We will be starting soon!

Thanks for joining us

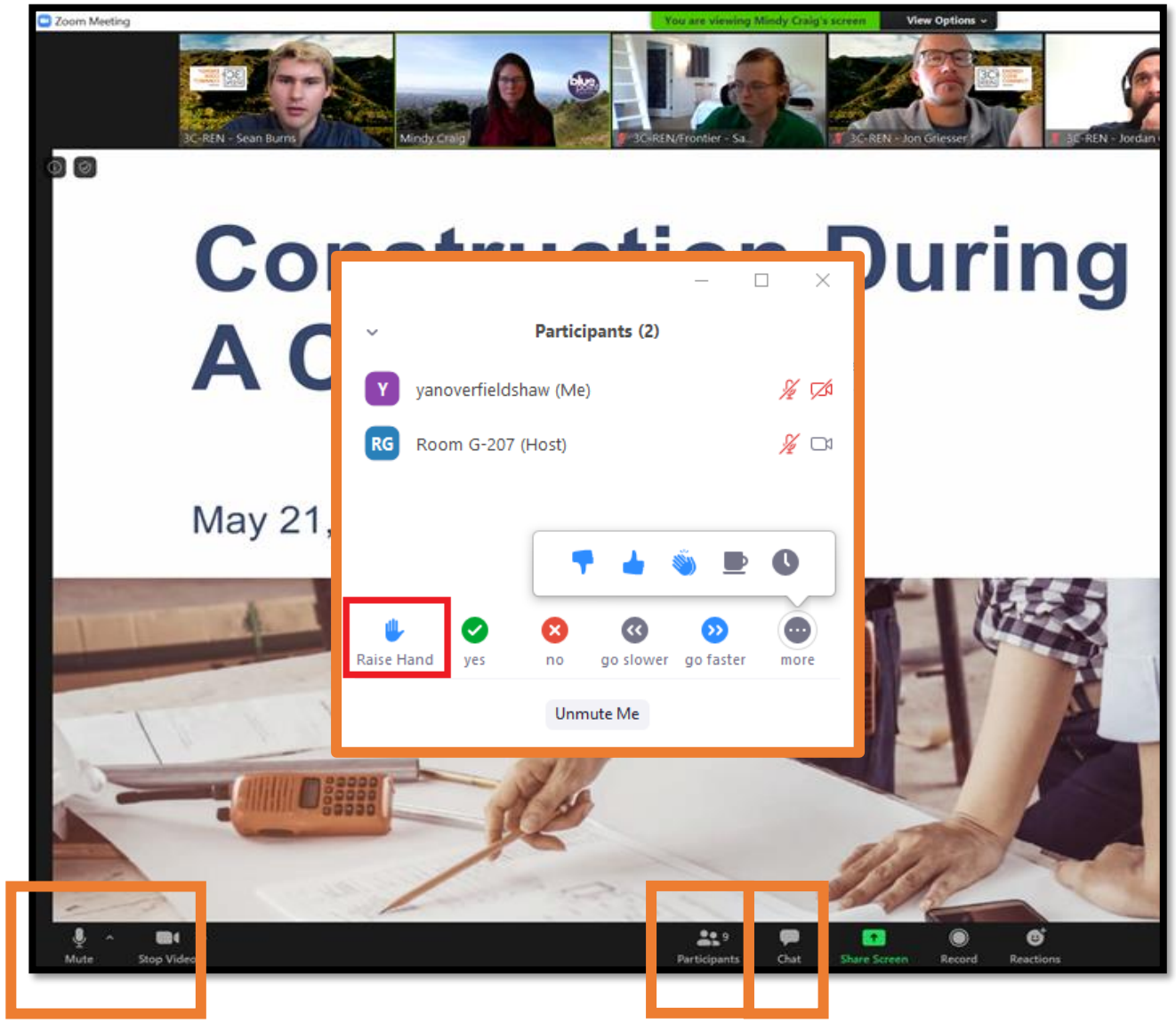
HRV & ERV Basics

Eric Fenno, Small Planet Supply

November 21, 2024

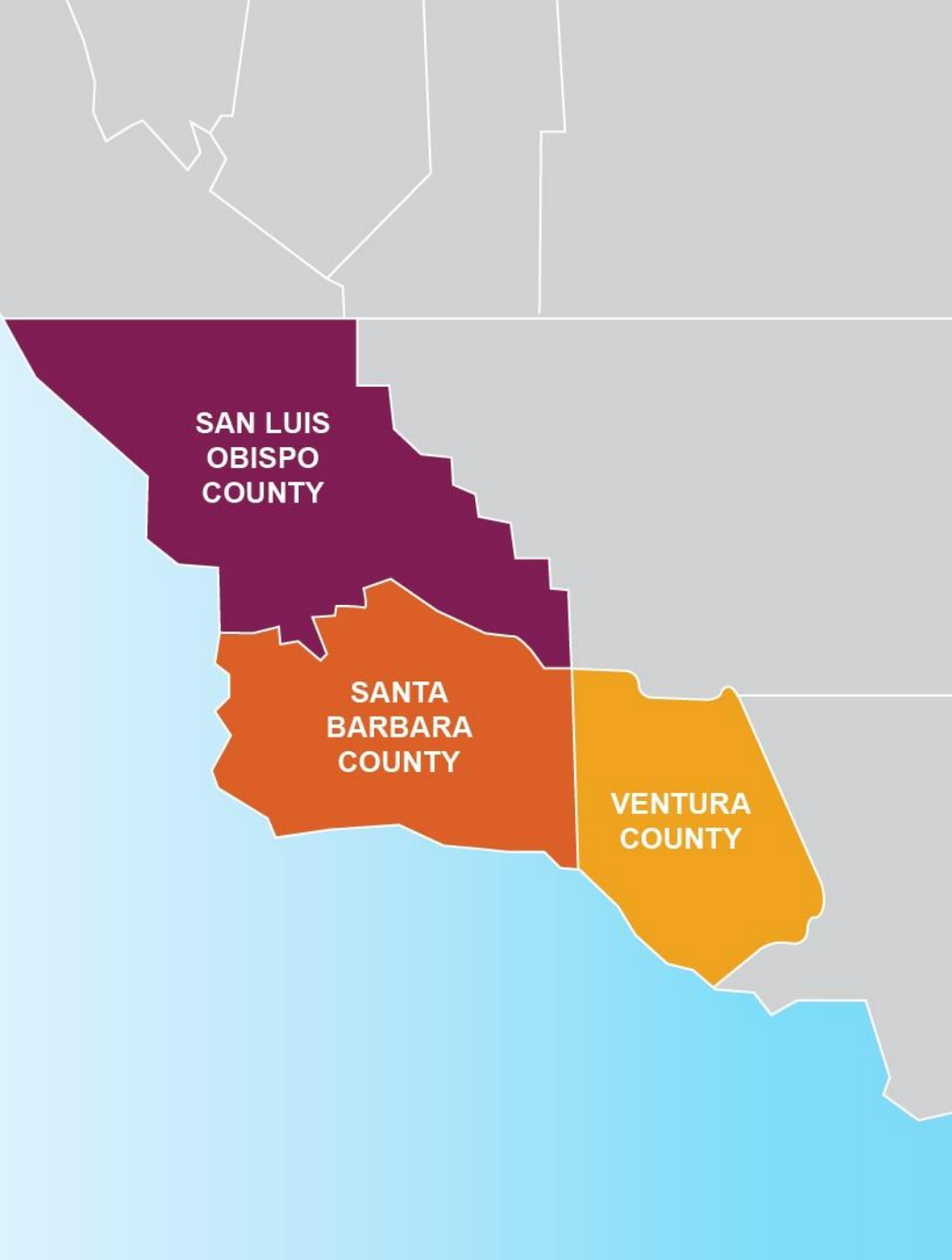
Zoom Orientation

- Please be sure your full name is displayed
- Please mute upon joining
- Use "Chat“ box to share questions or comments
- Under "Participant" select "Raise Hand" to share a question or comment verbally
- The session may be recorded and posted to 3C-REN's on-demand page. Feel free to ask questions via the chat and keep video off if you want to remain anonymous in the recording.



3C-REN: Tri-County Regional Energy Network

- Three counties working together to improve energy efficiency in the region
- Services for –
  - **Building Professionals:** industry events, training, and energy code compliance support
  - **Households:** free and discounted home upgrades
- Funded by ratepayer dollars that 3C-REN returns to the region



3C-REN Programs

- Energy Code Connect (ECC)
  - Industry Trainings and Regional Forums
  - Energy Code Coach: Title 24 Compliance Support Hotline (805) 220-9991
- Building Performance Training (BPT)
  - Industry Trainings & Certification for current and perspective building professionals
  - Helps workers thrive in an evolving industry
- Home Energy Savings (HES)
  - Flexible Home Energy Upgrades
  - Multifamily (5+ units) & Single Family (up to 4 units)

Instructor Introduction

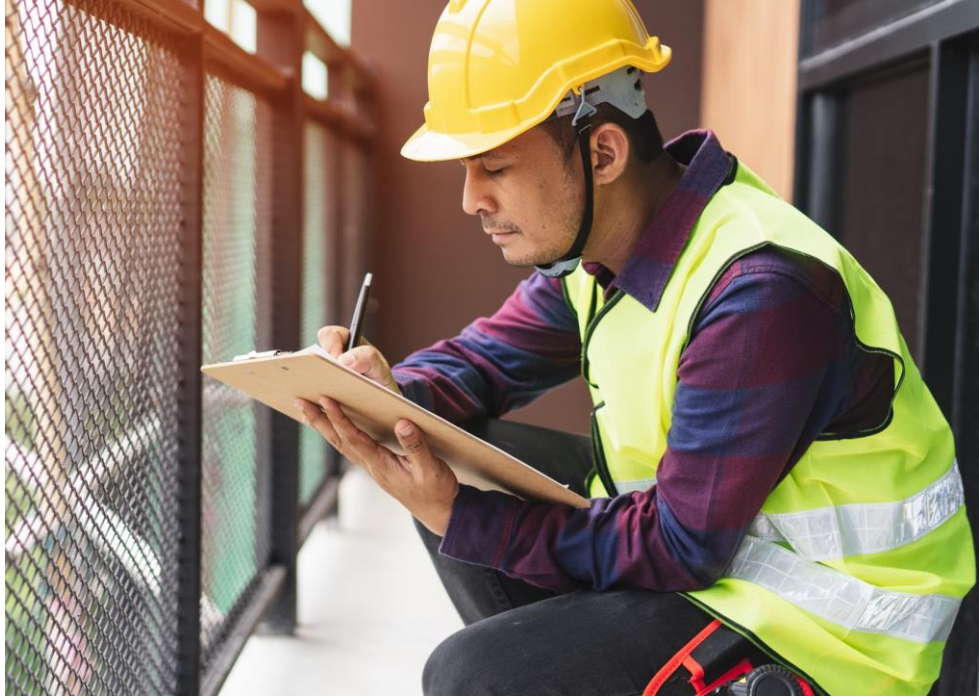
Eric Fenno

- Sales and Customer Support and Driver of the Better Building Coach and Occasional Service tech and Webinar Host at Small Planet Supply
- Accidentally technical
- 360-866-8779 ext 125

Course Objectives

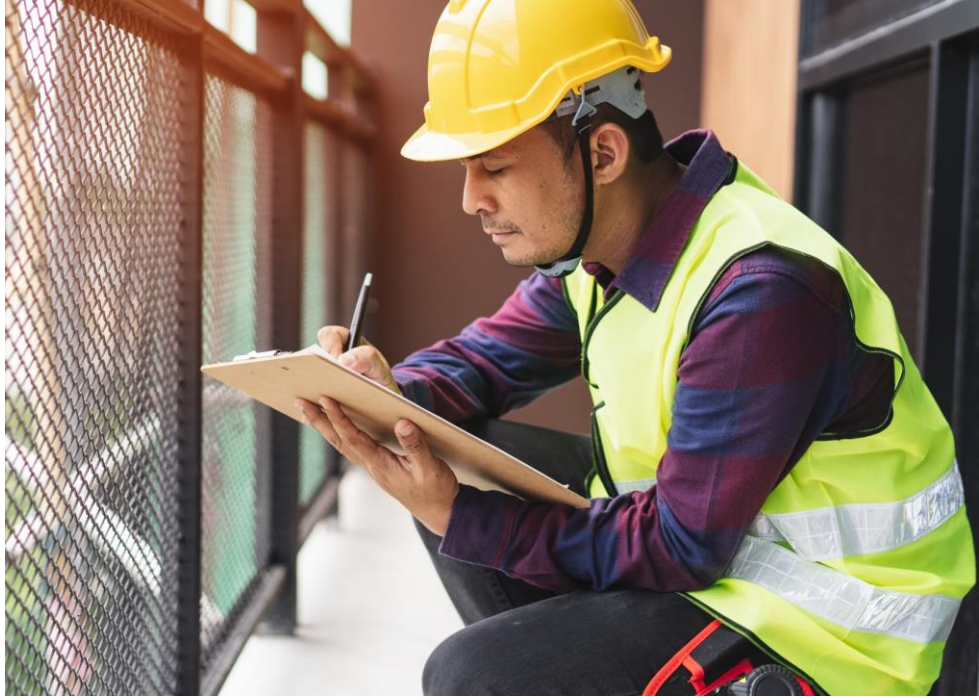
Heat Recovery & Energy Recovery Ventilation Course Objectives

- Describe how HRVs and ERVs provide fresh air into a home
- Identify the components of HRV and ERV systems
- Recognize and plan for climate and occupancy in system design
- Explain the difference between HRVs and ERVs and accurately select the appropriate system



Heat Recovery & Energy Recovery Ventilation Course Objectives

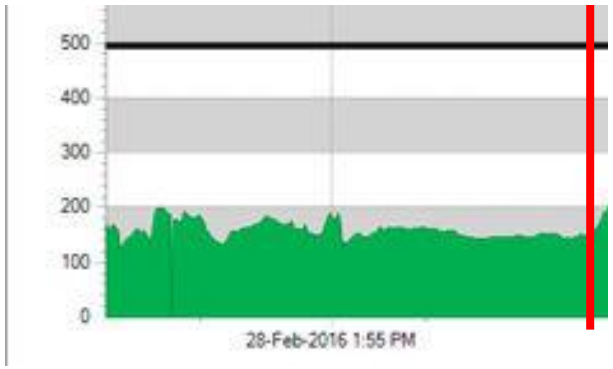
- Understand energy savings that can be achieved through correct installation of an HRV
- Develop basic system design: understanding specifications, system types and sizing, placement, airflows, system types and configurations



How HRVs Provide Ventilation in Today's Buildings

What Happens When There is No Ventilation in a Tight Home?

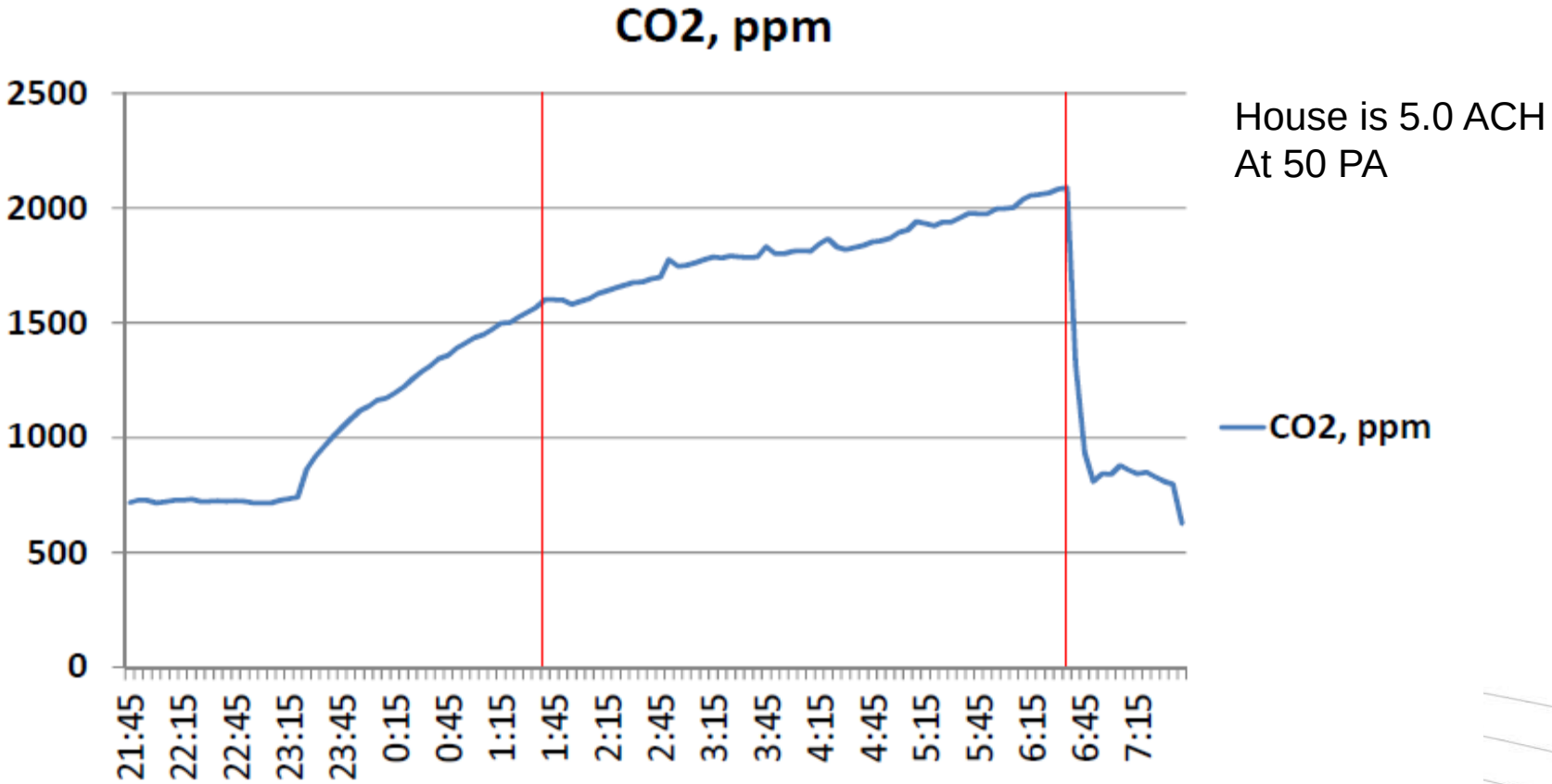
New home on Monterey Peninsula with ventilation system running shows VOC levels well below the WHO recommendation.



WHO Recommendation

TVOC ppb

Unventilated Bedrooms Get Stale

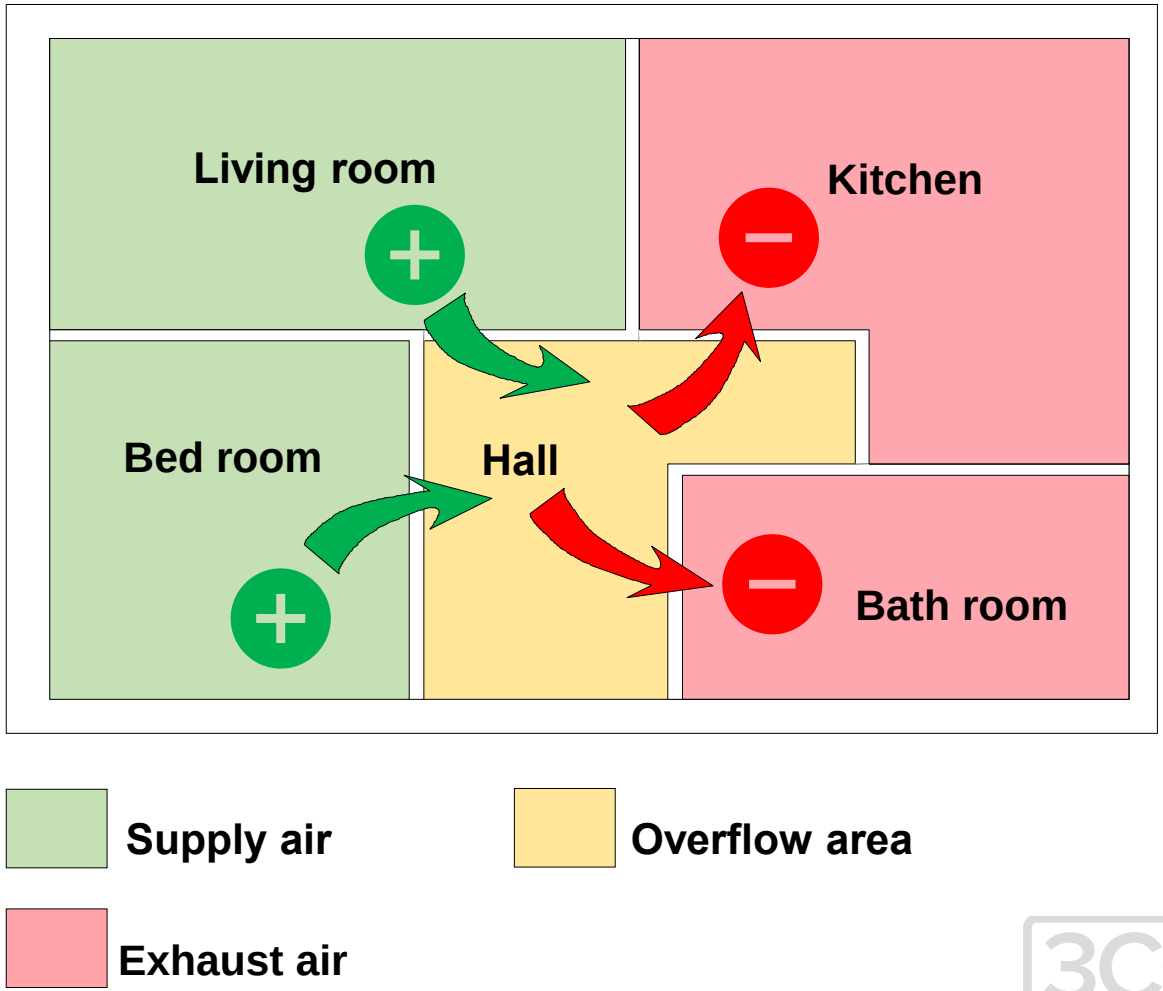


House is 5.0 ACH
At 50 PA

- Bedroom occupied at 11:15 pm with door closed
- Exhaust fan turned on at 1:30 am at 88 CFM (ASHRAE 62.2 Rate for house is 62 CFM
- Exhaust fan off at 6:00 am
- Door open at 6:30 am

Balanced with Distribution

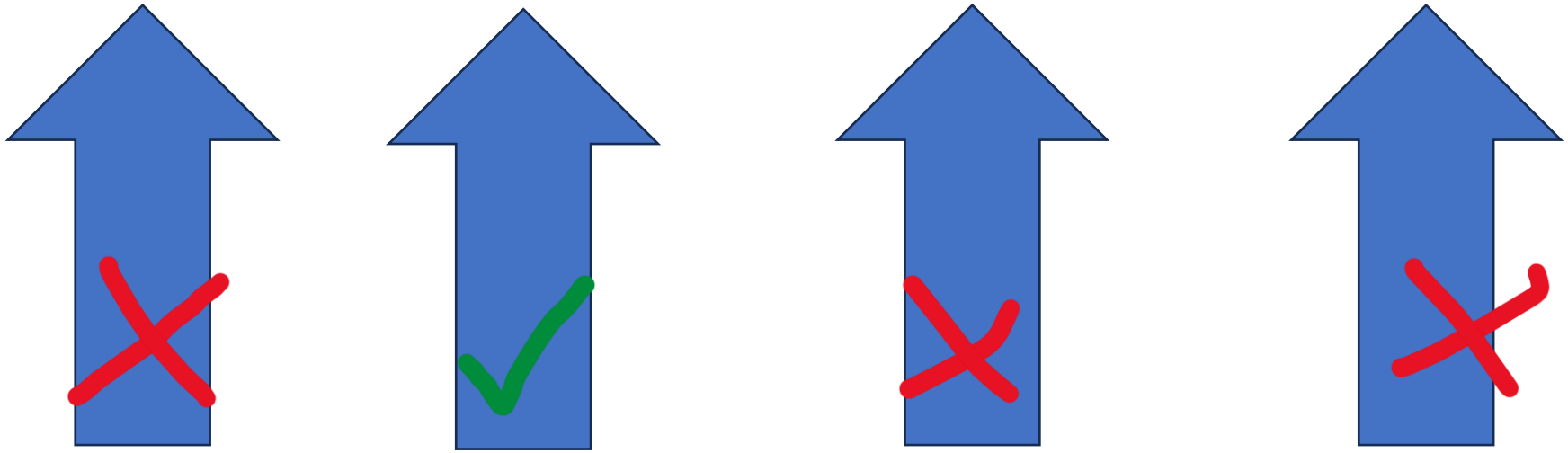
- The air goes where we design it to go.
- Bedrooms, living rooms, studies, get a steady flow of fresh air.
- Kitchens, baths, laundry and mudrooms get a steady flow of exhaust.



What is recovery ventilation not?

- H V AC R

Heating Ventilation Air Conditioning Refrigeration



How Much Ventilation Do I Need?

.03 x TFA + 7.5(Bedrooms +1), Or… There's a chart.

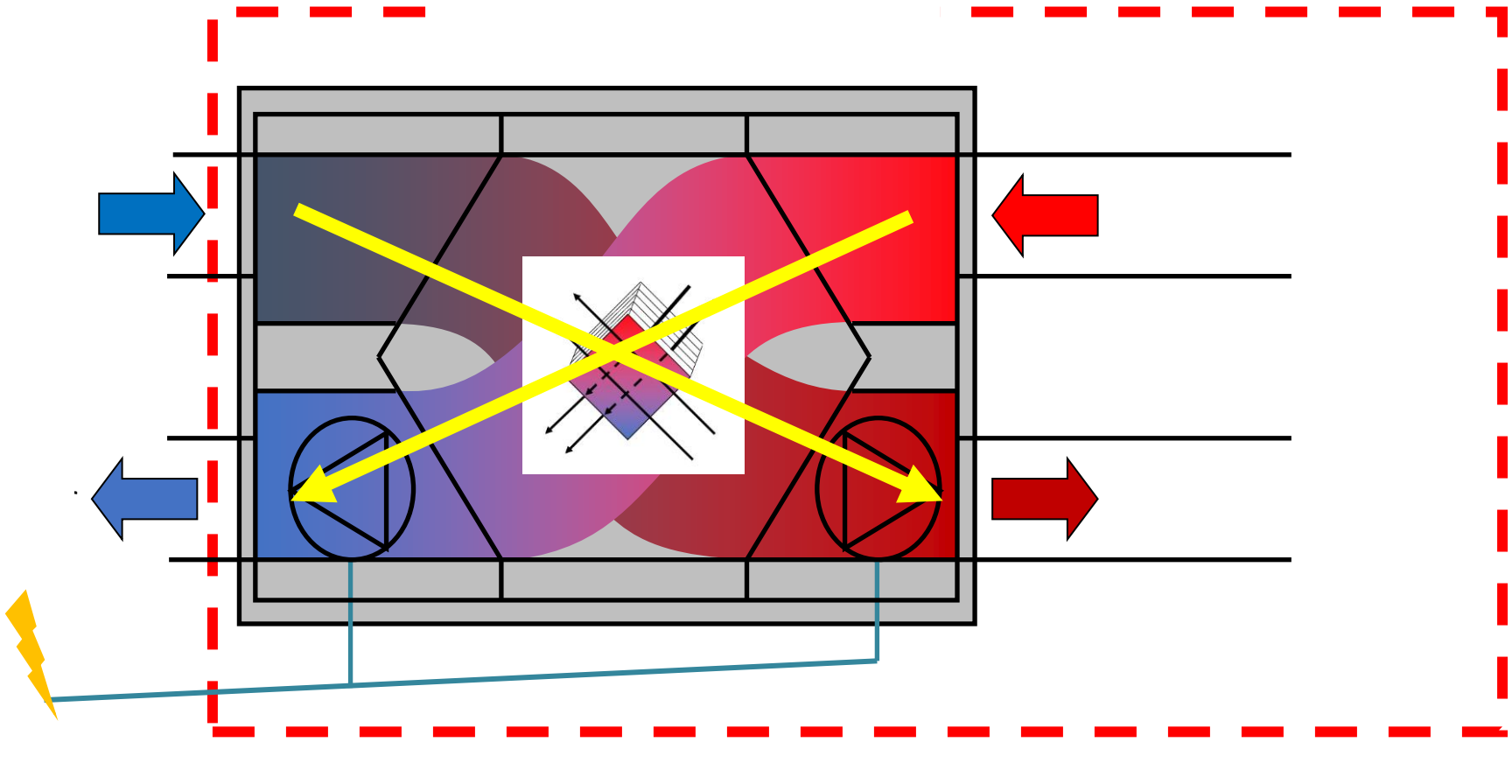
Table 4-1a (I-P) Ventilation Air Requirements, cfm

Floor Area, ft^2	Bedrooms				
	1	2	3	4	5
<500	30	38	45	53	60
501 to 1000	45	53	60	68	75
1001 to 1500	60	68	75	83	90
1501 to 2000	75	83	90	98	105
2001 to 2500	90	98	105	113	120
2501 to 3000	105	113	120	128	135
3001 to 3500	120	128	135	143	150
3501 to 4000	135	143	150	158	165
4001 to 4500	150	158	165	173	180
4501 to 5000	165	173	180	188	195

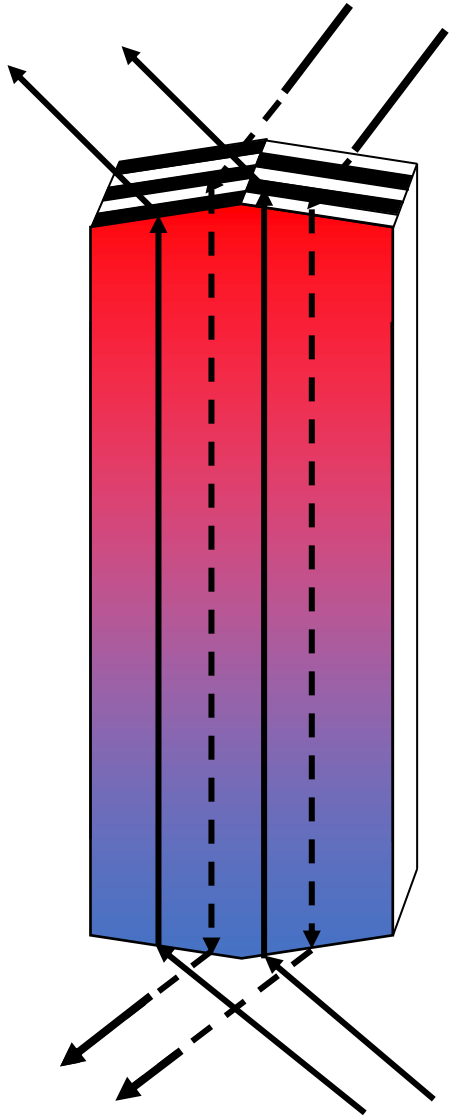
What's the Energy Impact of Continuous Ventilation?

Baseline Design Exhaust Ventilation min cfm
Walls 2x6 wood R-21
Roof R-38
Windows 14%, U=0.30; SHGC=0.23
Quality Insulation Installation QII HERS inspection
PV 22.37 kW
2.2 EDR short of compliance with Title 24

How Does Heat Recovery Work?

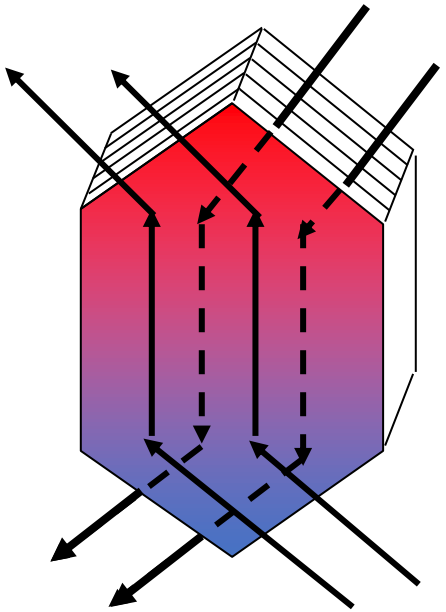


Types of heat exchange cores



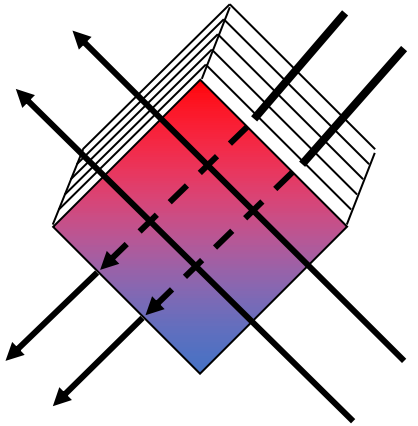
Counter flow 70 -95 %

Core size has an influence on heat recovery efficiency- be wary of small cores that claim high efficiencies



Cross-counter flow

70 - 85 %

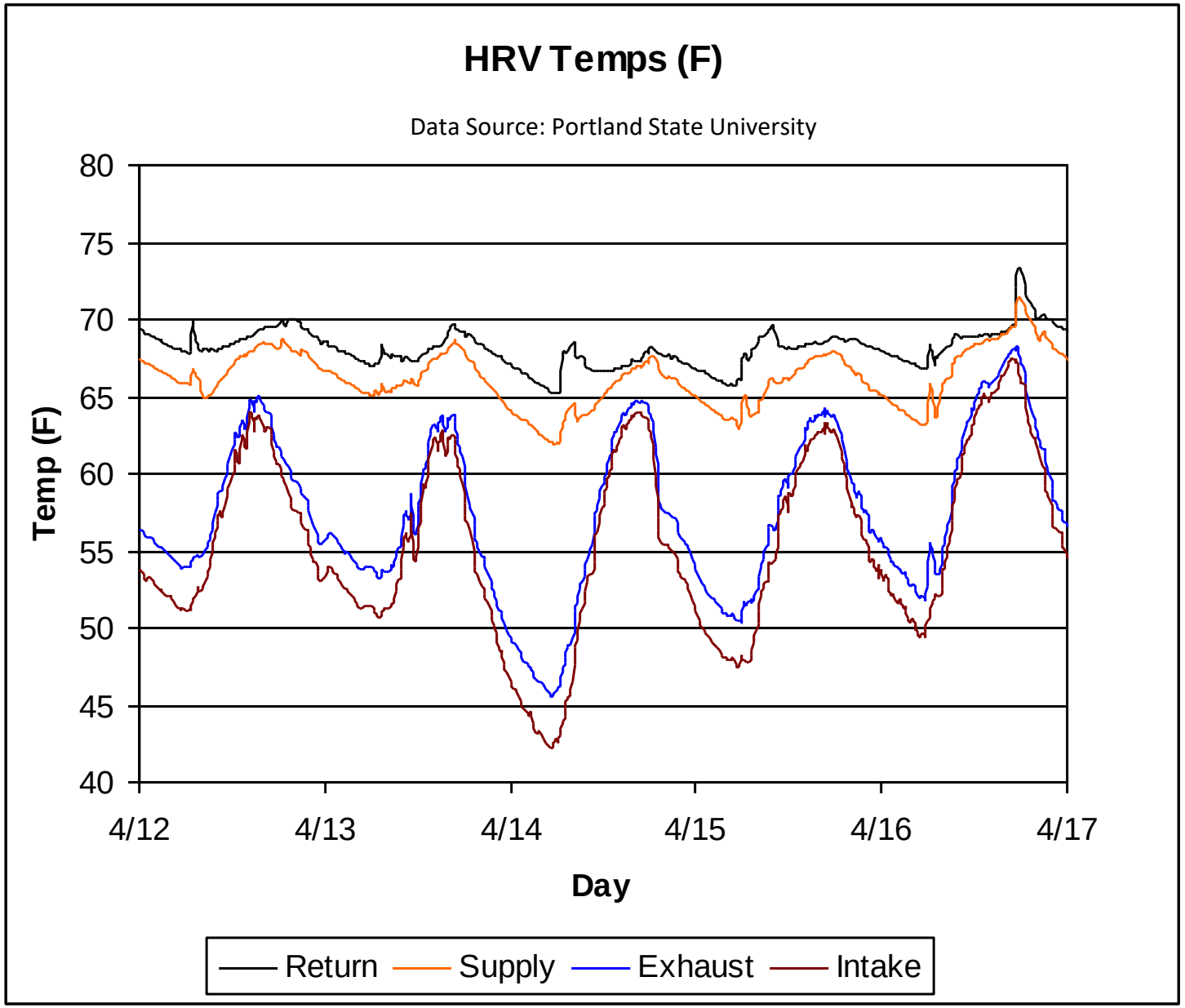


Cross flow

40 - 60 %

Use Heat Recovery to Reduce the Energy Impact

- April 2014
- New Home in Vancouver WA
- Well Insulated, Airtight.
- Heating System Not Turned on Yet.
- HRV 90% Effectiveness



Are More Efficient Ventilators Worth the Cost?

Reduce energy penalty associated with mechanical ventilation - which in turn improves building envelope performance.

Baseline Design Exhaust Ventilation min cfm	With Recovery Ventilator 53 cfm
Walls 2x6 wood R-21	Walls 2x4 wood R-13
Roof R-38	Roof R-19
Windows 14%, U=0.30; SHGC=0.23	Windows 28%, U=0.50; SHGC=0.23
Quality Insulation Installation QII HERS inspection	No QII
PV 22.37 kW	PV 16.00 kW
2.2 EDR short of compliance with Title 24	Complies with Title 24

THE LEFT SIDE OF THE CHART DEMONSTRATES A PROJECT WITH EXHAUST ONLY VENTILATION AND THE RIGHT SIDE IS A PROJECT USING A ZEHNDER HRV.
TABLE CREDIT: BUILD SMART GROUP (2019)

Cost in terms of Comfort?

Effective Recovery

Example: Inside air: 70F and outside air: 40F

Questions?

Enthalpy Recovery

Controlling Moisture with Ventilation

In order to determine indoor humidity, we need to know the humidity that's coming in with the fresh air, and add the humidity being generated inside.

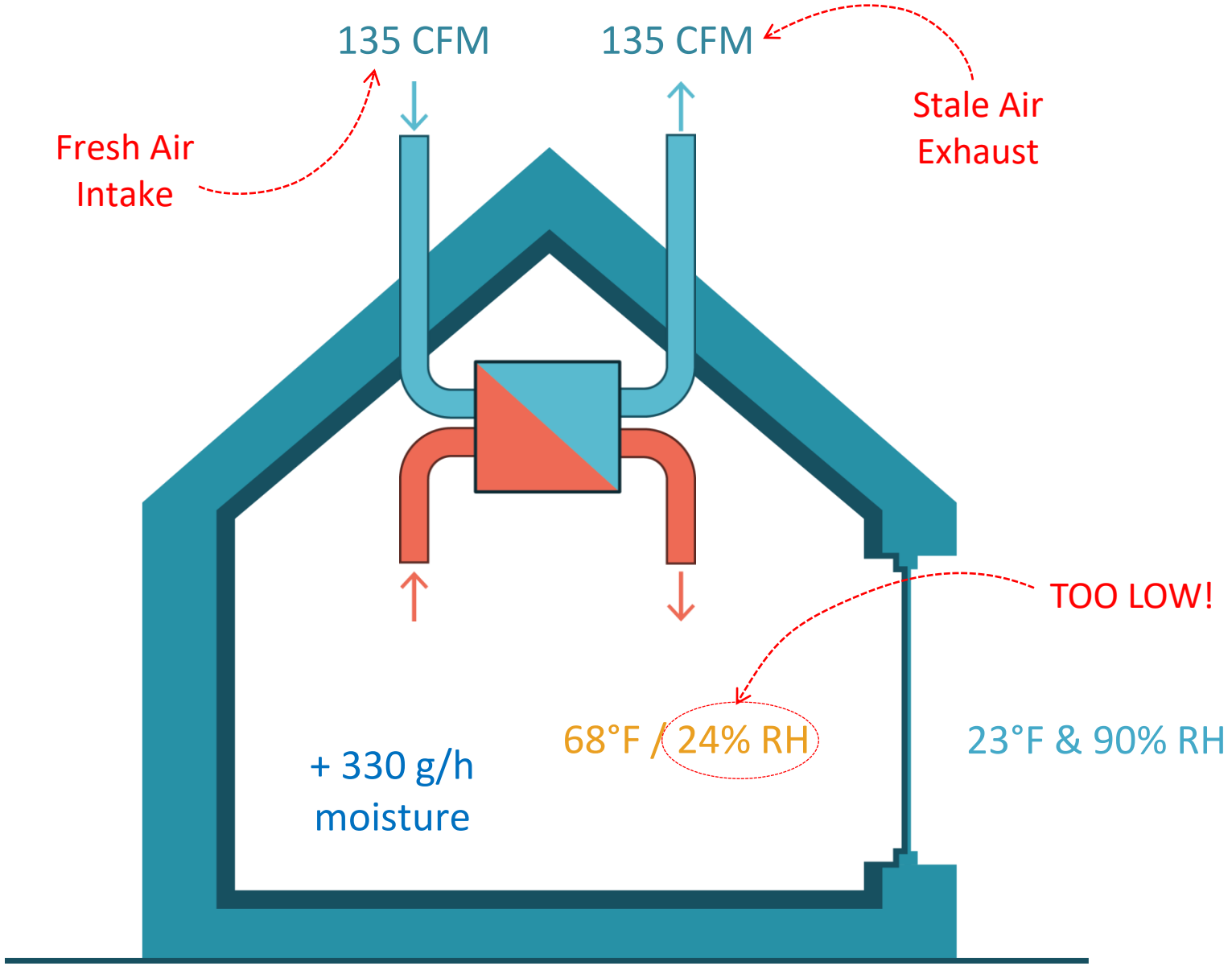
Internal Humidity Sources

Sample calculation of mean humidity levels accumulated in an apartment with 4 residents

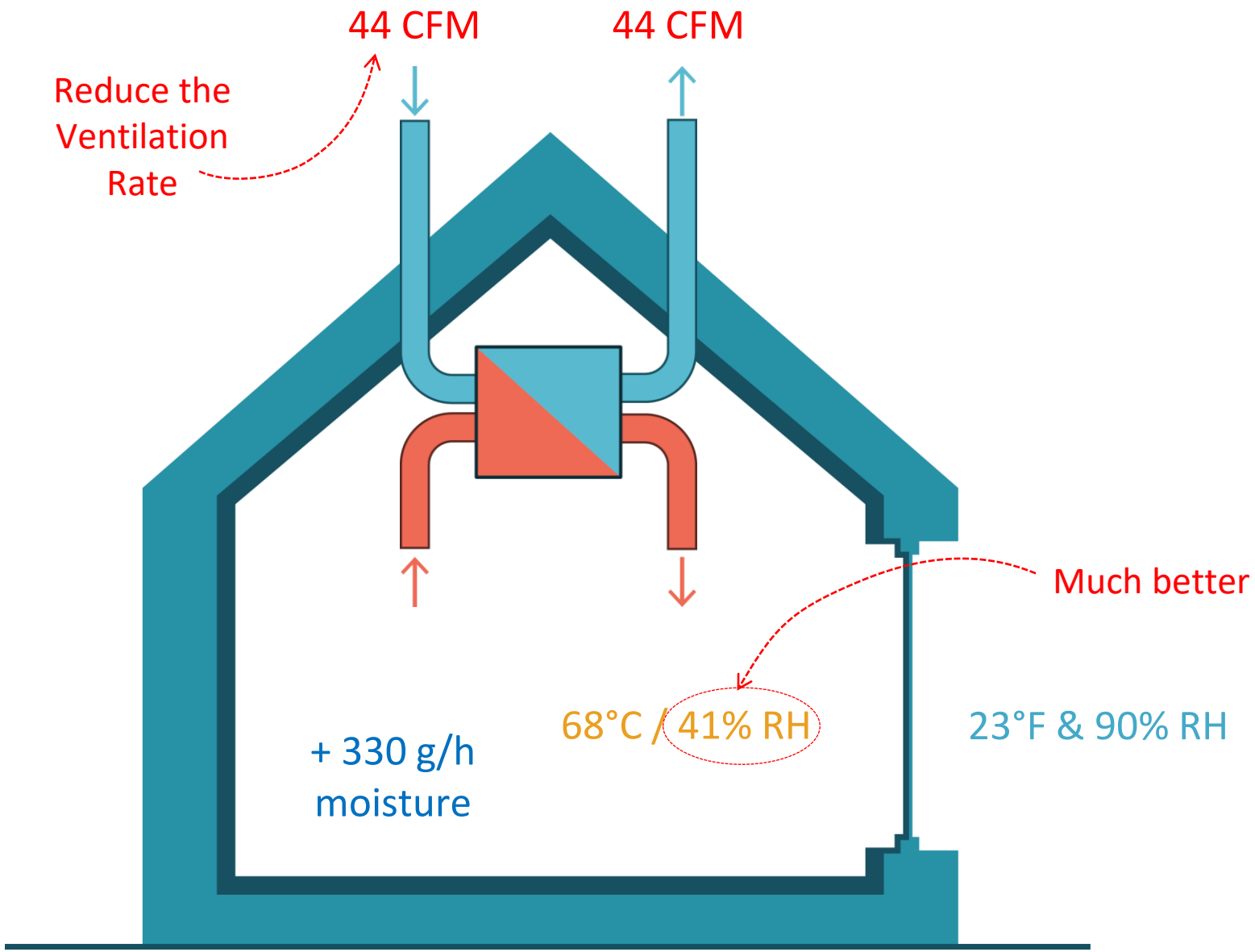
Humidity accumulation				
	Amount per week!	mean humidity accumulation:		Humidity production per h
Potted plants	5.0	5	g/Watering plants	25.0
Medium-sized rubber tree	1.0	15	g/Watering plants	15.0
Drying clothes 4.5kg, not inside the apartment	0.0	3200	g/Cloth drying	0.0
Bath	2.0	1100	g/Bath	13.0
Shower	14.0	1600	g/shower	133.0
Quick meal (cooking)	7.0	70	g/Cooking	3.0
Extensive meal	7.0	200	g/Cooking	8.0
Dishwasher	5.0	200	g/Dish washer	6.0
Washing machine	0.0	300	g/Washing	0.0
Sleeping human being (Assumption 8 hours)	4.0	50	g/Day	67.0
Human being awake (Assumption 6 hours)	3.0	80	g/Day	60.0
Steam air humidifier	0.0	1	l/d	0.0
Total humidity load			g/h	330.0

Source: PHI

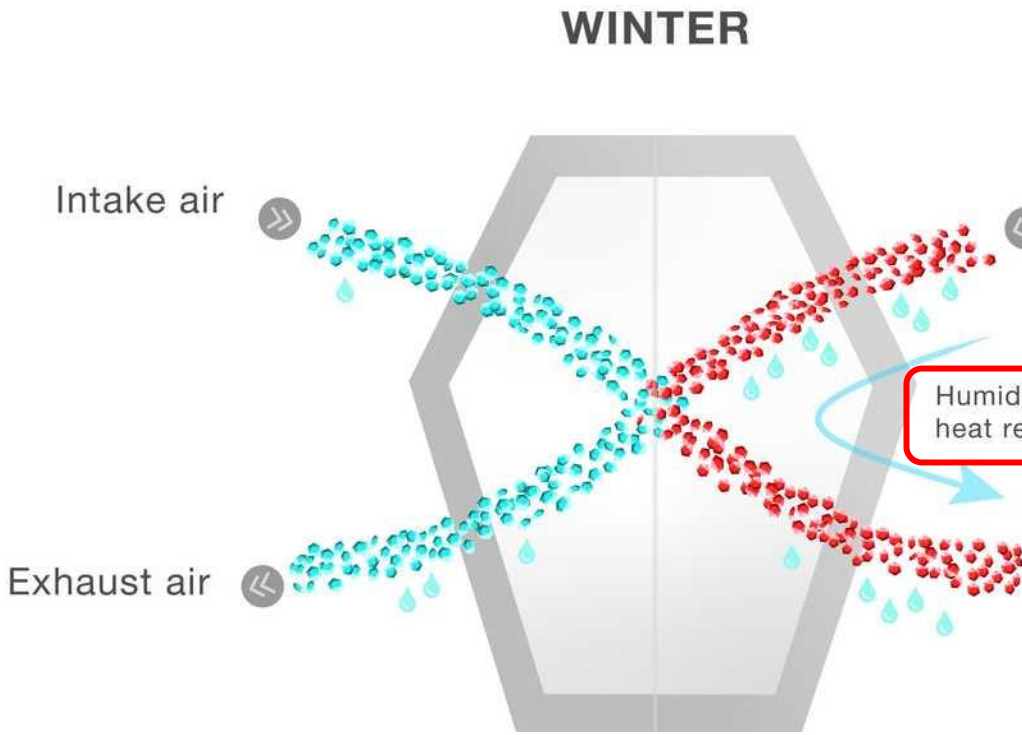
Example: Over-Ventilation (Winter)



Corrected Ventilation (Winter)



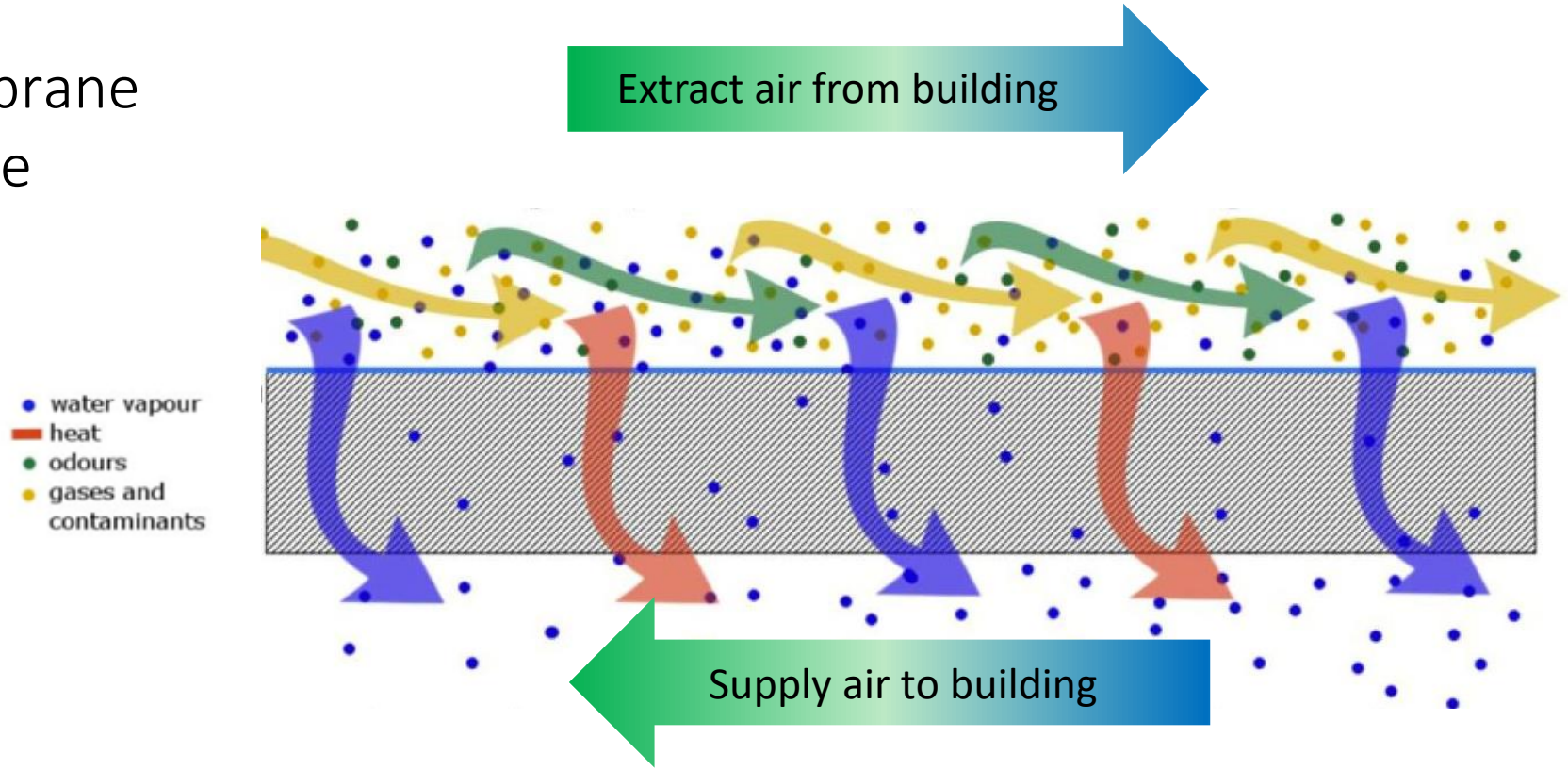
What is Enthalpy Recovery?



Source: Zehnder America

How Does Enthalpy Recovery Work?

ERVs - Membrane with Selective Transfer



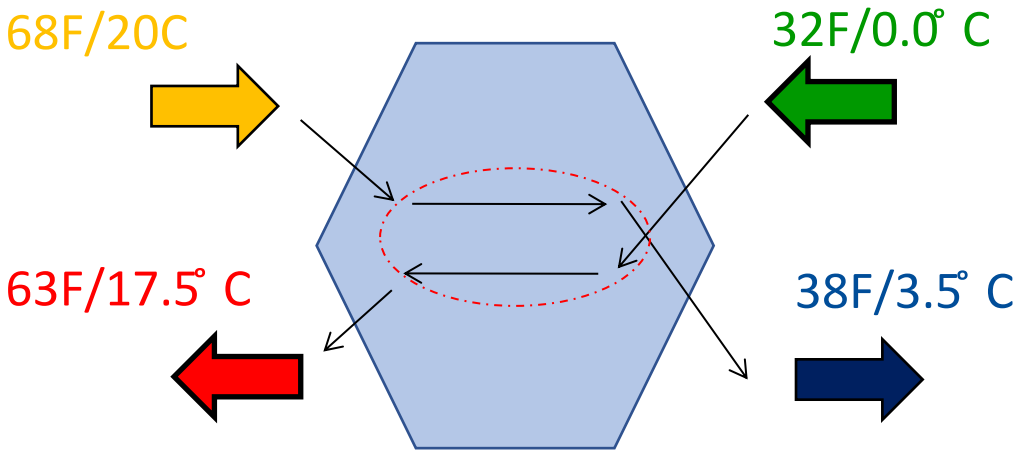
- Only transfer of heat and water vapour through the membrane
- No transfer of gases, contaminants or odours

Source: CoreLife

HRV versus ERV

Counterflow HRV

Winter Scenario

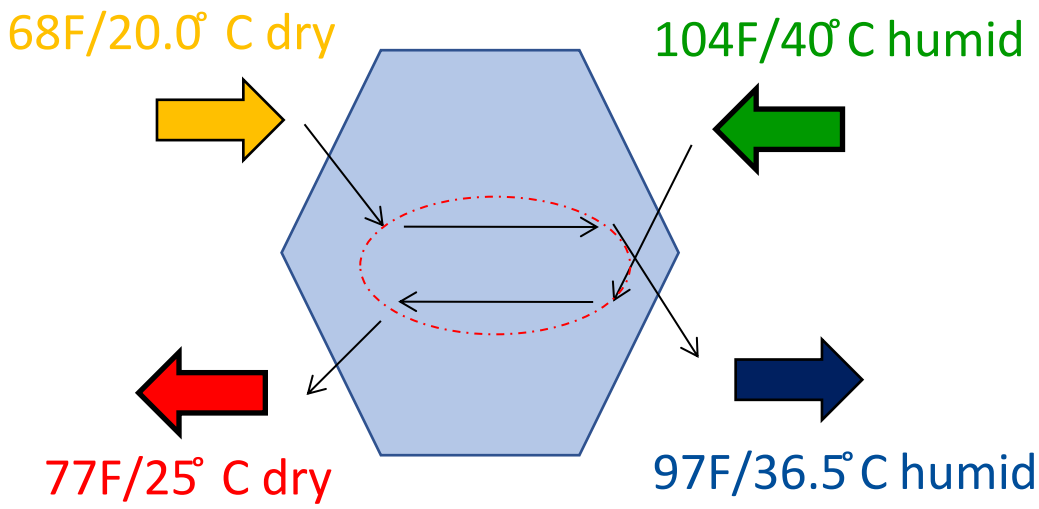


Counter flow heat-exchanger

≈ 90 %

Counterflow ERV

Summer Scenario



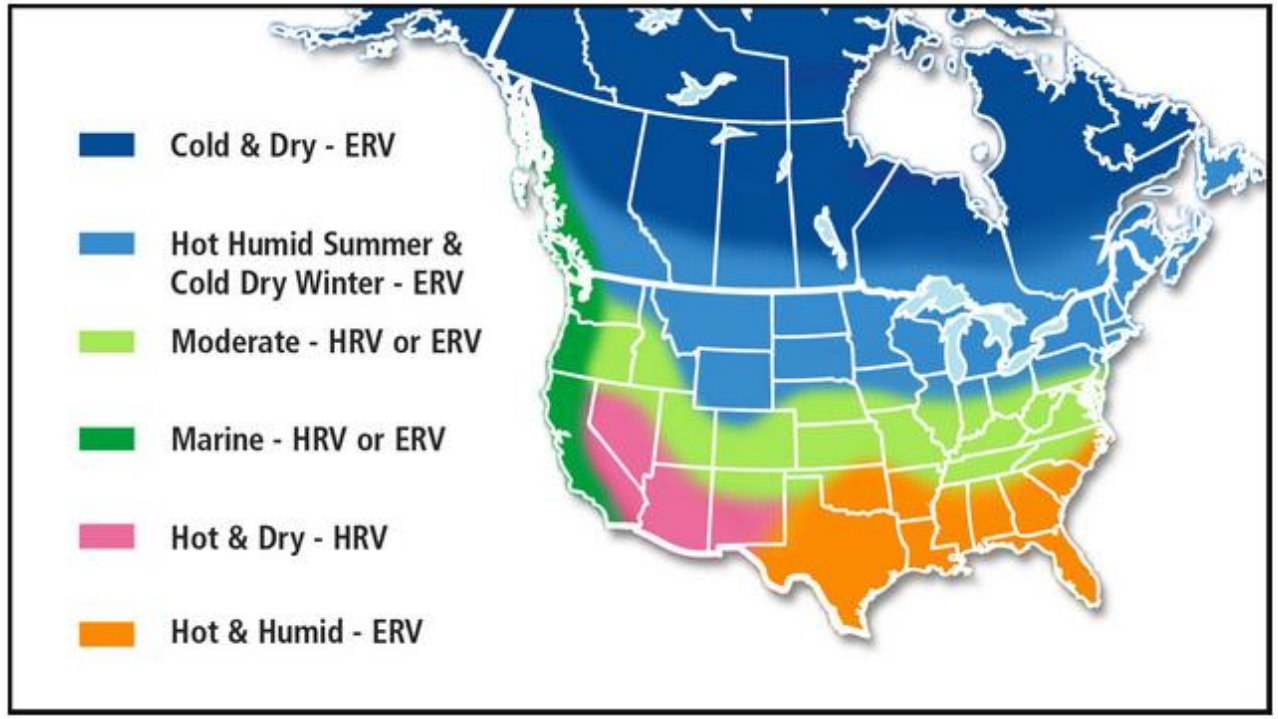
Counter flow energy-exchanger

≈ 90 %

Source (adjusted): Zehnder

Where to Use HRV or ERV?

- Climate conditions (temperature and humidity) have a significant influence on HRV / ERV selection



Benefits of using an ERV in a cold climate:

- Indoor humidity partially transferred to dry fresh air
- Lower frost point, requiring less pre-heating
- Reduced condensate, possibly eliminating need for condensate drain (not recommended!)

Source CoreLife.ca

Questions?

Frost Prevention

Frost Prevention Required For Cold Conditions

Fresh Air and Exhaust Imbalance

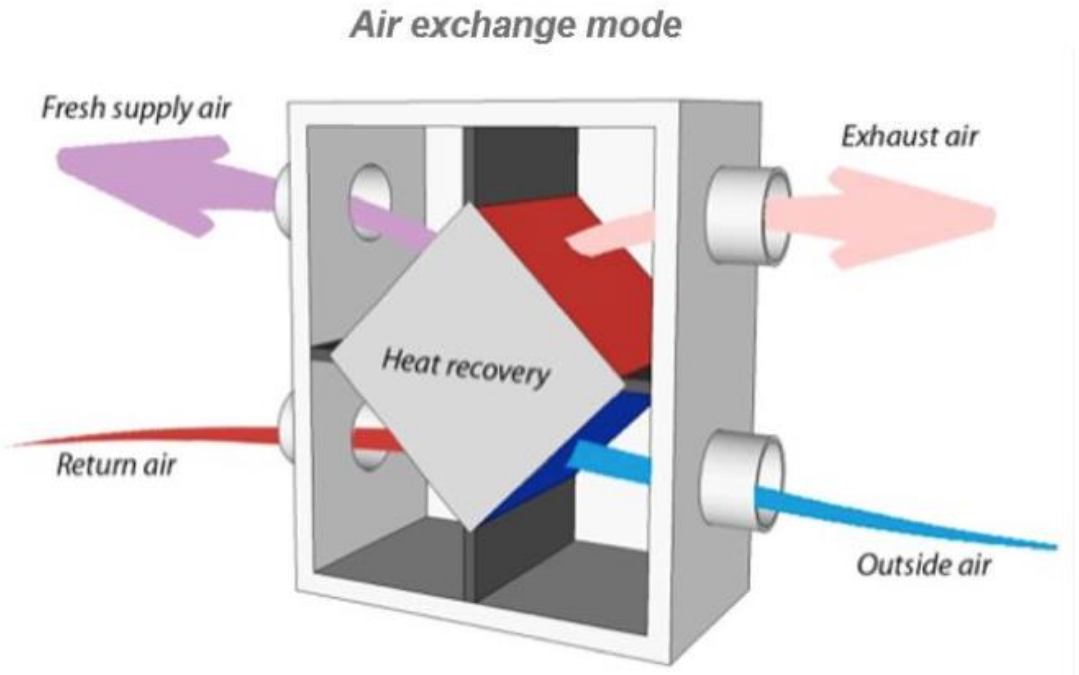
Defrost by recirculation

Pre-heat Incoming Air Above Freezing

Pre-heat frost prevention

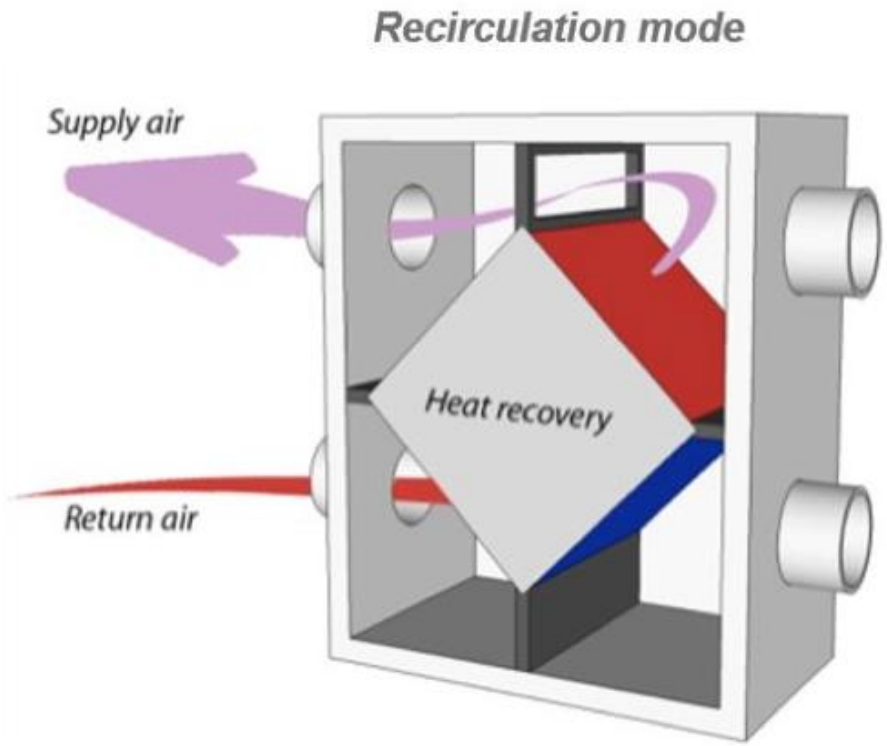
Source: Zehnder America

Normal Flows – System in Balanced State



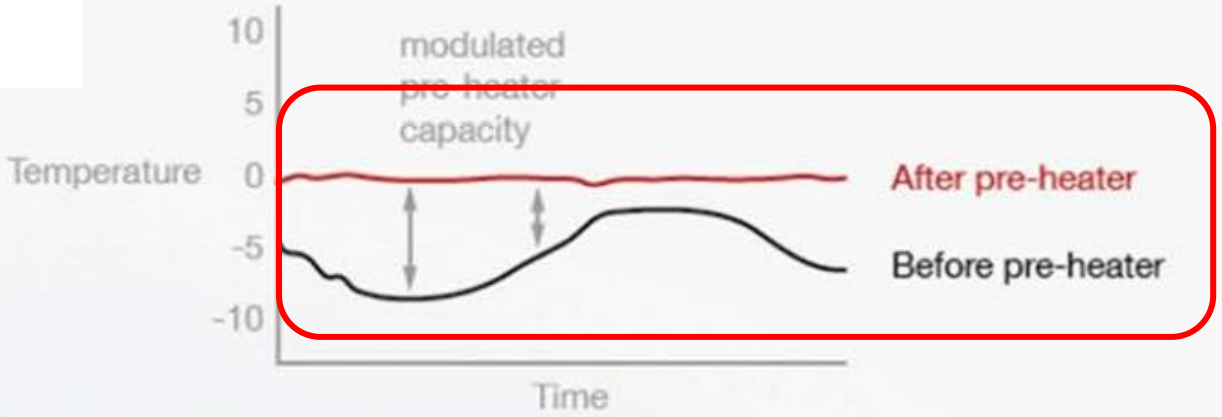
- Balanced Flows
- Return air leaves the building.
- 100% fresh Air
- Internal or external pre-heater to lift fresh air above freezing
- No breathing exhaust flows

Frost Prevention – Recirculation Imbalance



- Uses the warm return air from kitchens and baths to warm the core.
- The return air is re-directed to the supply air in a % to prevent frosting the core.
- You get what you give.
- Not allowed in a Passive House

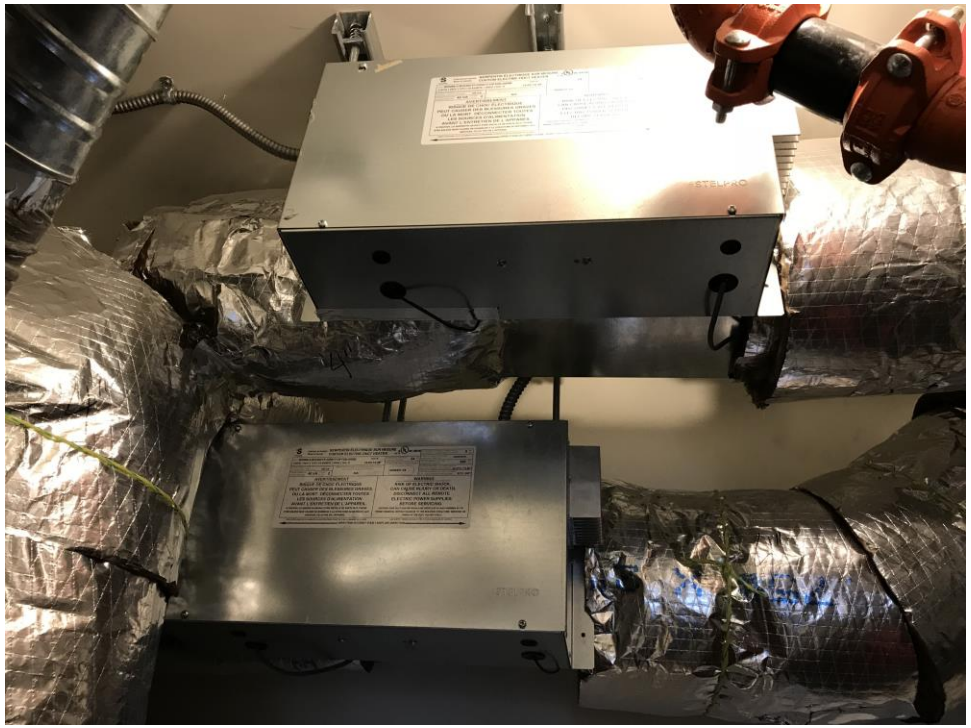
Modulating Internal Pre-heater

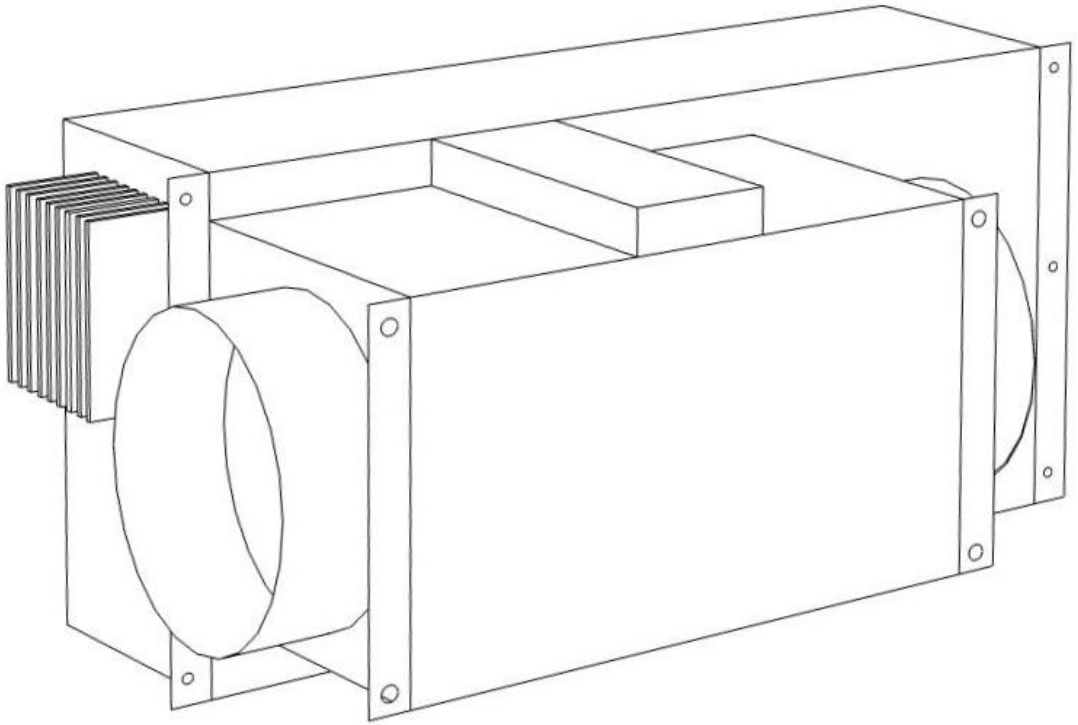


Intelligent Control

- Adaptive pre-heater
- Accurate modulation due to flow rate and temperature measurements.
- Units without pre-heater have defrost function based on a temporary imbalance

External Electric Pre-Heaters

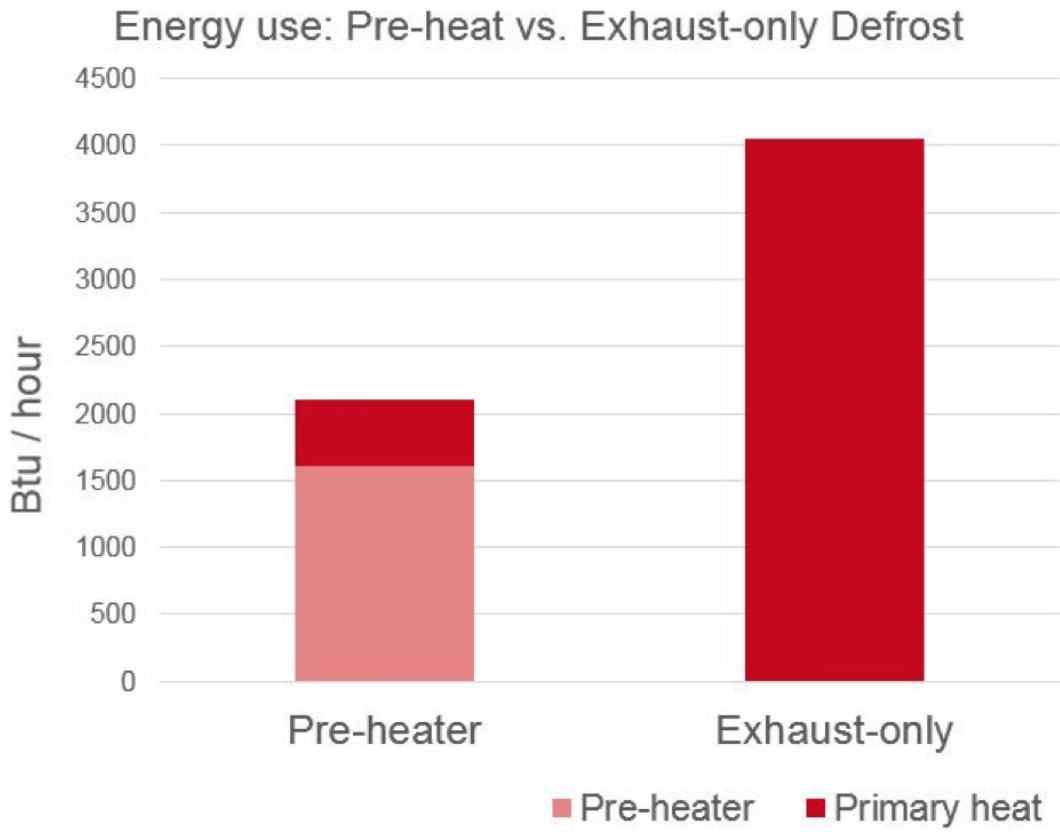




Electric Resistance Pre-heat is Efficient

Assumptions:

- 1,500 s.f. house
- 3 bedroom/1 bath
- ASHRAE rate 45 cfm
- Outdoor Air -13˚F (-25˚C)
- Pre-heated Air 20˚F (-7˚C)
- Indoor Air 72˚F (22˚C)
- 80% SRE H/ERV
- Specific heat (Cp) = 0.24 Btu per lb. per ˚F



Ground Source Pre-heat and Cooling Uses Loop at Foundation – Only Uses Pump Energy

Questions?

HRV and ERV Installation

Correctly Locating the ERV

- ERV located adjacent to exterior wall ensuring minimal length of cold air ducts
- Positioned at comfortable height for changing filters
- Plenty of room for condensate drain to bottom (yet to be fitted)
- Could have left more room to right hand side for internal finishes

Duct Insulation

Cold* Air Duct Insulation:

- If the H/ERV is inside the thermal enclosure (thus these ducts are surrounded by warm air), 2”- 4” is required, and it must have a vapor-tight facing to prevent interior moisture from getting to the duct surface and condensing.

- These ducts should be as short as possible – so locate the H/ERV near the enclosure!

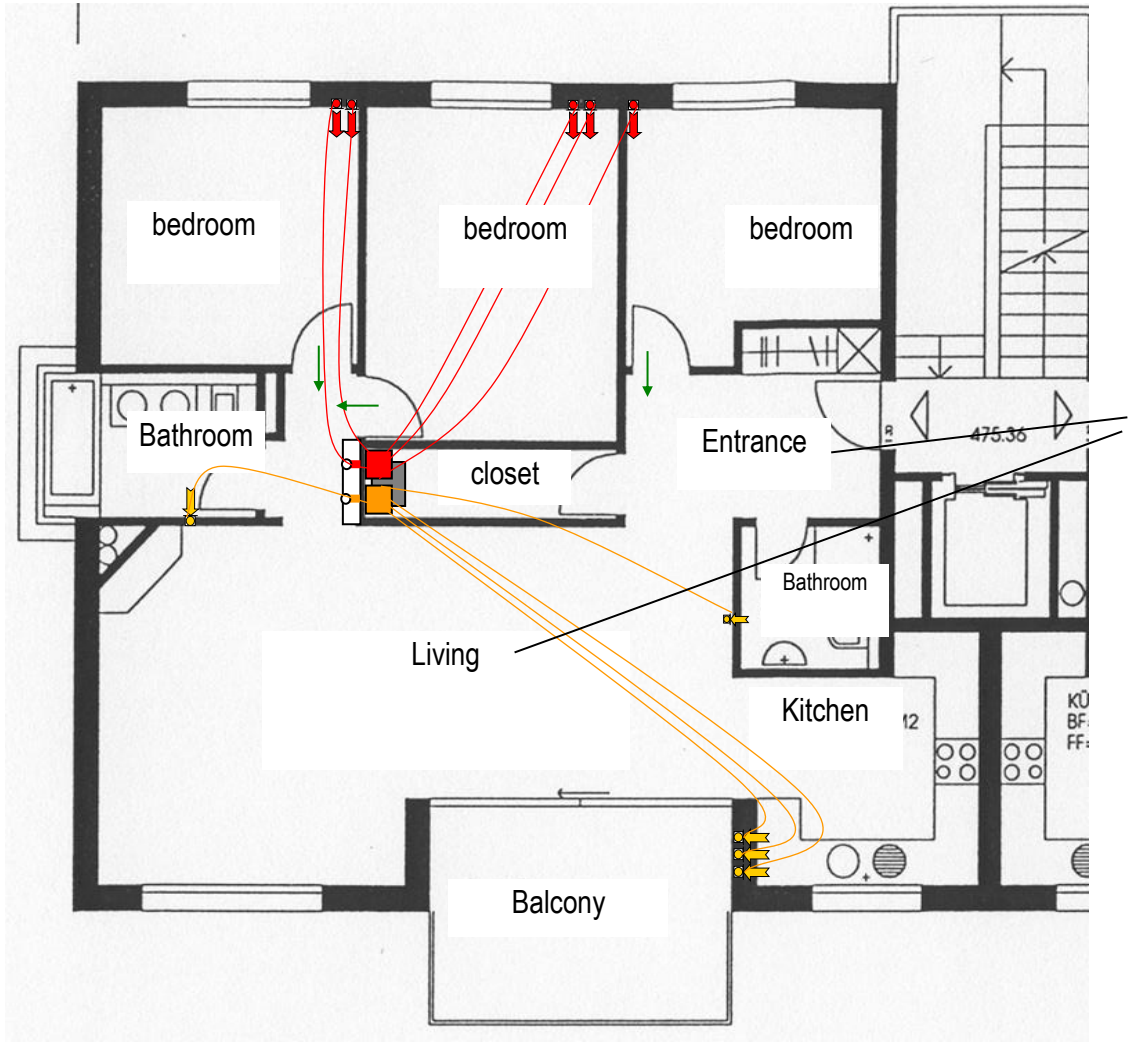
*in winter

Condensate Drain

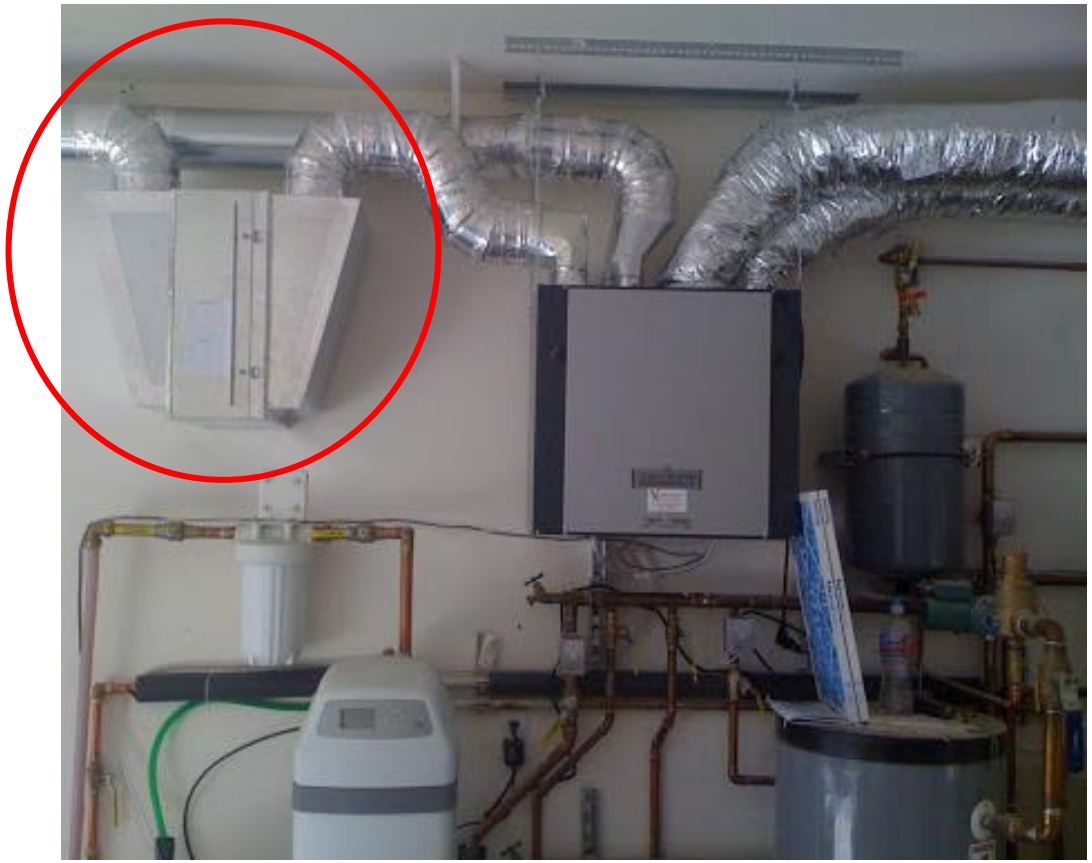
- Condensate will be produced in winter
- Drain must have P-trap to prevent gases returning from foul sewer
- Position and protect drain to prevent damage from homeowner

Distribution Strategy

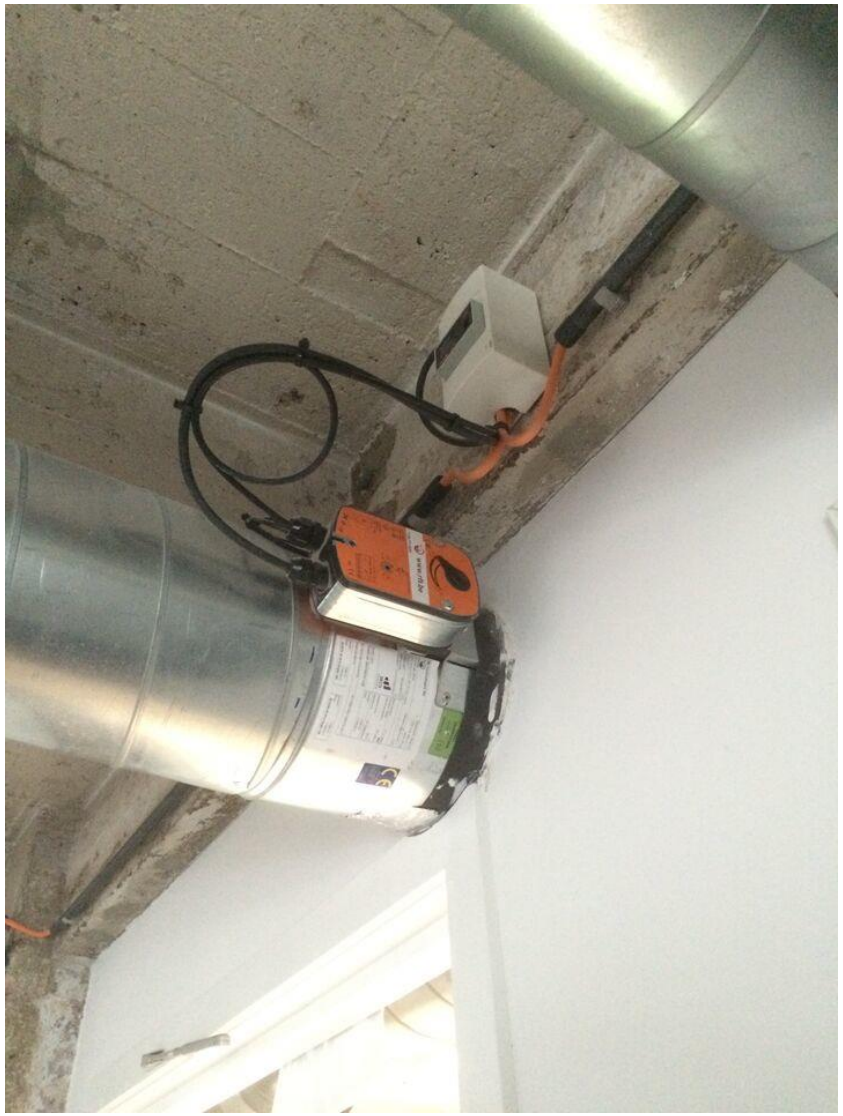
- Supply to Bedrooms
- Return from Baths & Kitchen
- Cascading Effect
- Common Areas are Transitional



Use Flex Duct with Care - Consider Static Pressure



Fire and Smoke Protection



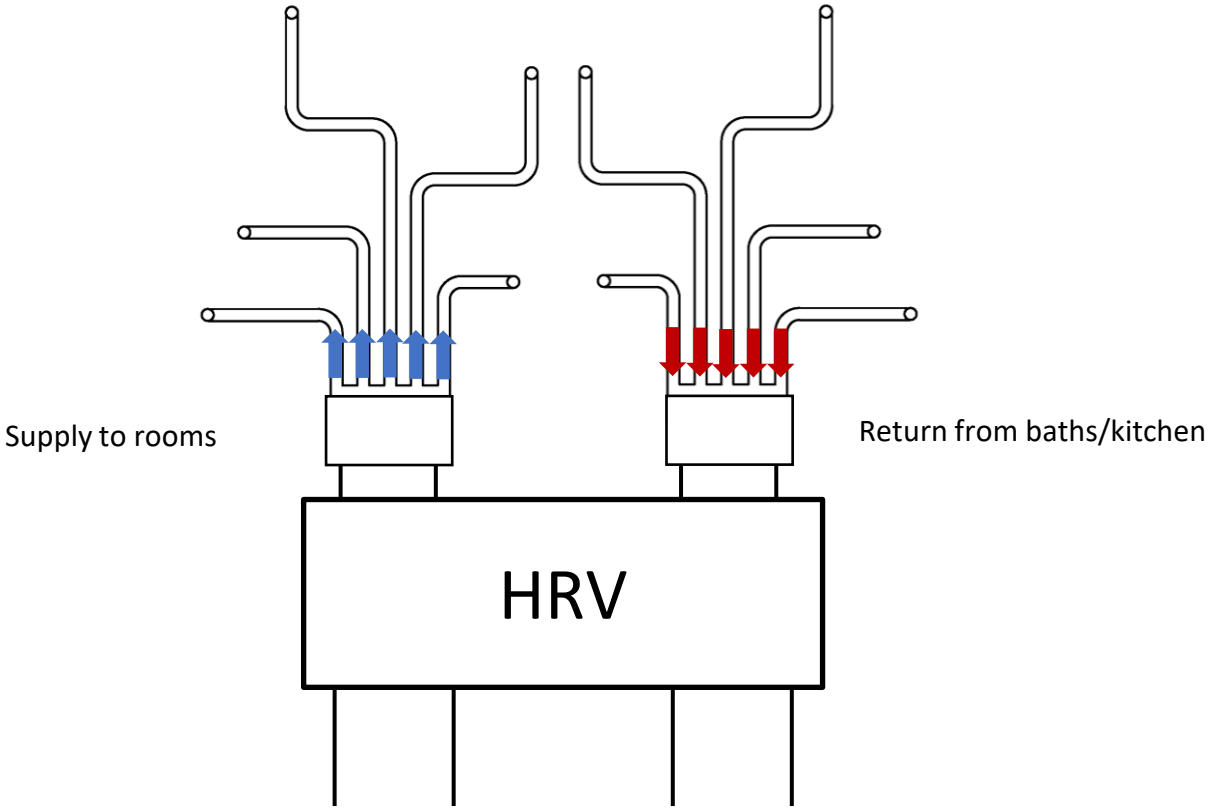
© Passive House Academy

© www.rft.be

- Commercial and multifamily projects typically require separation of fire compartments
- Fire dampers and actuators on ventilation ducting create separation
- Place in accessible location for testing and resetting

Duct System Types

A manifold divides up all the air at one point, and smaller individual ducts (usually all the same size) run to and from each space. One manifold for supply air, one for extract air.



Plan.
Don’t make a Ductapus

- Exterior – still needs insulation!
- Heating/Cooling Coil.
- Conditioned Room Supply
- HRV

HRV and ERV Balancing

Ventilation Commissioning

Heat Recovery reaches highest efficiency stated in energy model with balanced flows.
Design flows maintain humidity levels and comfort.

Steps to balance a ventilation system:

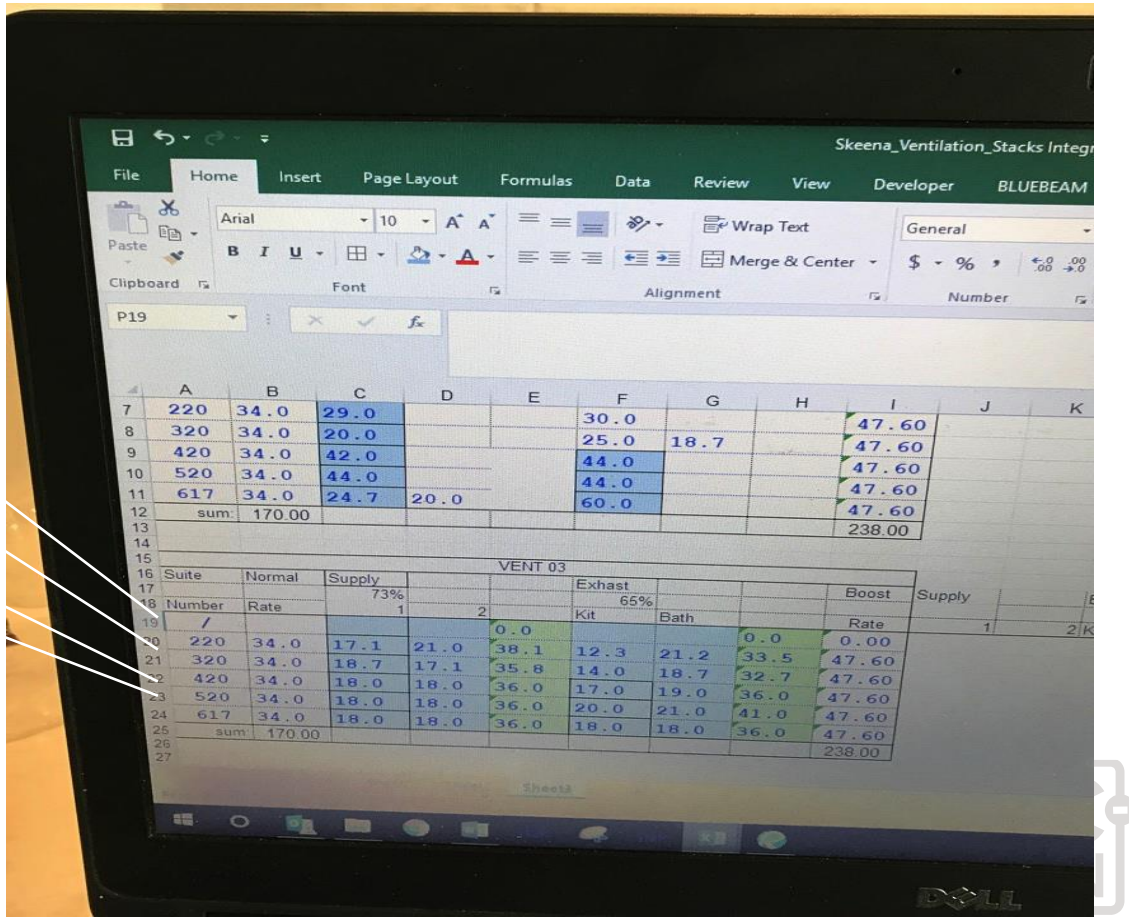
1. Performed by qualified tradesperson.
2. Inspect the overall system and installation.
3. Measure flows at exterior.
4. Measure flows at interior.
5. Calculate difference to note any leakage.
6. Equalize flows.
7. Set normal flows to design.
8. Set additional levels, (boost, low occupancy).
9. Record all settings

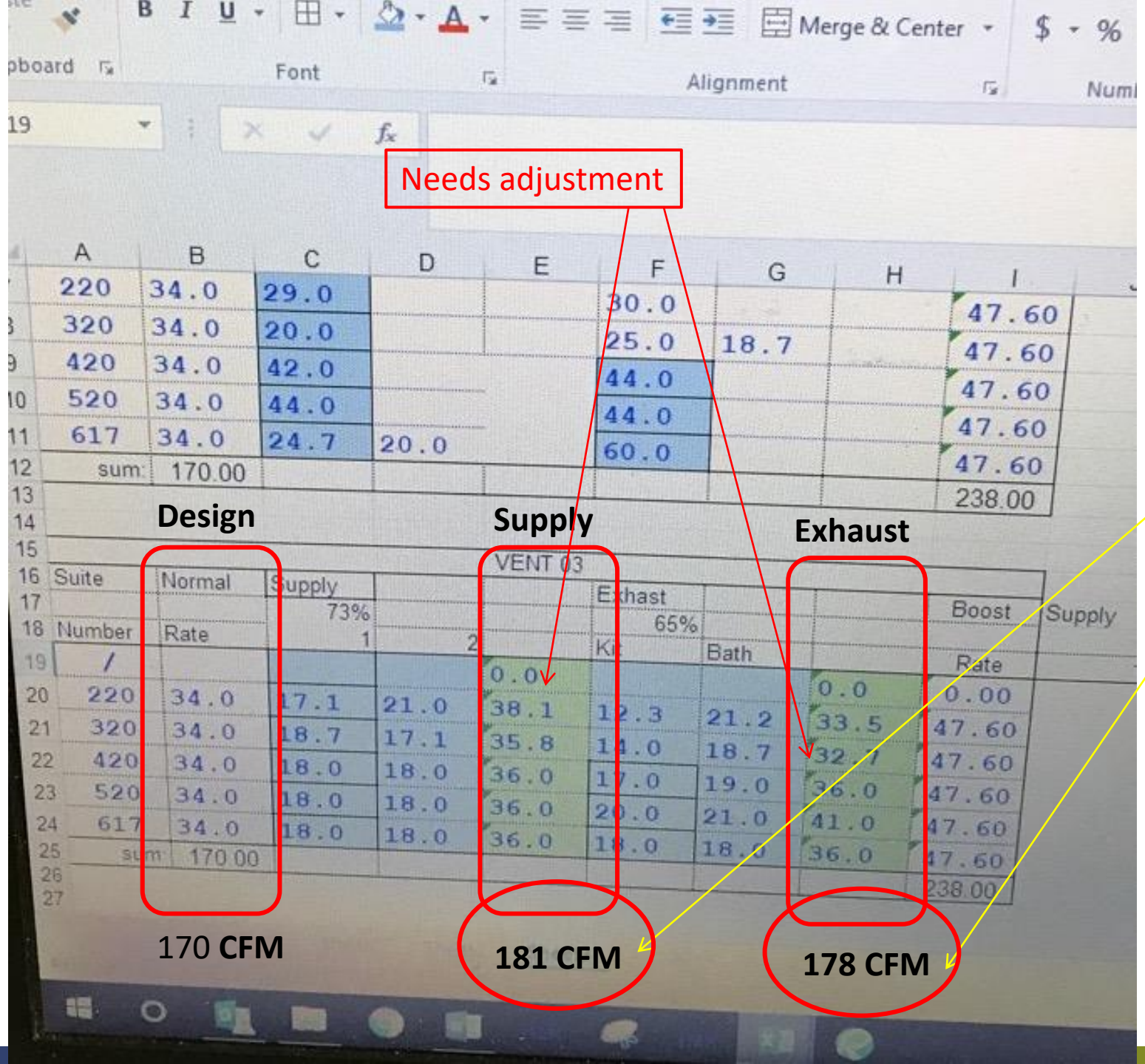
Balancing Methods – Critical for Performance

Measuring Static Pressure

Measuring Flow

Adjust balancing dampers





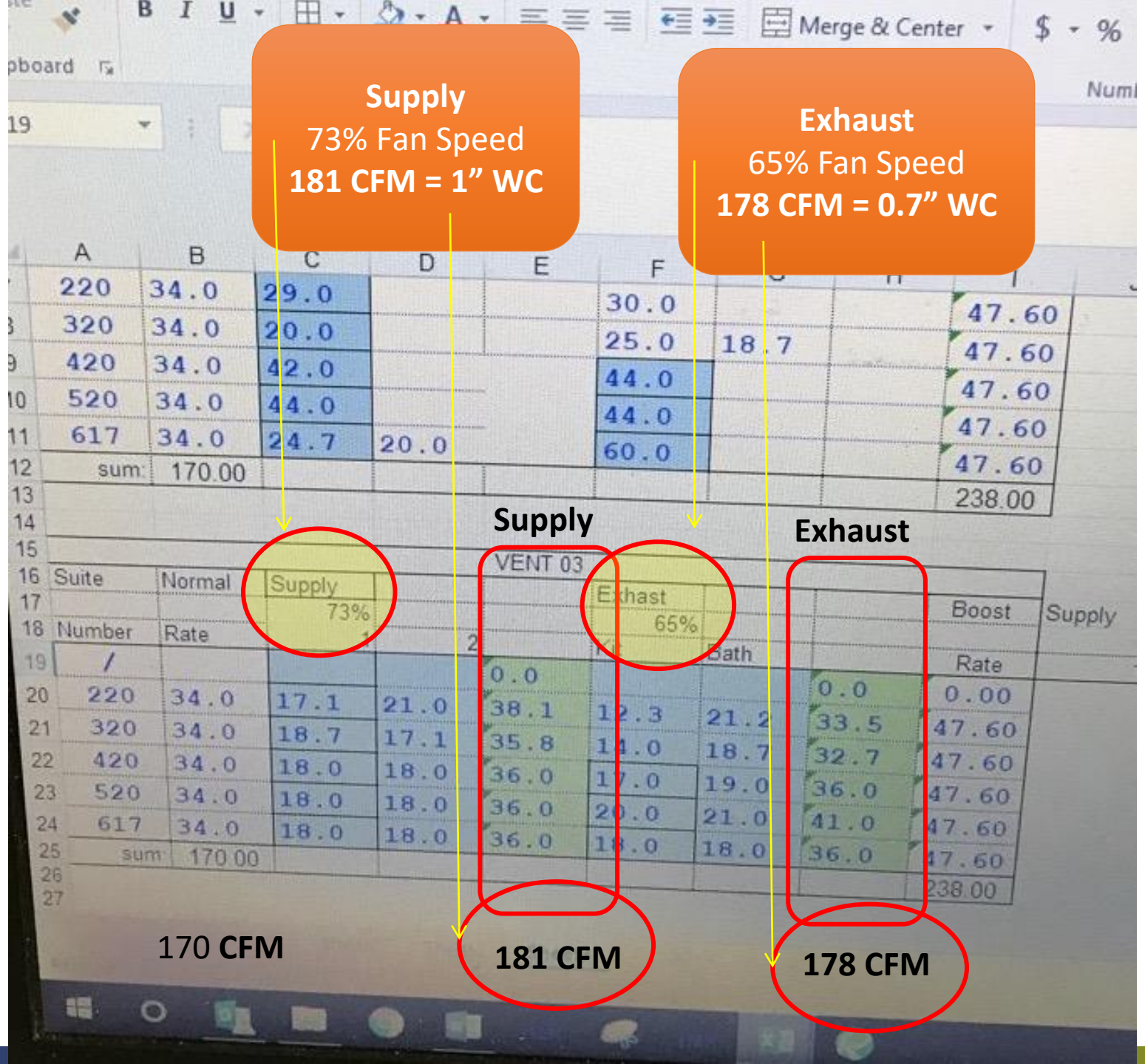
Progress readings on Vent 3

Design for 170 CFM at normal.

Reading 181 supply

Reading 178 exhaust

Results are in the +/- 10% range and acceptable.



How much pressure drop is created?

Total Flow at Fan speed shows Inches WC created by 8” risers over 5 floors, smoke dampers, balancing dampers, silencers, and en-suite distribution

Questions?

3C-REN Overview & Upcoming Events

Closing

- Continuing Education Units Available
  - Contact ian.logan@ventura.org for AIA & ICC LUs
- Coming to Your Inbox Soon!
  - Slides & Survey – Please Take It and Help Us Out!
- Upcoming Courses
  - 11/27: Contractor Connection Hub @ Standard Plumbing Supply Ventura
  - 12/3-12/5: Installing HPWH's (SLO, SMV, SB, VTA)
  - 12/10: Ventura County Electrification Incentive Breakfast
  - 12/10: SB County Electrification Incentive Lunch
  - 12/11: Santa Maria Electrification Incentive Breakfast
  - 12/18: Centralized vs Decentralized Ventilation Systems

Questions about Title 24?

Energy Code Coaches are local experts who can help answer your Title 24 questions. Coaches have decades of experience in green building and energy efficiency improvements. They can provide citations and offer advice for your project to help your plans and forms earn approval the first time.

Online:
3c-ren.org/codes

Call:
805.781.1201

Thank you!

For more info:
3c-ren.org

For questions:
info@3c-ren.org

3C REN

TRI-COUNTY REGIONAL ENERGY NETWORK

SAN LUIS OBISPO • SANTA BARBARA • VENTURA