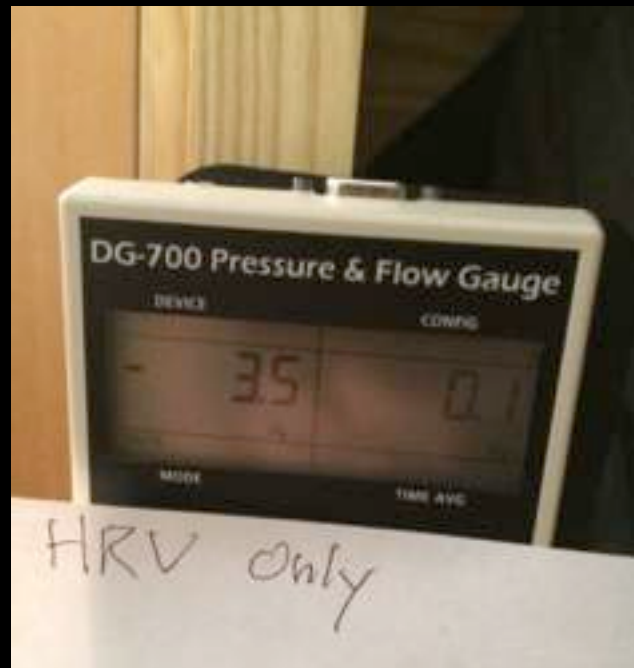


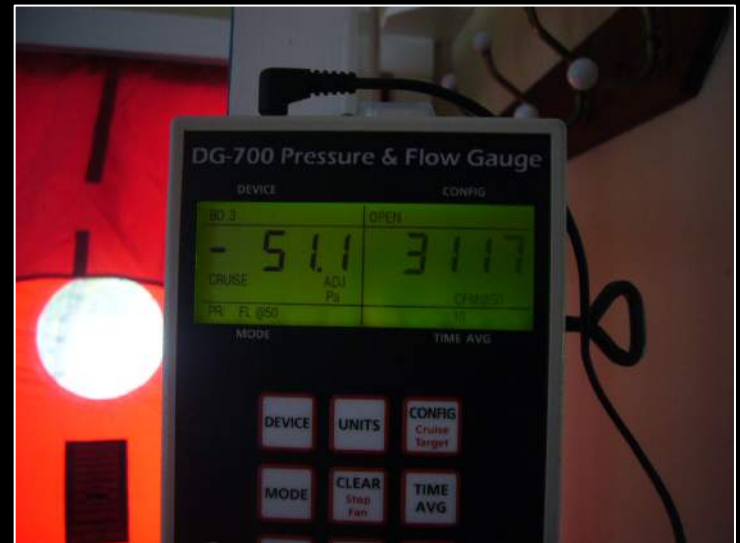
# Ventilation, Radon, Pressure, Effectiveness



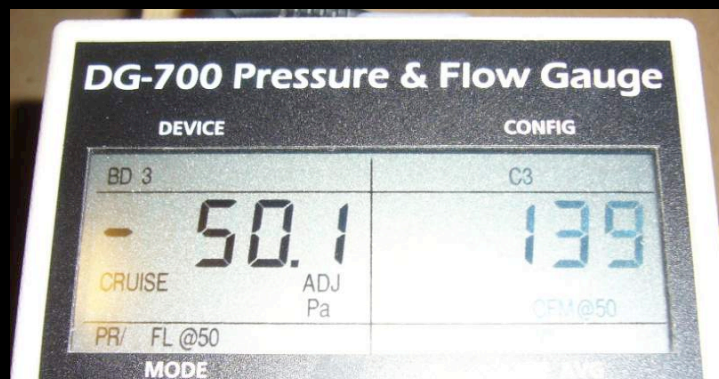
Speculation on non-statistically valid, anecdotal measurements...

# My House

- 1,334 ft<sup>2</sup> over 1,142 ft<sup>2</sup> full basement
- DER in 2013



# DER



140 CFM50;  $n = 0.752$

# Ventilation

- ComfoAir 200
- 3 Supplies, 2 Exhausts
- ~50 CFM on speed 2



# Commissioning Report

## COMMISSIONING REPORT

always  
around you

**zehnder**

Customer:	Marc Rosembaum	Date:	1-9-2014
Address:	235 Great Plains Road	Order Number:	3-0200-0413
City, State, Zip	West Tisbury, MA	Outdoor Temp:	30°F
Commissioning Agent:	Aubrey Gewehr		
Installer:		Date:	

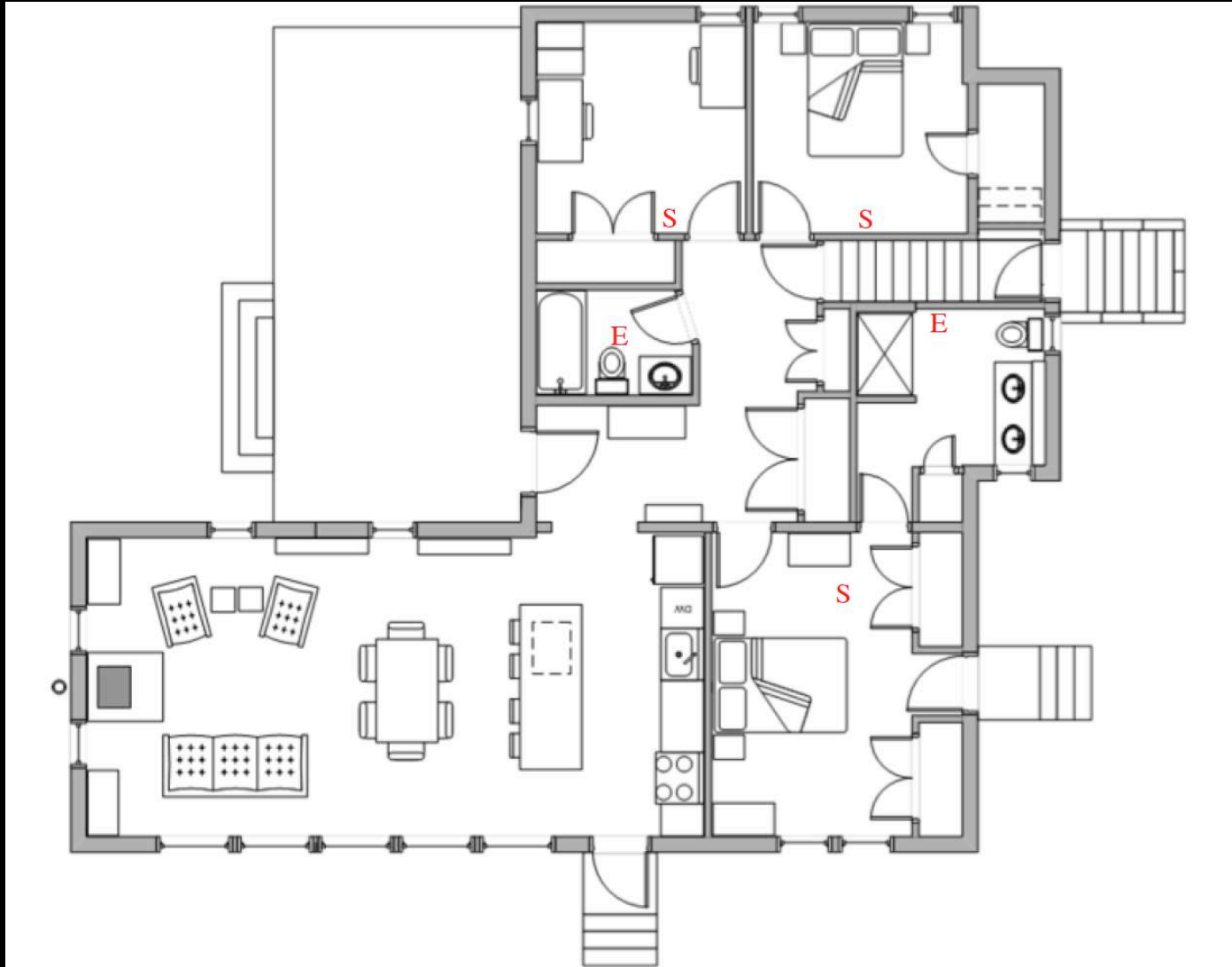
### Ventilation Measurements

Return Air						
	planned medium	measured			valve type	Valve position or ComfoSet disk 0-4
		high	medium	low		
	cfm	cfm	cfm	dBa	cfm	
1 Master Bath	25	71	26			Fantech Diffuser Open
2 Bathroom	25	64	25			Fantech Diffuser Open
<b>Sum:</b>	<b>50</b>	<b>135</b>	<b>51</b>			

Fresh Air						
1 Master Bedroom	24	73	27			Fantech Diffuser Open
2 Bedroom	13	36	15			Fantech Diffuser ¼ Open
3 Bedroom	13	32	10			Fantech Diffuser ¼ Open
<b>Sum:</b>	<b>60</b>	<b>141</b>	<b>52</b>			

Trim	Medium	High	Note:
Ventilator setting fresh air:	45 %	100 %	
Ventilator setting return air:	45 %	100 %	
Comfort temperature	21.5°C (71°F)		
Time-lag ComfoAir settings	Weather – Cold & Clear Filter Condition – New		

# Plan



# Radon

	Radon Level, pC/l
Existing house before purchase, basement	5
After move-in, HRV (excess supply?)	1-2
After HRV balanced (Testo vane anemometer)	11-12
MBR after HRV balanced	1.3

# Passive House in PA

- 1,976 ft<sup>2</sup>, 2 stories, over a full basement
- 103.5 CFM50; n = 0.667
- ComfoAir 350, balanced with Testo vane anemometer
- Radon at 6 pC/l
- Installed a radon mitigation system, dropped radon to 1 pC/l



# Pressure testing wrt outdoors

- ERV + radon fan -8 Pa
  - Radon fan only -3 Pa
  - ERV only -5 Pa
  - Both off 0 Pa
- 
- Powered flow hood measured 10 CFM excess exhaust on low
  - Re-balanced to neutral on low, +1-2 Pa on medium – radon to 1.3 pC/l
  - In summer with open windows, radon increases to ~2 pC/l

# Passive house in CT

- 195 CFM50
- ComfoAir 350, running on low
- Pre-mitigation radon levels -5 to -18 pC/l
- Both off 0 Pa
- HRV only -2.3 Pa
- Radon fan only -1.4 Pa
- HRV + radon fan -4.3 Pa

# House pressure vs. CFM imbalance

<b>Depressurization/pressurization</b>	
Blower door test pressure	-50
Blower door CFM	140
Blower door exponent	0.752
Fan flow supply/exhaust	15
House pressure	<b>-2.6</b>

<b>Depressurization/pressurization</b>	
Blower door test pressure	-50
Blower door CFM	103.5
Blower door exponent	0.667
Fan flow supply/exhaust	10
House pressure	<b>-1.5</b>

# Questions, not conclusions

- Needs focused research
- Do we need to use powered flow hoods to balance?
- Should we balance on calm days and check  $\Delta P$  wrt outdoors?
  
- My plan:
  - Buy a radon monitor/datalogger
  - Log basement pressure wrt outdoors
  - Possibly change house pressure wrt outdoors

# Electric preheat energy

- VT DER with ComfoAir 350 HRV
- Low speed 75 CFM
- Electric preheat for defrost
- Hourly data for energy and outdoor temperature
- October 2014 through April 2015 7,769 HDD68F
- Ventilator fan/control energy is 24W
- Total HRV energy during this time is 377 kWh
  - Fan control energy is 122 kWh
  - Preheater energy is 255 kWh

# Preheat energy vs. HDD68F

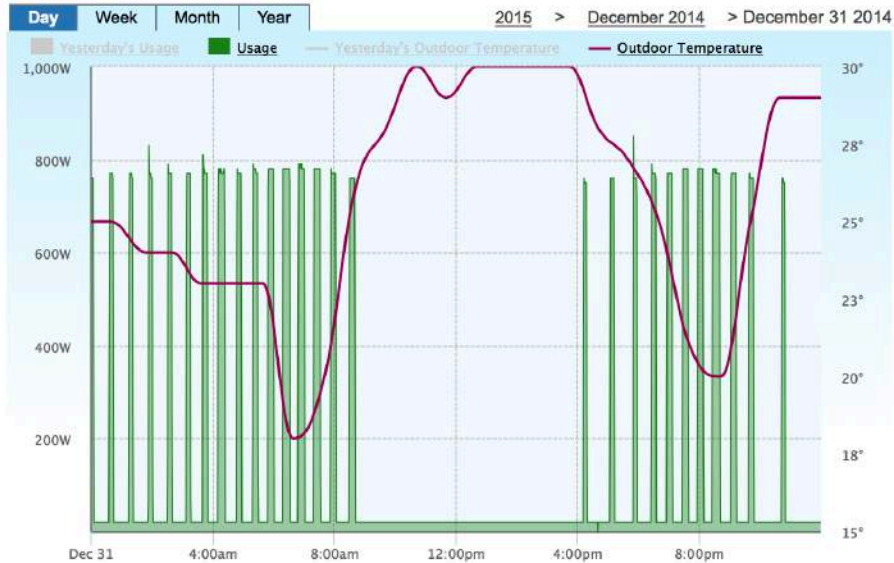


# Effectiveness vs. preheat

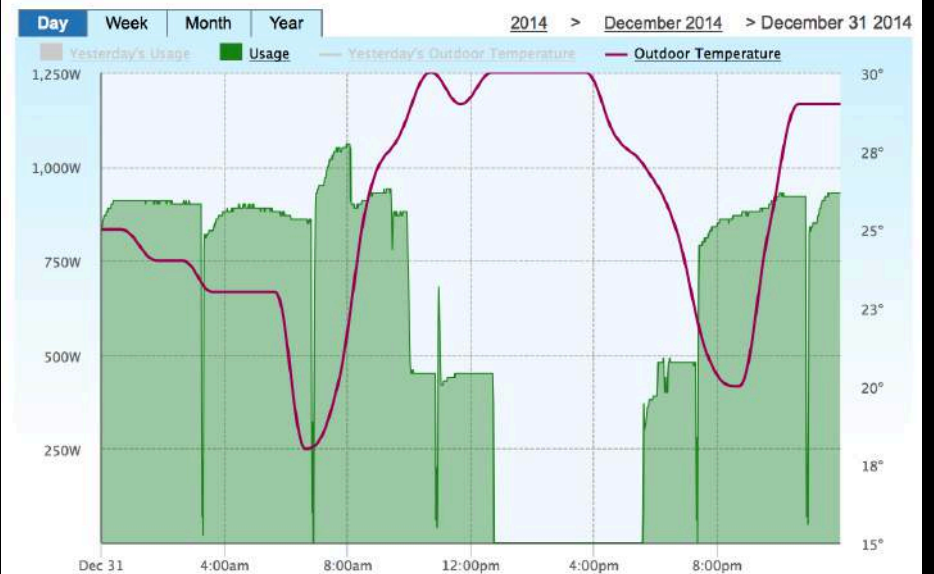
- In this house, ventilation load at 75 CFM is 4,426 kWh/year
- Each 1% of effectiveness is worth 44 kWh/year
- For two ventilators at 24W fan/control power, and 255 kWh preheat energy/year, if one ventilator uses no preheat energy it can be  $255/44 = 5.8\%$  less effective
- Figuring heat pump COP (call it 2.3 in this VT climate), that differential can be 13.2% less effective
- If a less effective ventilator uses 40W to move the same air flow in this case, that additional fan/control energy is deducted from the preheat energy - @8760 hours annually, that 16W is 140 kWh – net preheat energy reduces to 115 kWh/year
- Equivalent effectiveness reduction is 2.6% and 6.0%

# Effectiveness measurements

HRV



Minisplit heat pump(1)





# Effectiveness measurements

- The unit was balanced to 51 CFM
- Using an Omega digital thermocouple I measured air temperatures at all four ports on the HRV
- Outdoor fresh 33.8F Supply 63.5F
- Exhaust 75.5F Exhaust to outdoors 45.9F
- Indoor RH ~26% - dewpoint ~38F
- Rise on intake is 29.7F; drop on exhaust is 29.6F
- Effectiveness is 71%  $(63.5-33.8)/(75.5-33.8)$
- If this was caused by excess supply air, the rise would be less than the drop – especially if there was condensing in the core

# More questions

- Zehnder USA was very helpful, and had me look to see there was no damper bypasses or water in the core
- Is this a legitimate measurement approach?
- Have others done this on any ventilators? (I have on a Renewaire EV200 at -3F – 85% effectiveness; John Semmelhack has done on a Renewaire EV90P, similar result)
- My plan is to monitor this coming winter

architecture

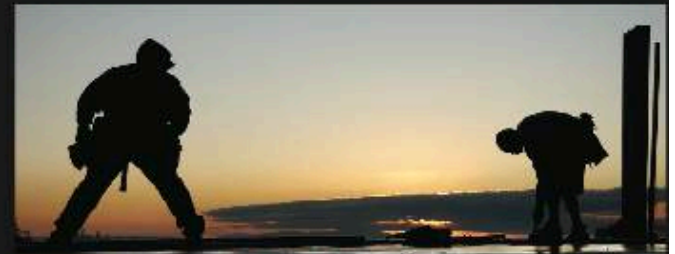
building

renovations

interiors

fine woodwork

green energy



Thank You

Marc Rosenbaum, P.E.  
South Mountain Company  
West Tisbury, MA

south  
mountain

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