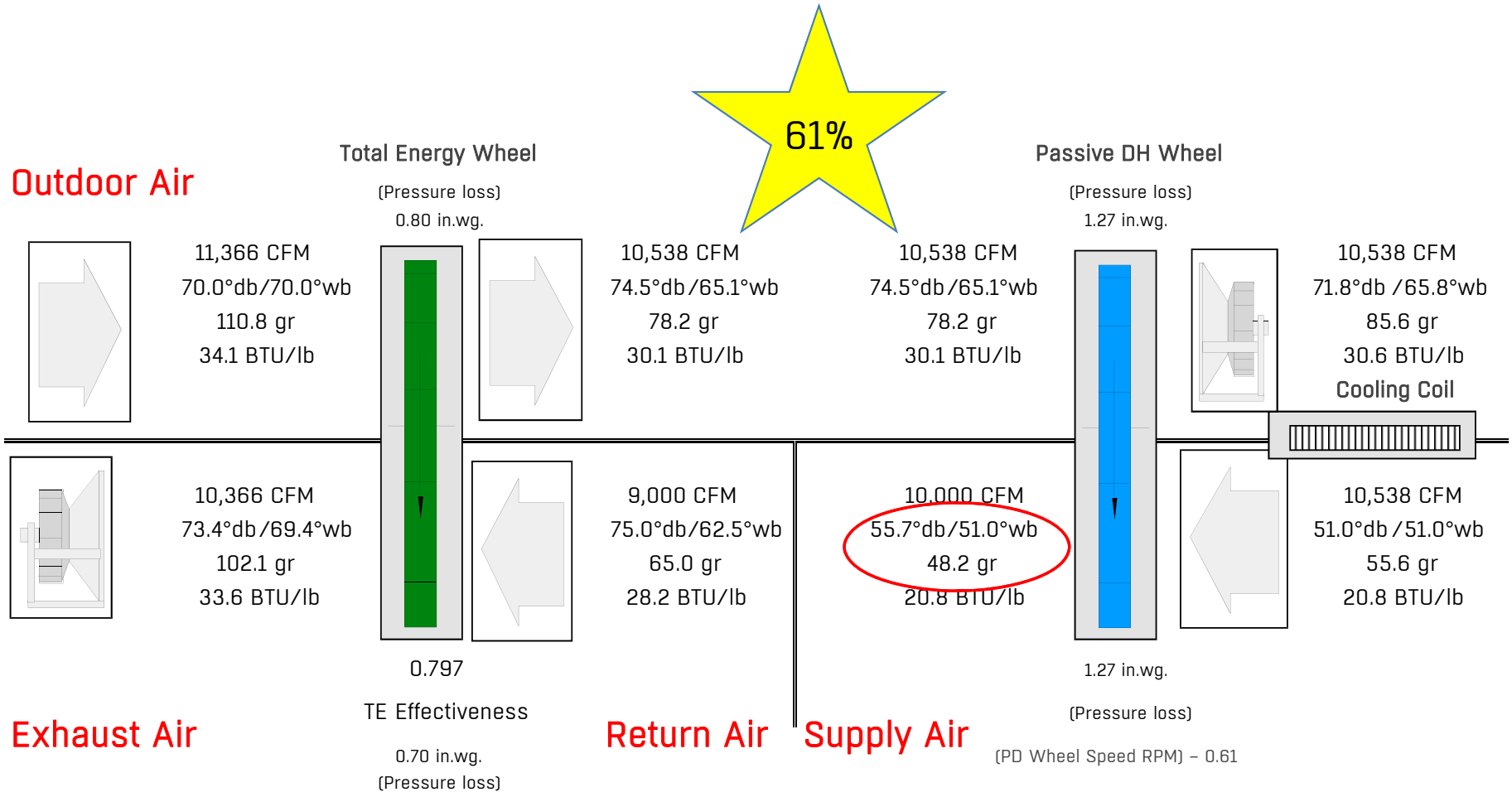
COMPETITION
DUAL WHEEL DEHUMIDIFIERS

Competitor #1 – Peak Dry Bulb



Competitor #1 – Part Load



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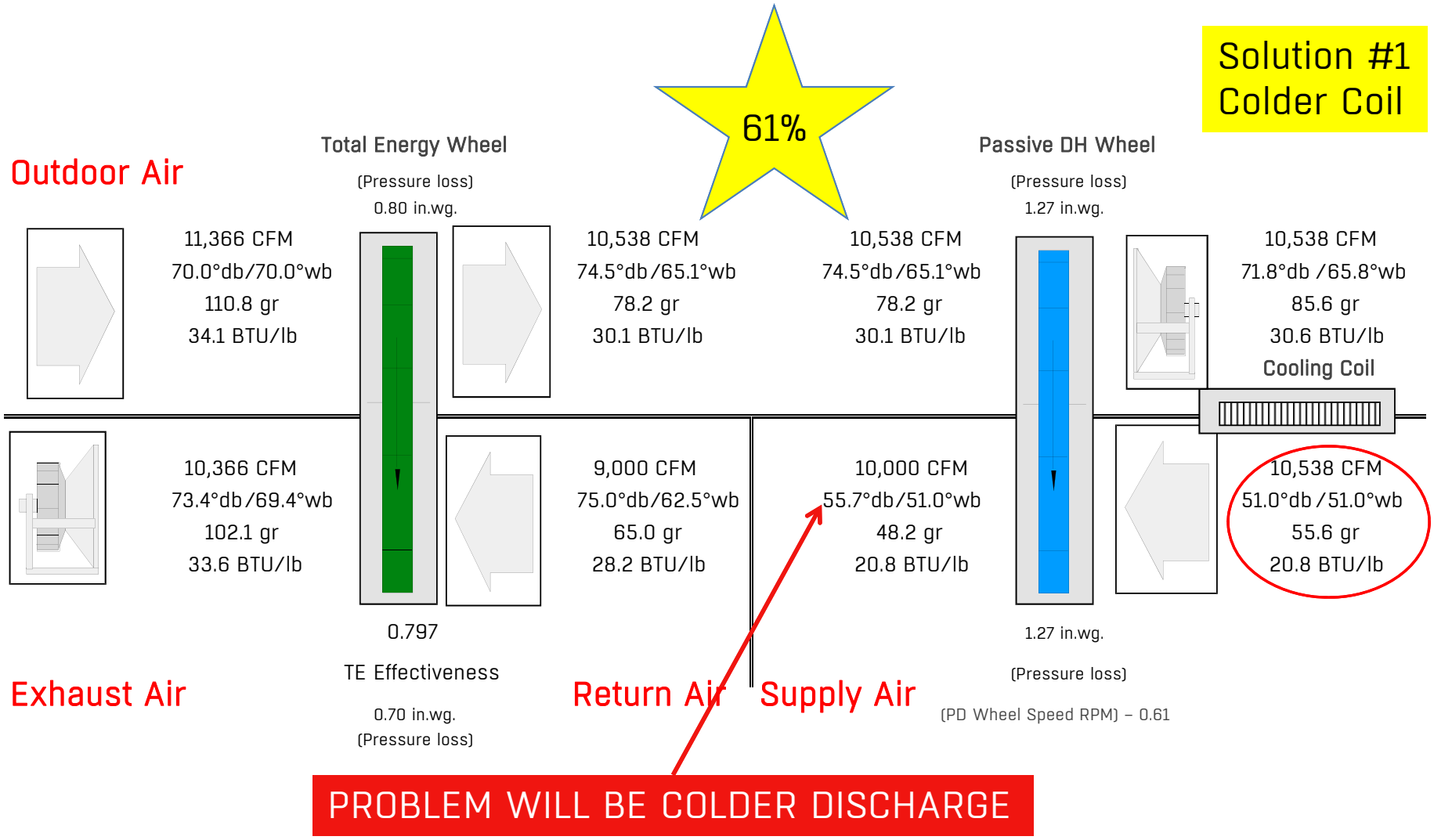

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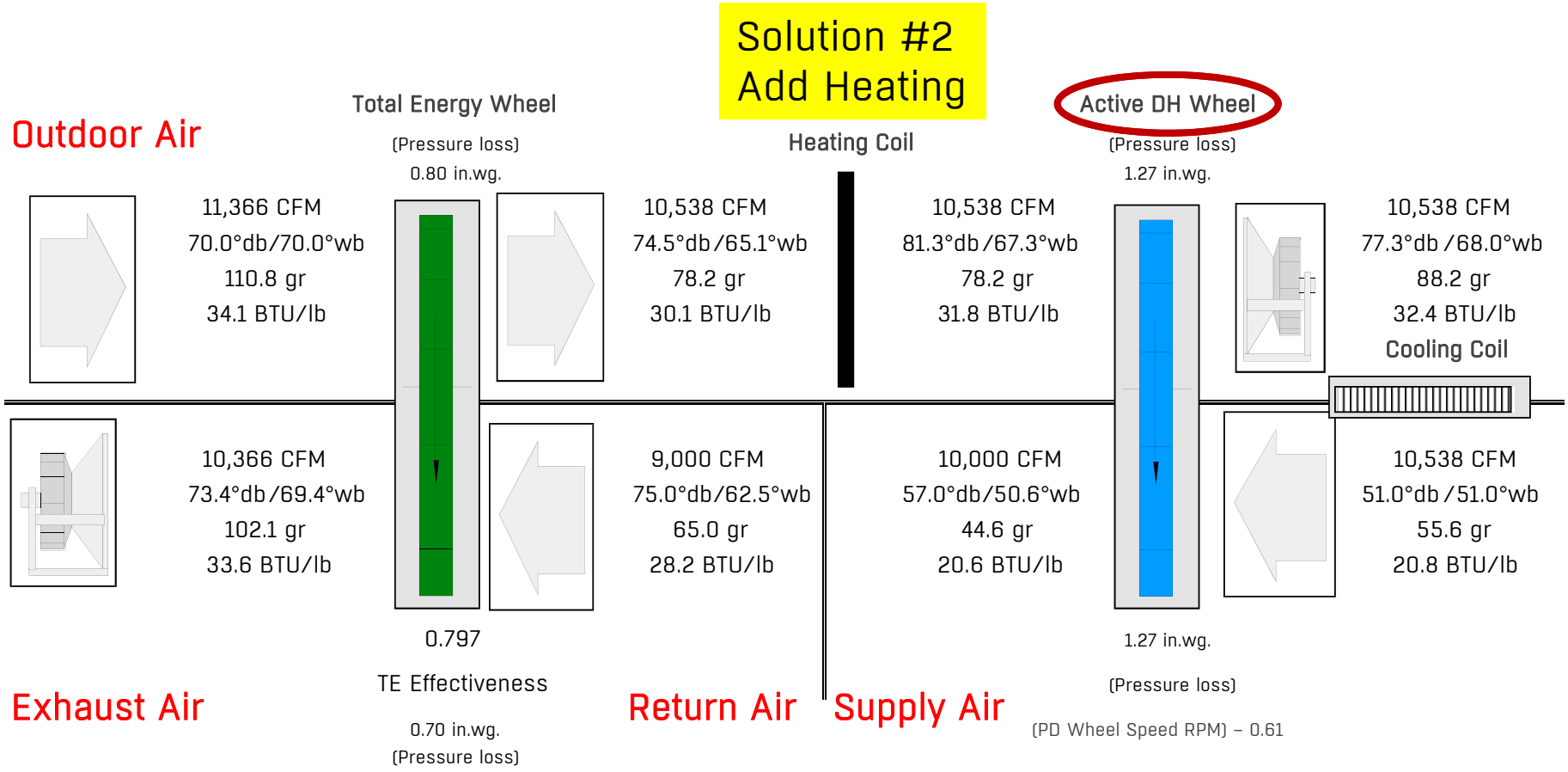
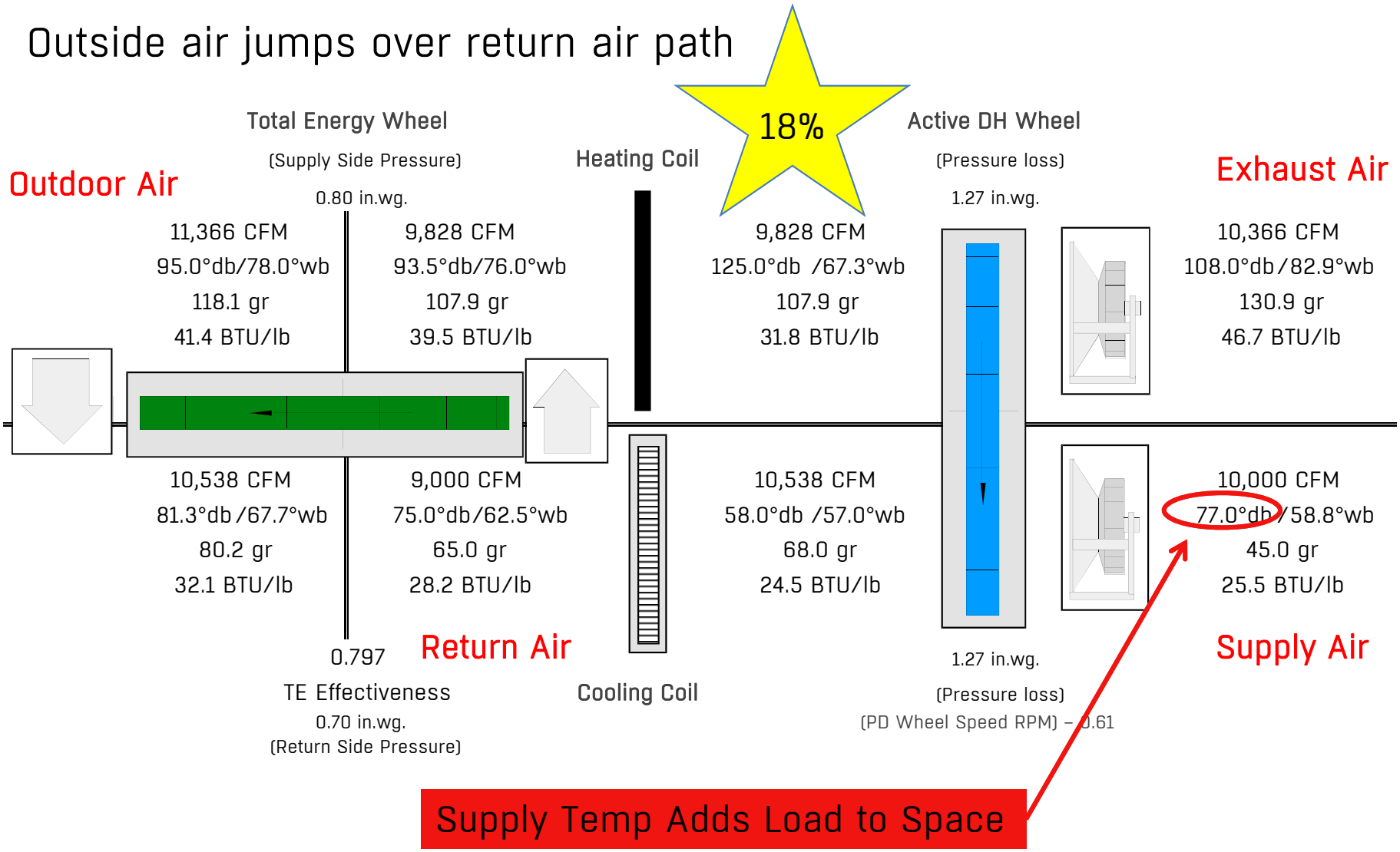
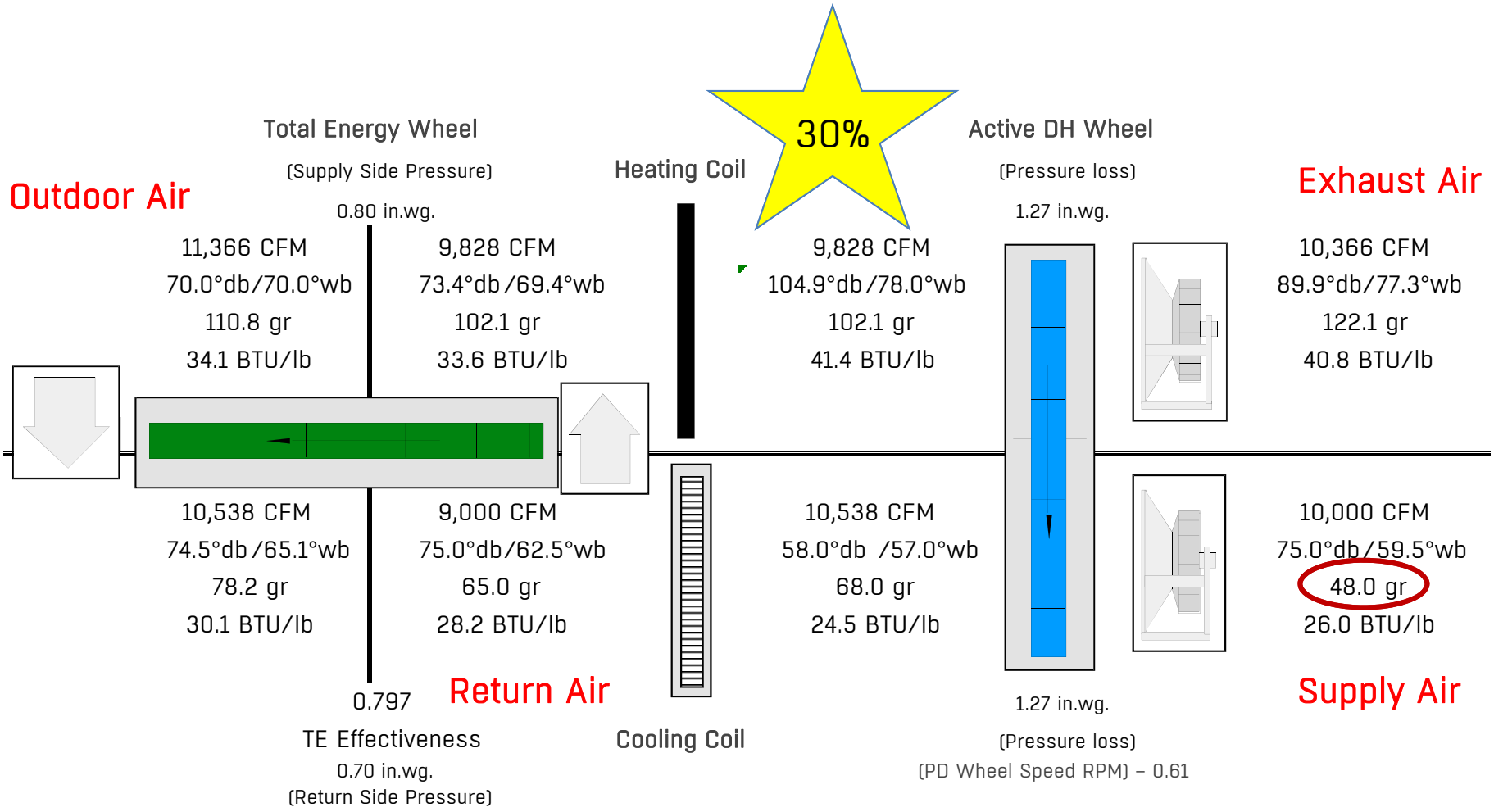


Competitor #2 – Peak Dry Bulb

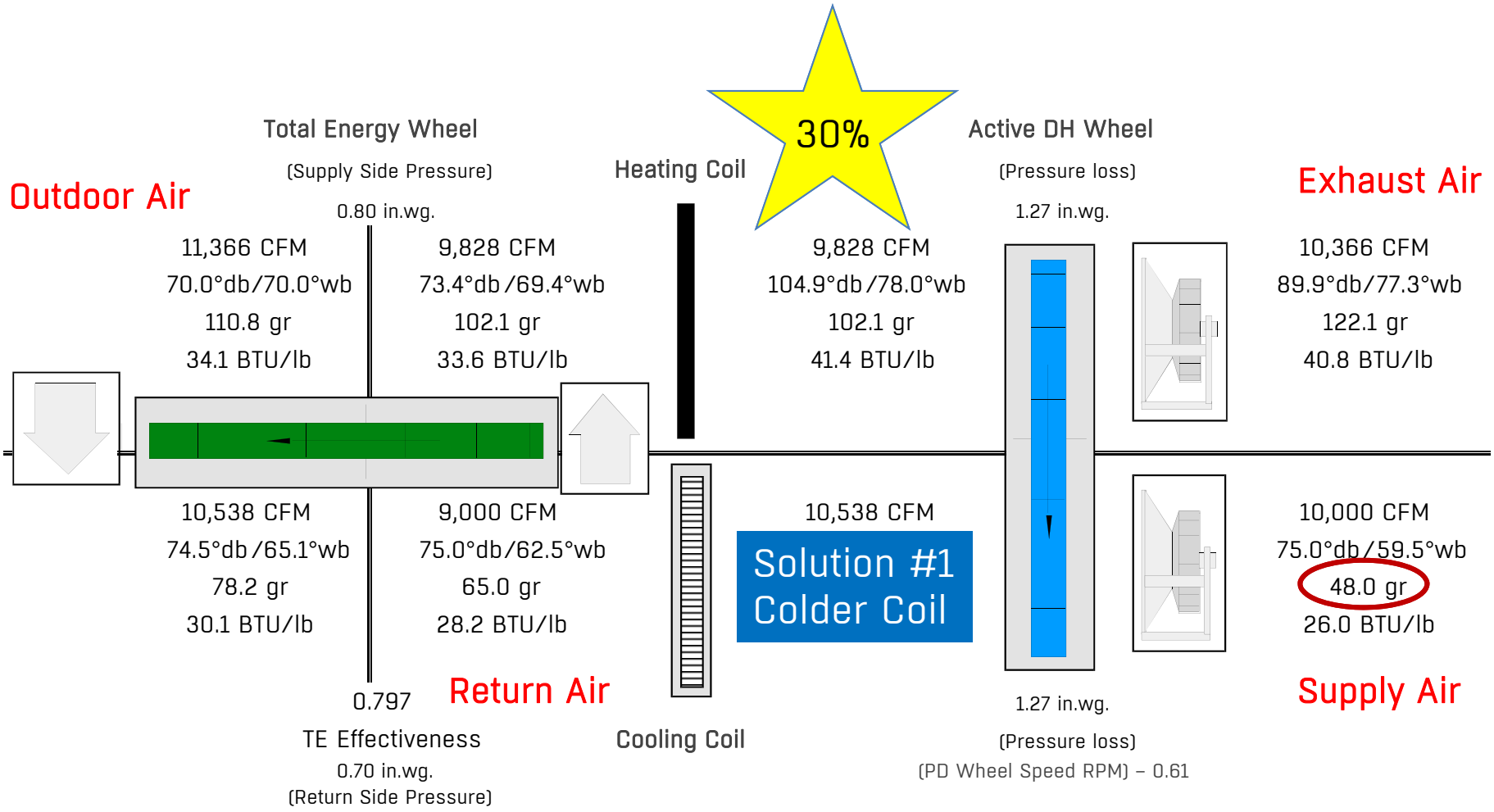
Outside air jumps over return air path



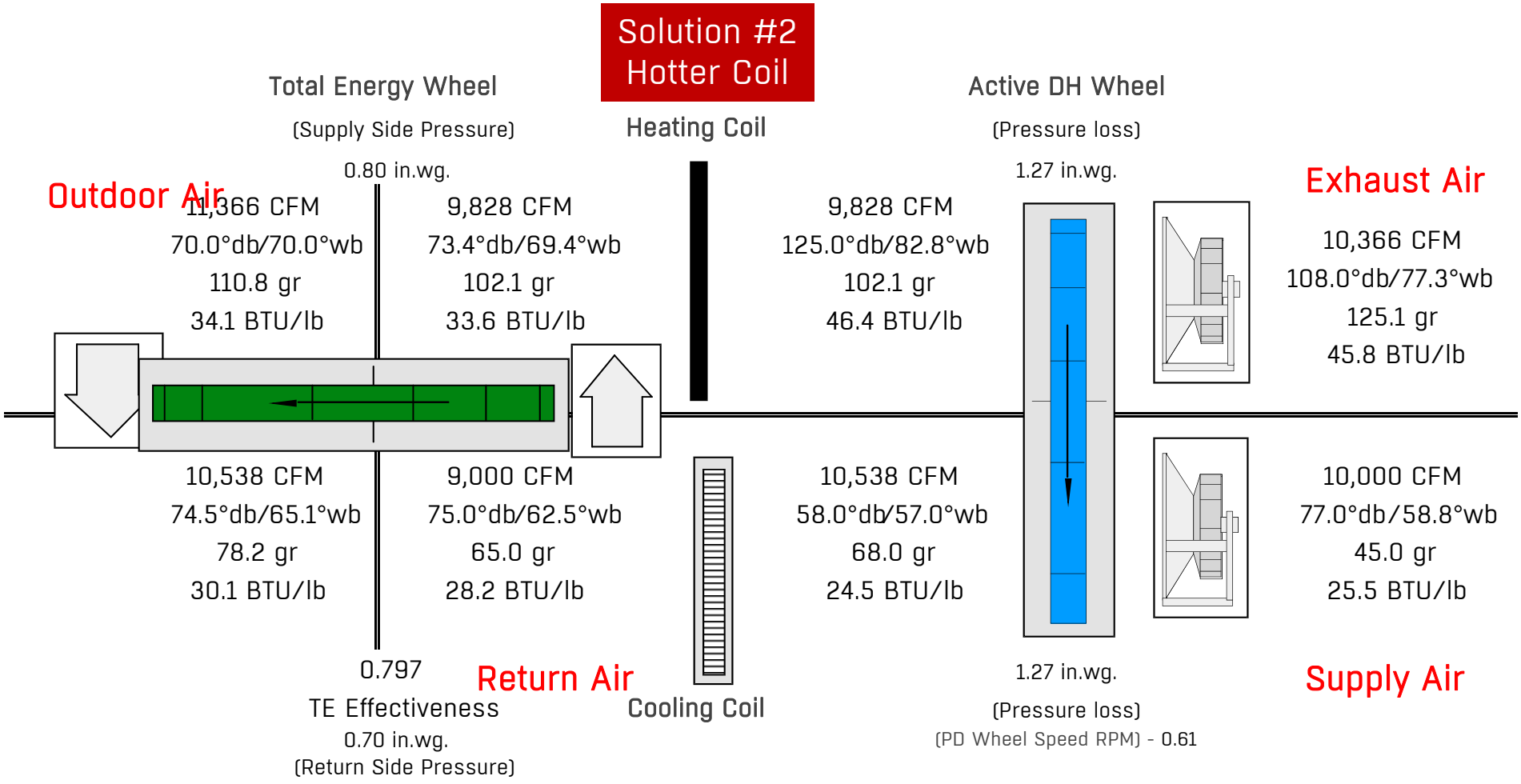
Competitor #2 – Part Load



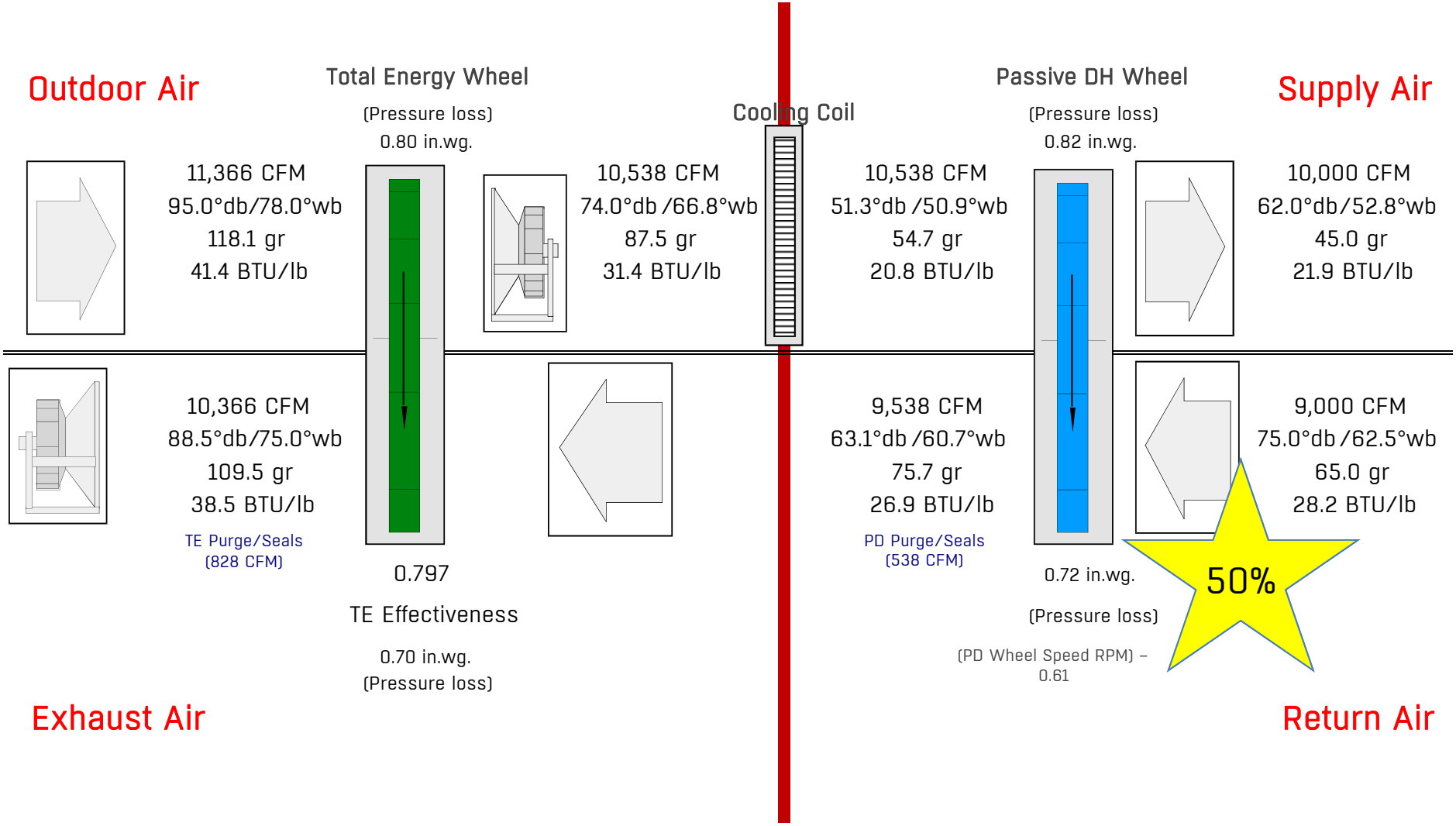
Competitor #2 – Part Load



Competitor #2 – Part Load



SEMCO Pinnacle



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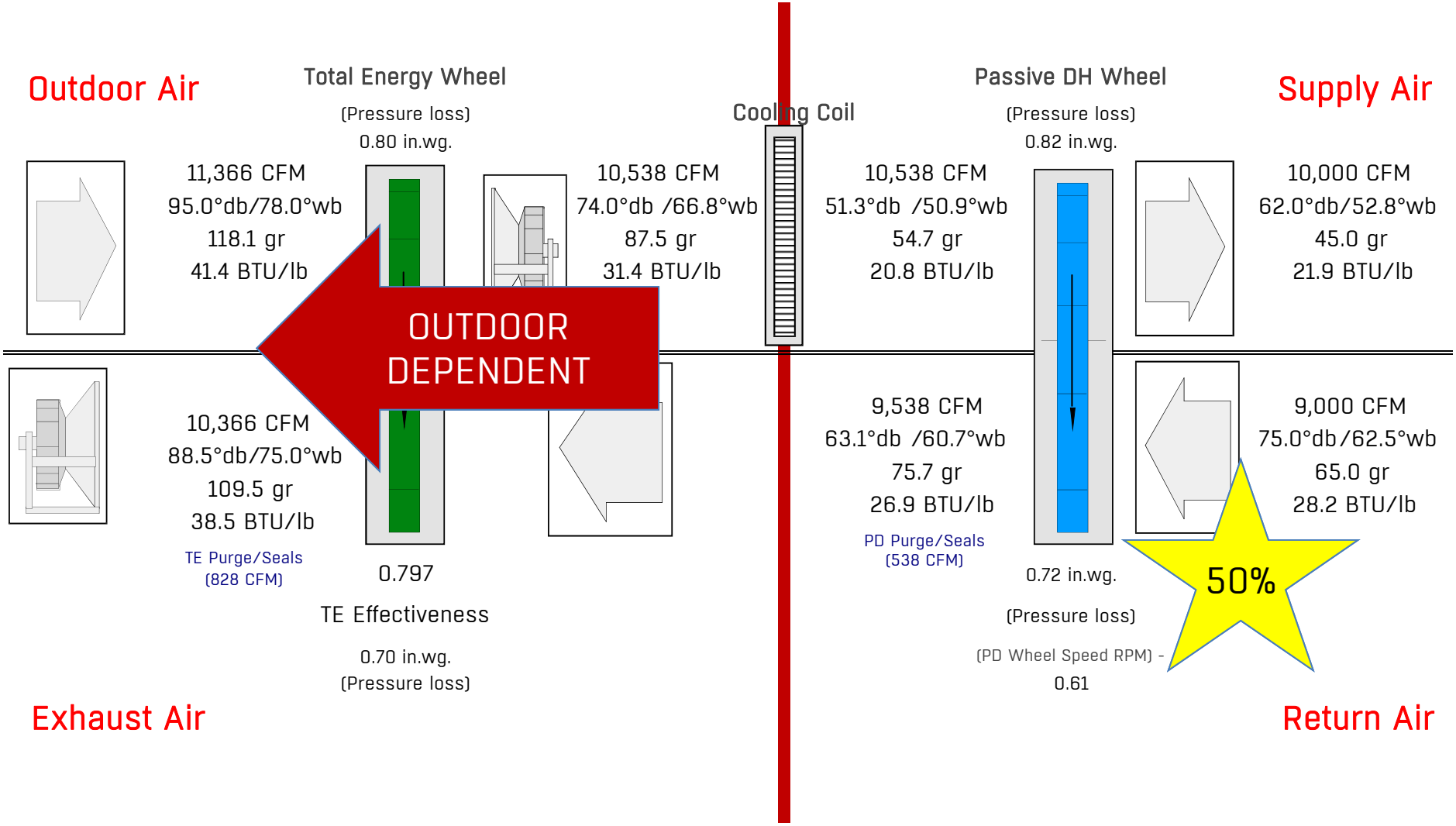

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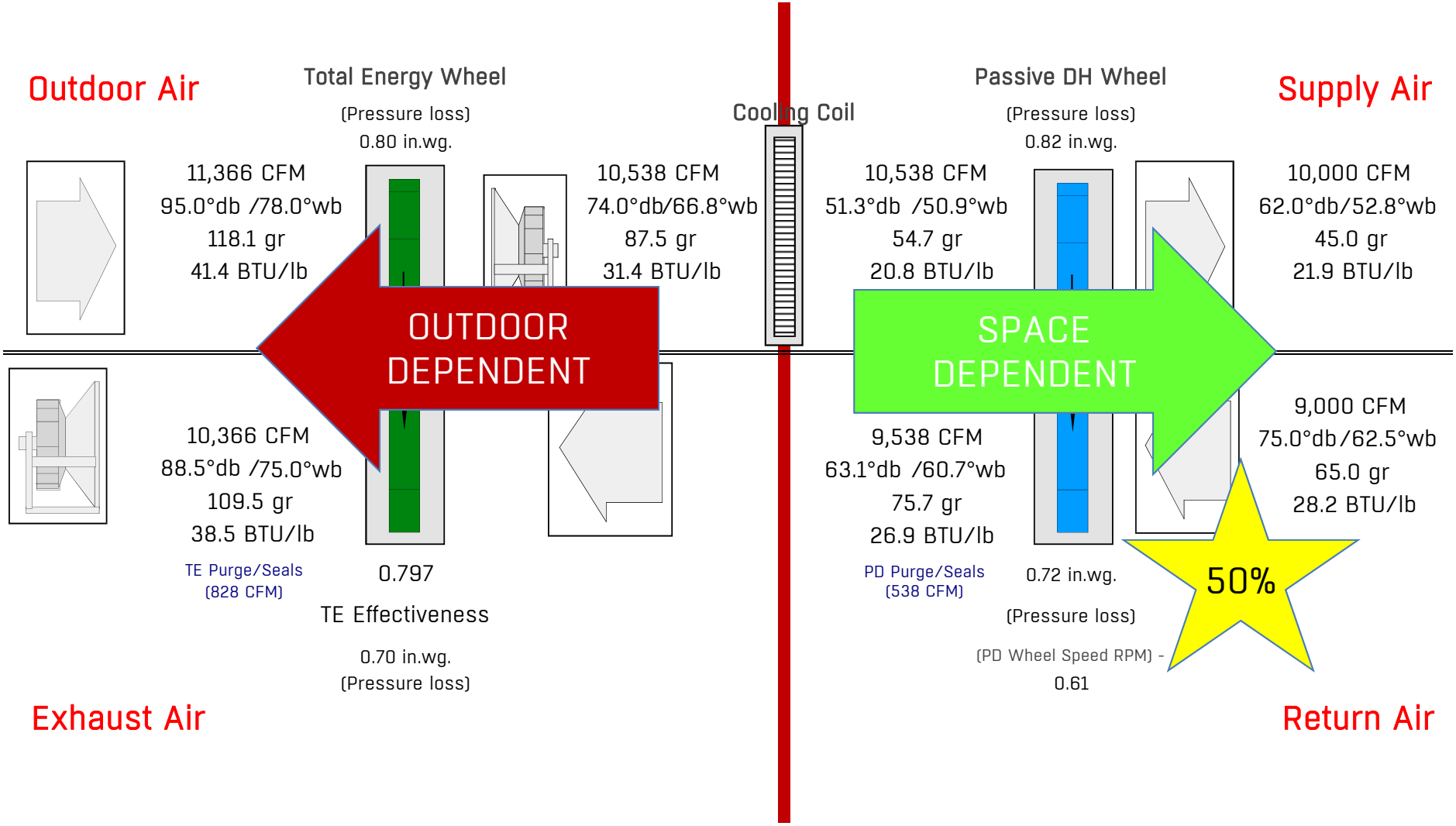

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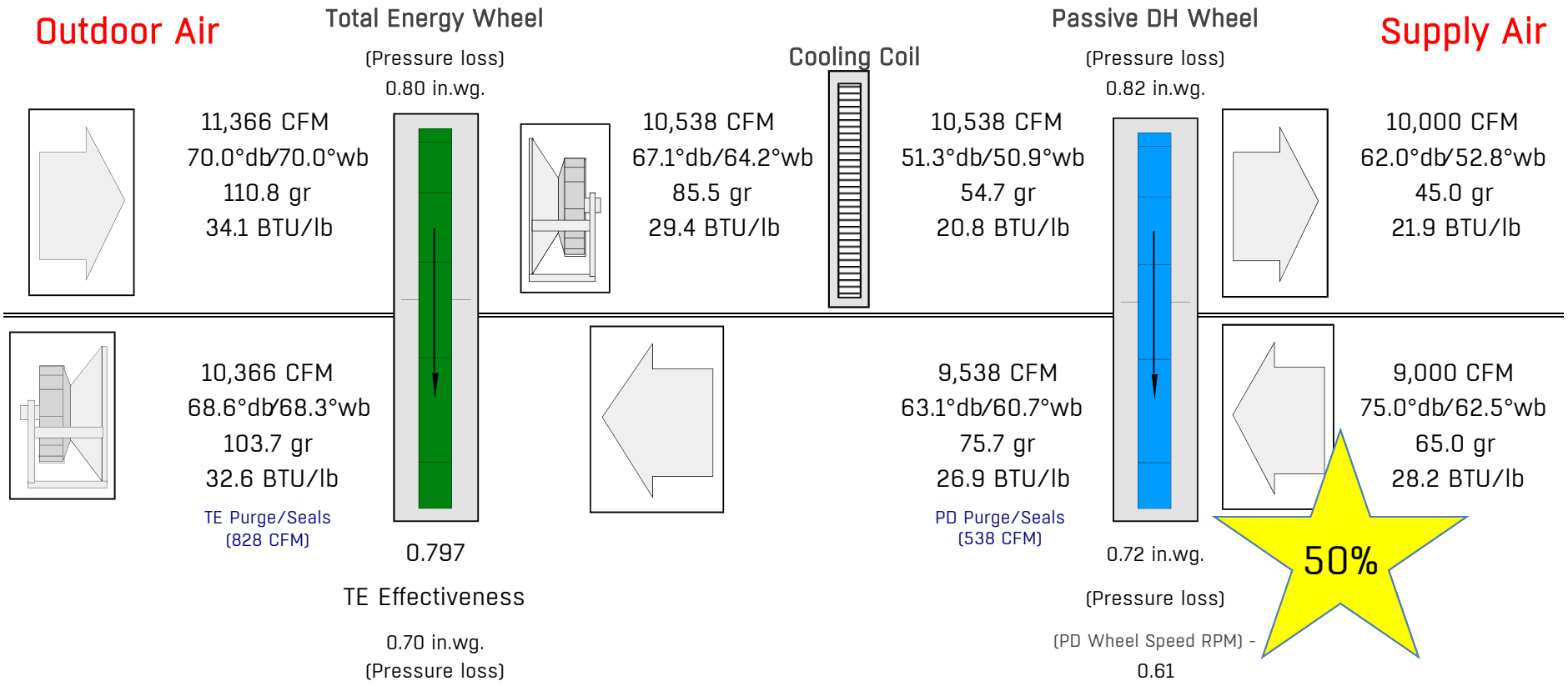

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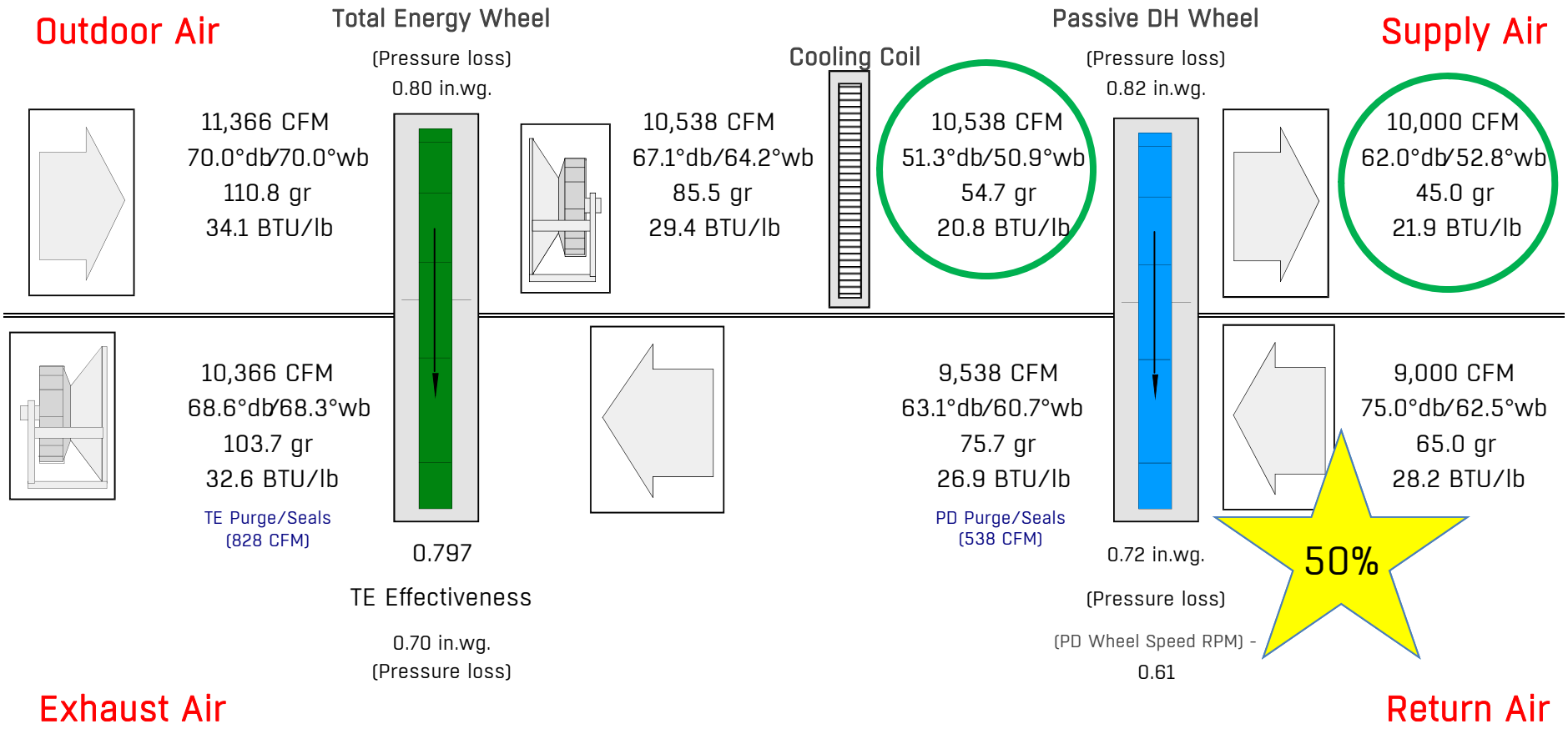

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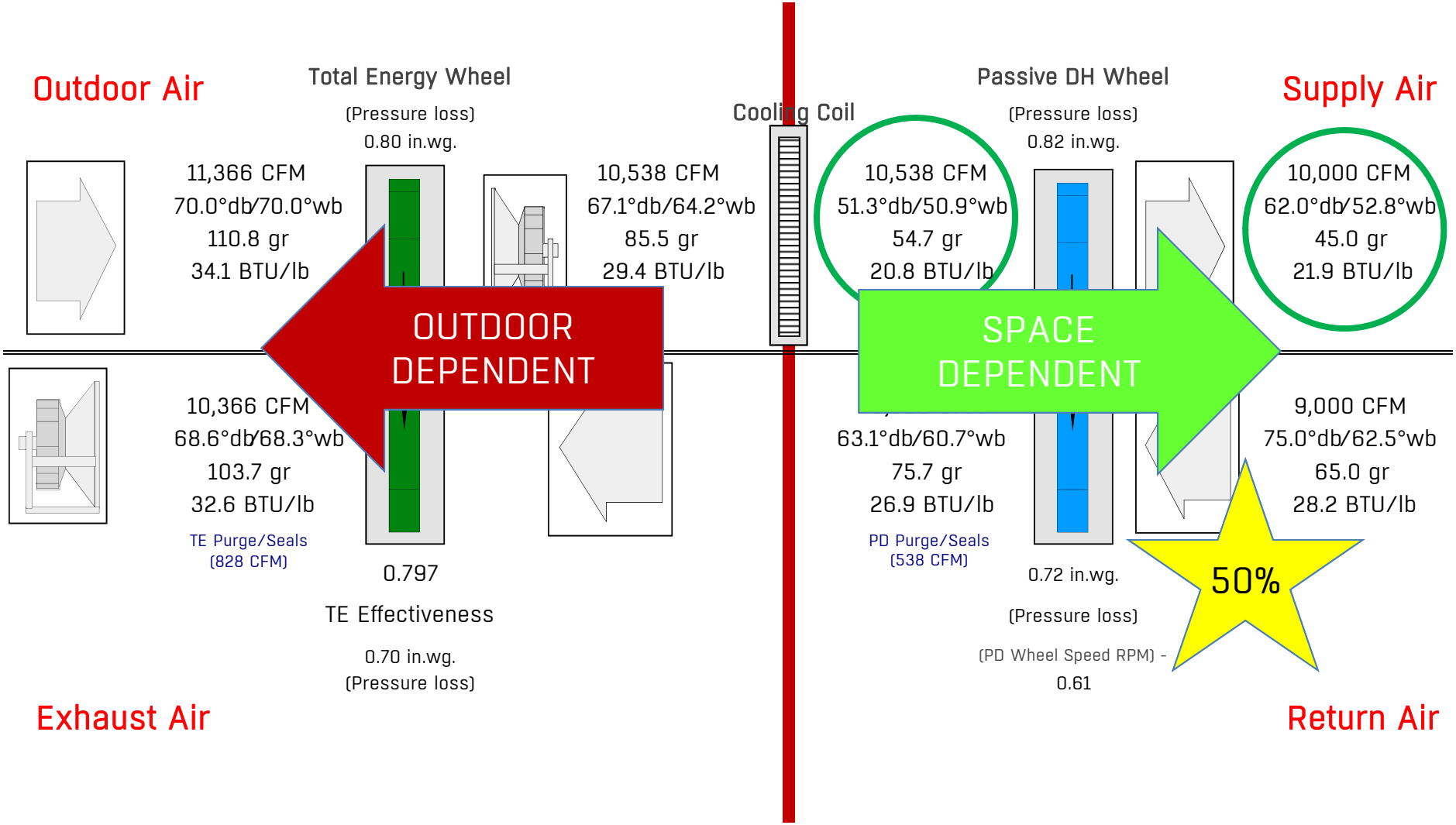
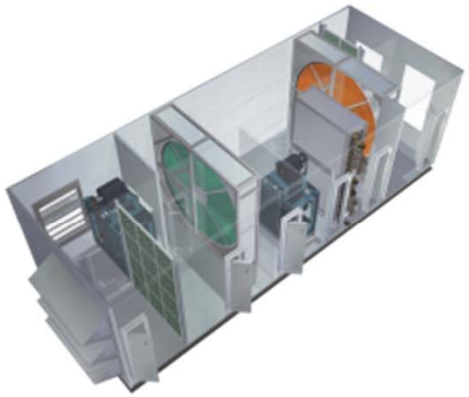


3fficiency – QUESTIONS?

3fficiency™
PINNACLE + NEUTON + CHILLED BEAMS



QUESTIONS?

3fficiency™ is the “Pinnacle” of chilled beam systems.

The 3 components included in the system package are:

- Pinnacle™ Dedicated Outside Air System (DOAS),
- NEUTON™ Chilled Beam Pump Module, and
- SEMCO Active Chilled Beam line.

NEUTON is what makes 3fficiency™ possible.