Ventilation

Affordable Comfort
April, 2008

John Proctor, P.E.
Proctor Engineering Group, Ltd.
www.proctoreng.com
415-451-2480

Why I took the “Con” side

1. I hate to waste energy
2. Ducts suck
3. It fits perfectly into the: “I just do what I have to” approach

Fresno California 1979?

"Holy Sox, I've got to get a Polaroid® of that!"

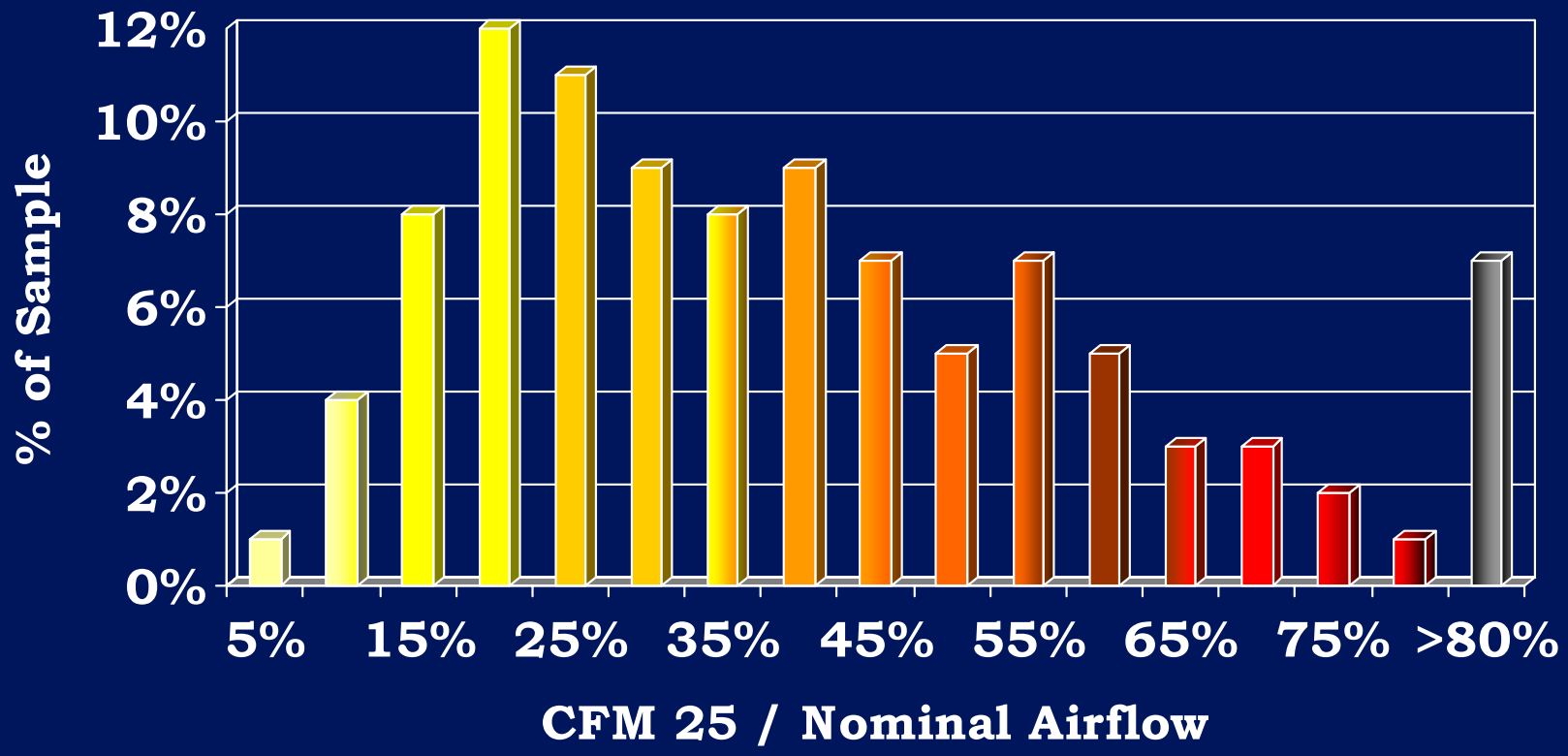
Some Problems with A Hole in the Return Plenum

1. It is always there but;
2. It provides no ventilation when the furnace or air conditioner is not on.
3. It provides excess outside air when the infiltration is already high (very cold or very hot outside).
4. The amount of outside air it provides varies inversely from the need and is of unknown volume.

Ducts Suck

1. Ducts leak – Often more than the ventilation we are trying to provide.
2. Ducts pressurize or depressurize the house – either of which can be bad depending on the climate conditions – resulting in moisture in the walls.
3. The closest to a total consensus I have ever seen with the “Duct Guru” group is that ducts are a bad idea.

Duct Leakage in Existing Homes



Sample size: 1210 (no mobile homes)
Test method: Duct Blaster® at 25 pa. (0.10”WC)
Source: CheckMe!® database

How Much Energy Does it Take to Move Air?

Air HorsePower (AHP)

Has two components:

Pressure

$$AHP = CFM/6356 \times \text{Static Pressure}$$

Velocity

$$AHP = CFM/6356 \times [CFM/(4005 \times Area)]^2$$

Energy to Move Air

Air HorsePower (AHP)

80 CFM, 0.10 IWC, 0.083 SqFt

Pressure
0.001258653 Horsepower

Velocity
0.000723175 Horsepower

Energy to Move Air

Total Air HorsePower (AHP)

0.001258653 + 0.000723175 =

0.001981828 Horsepower

2/100 ths HP

Energy to Move Air in Watts

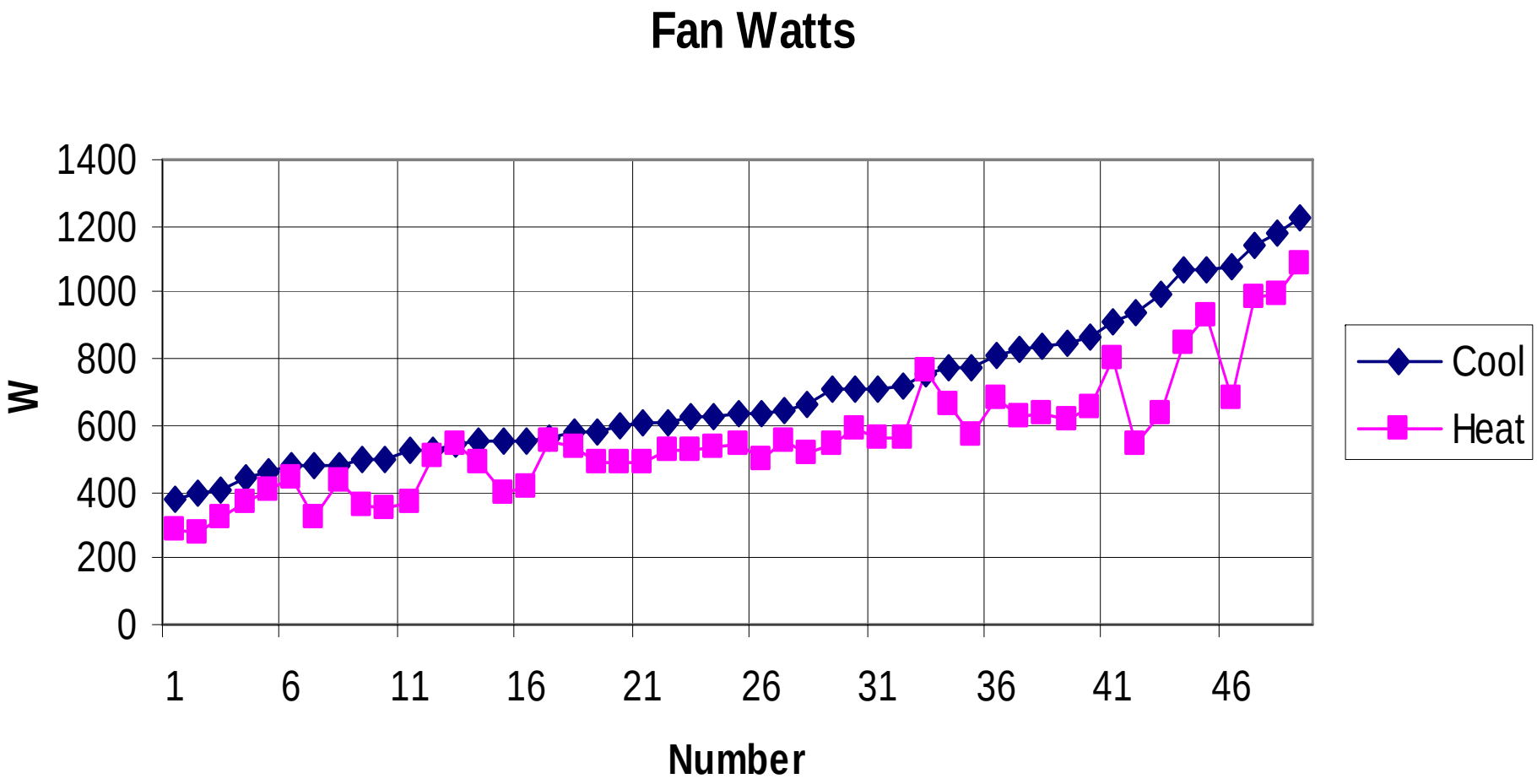
Total Air Watts (AWWWWWWW)

AHP x 745.7 = AW

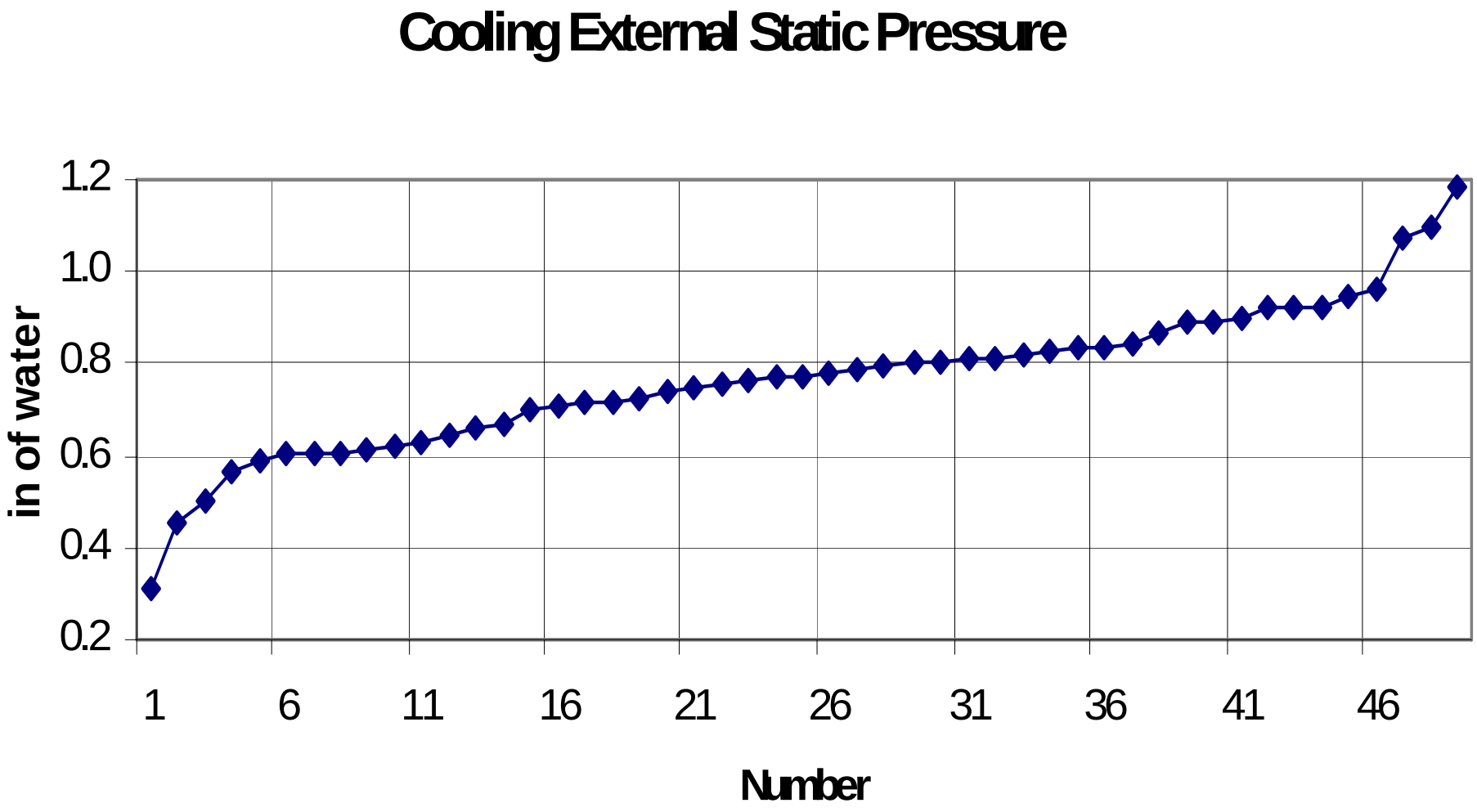
0.001981828 AHP x 745.7 =

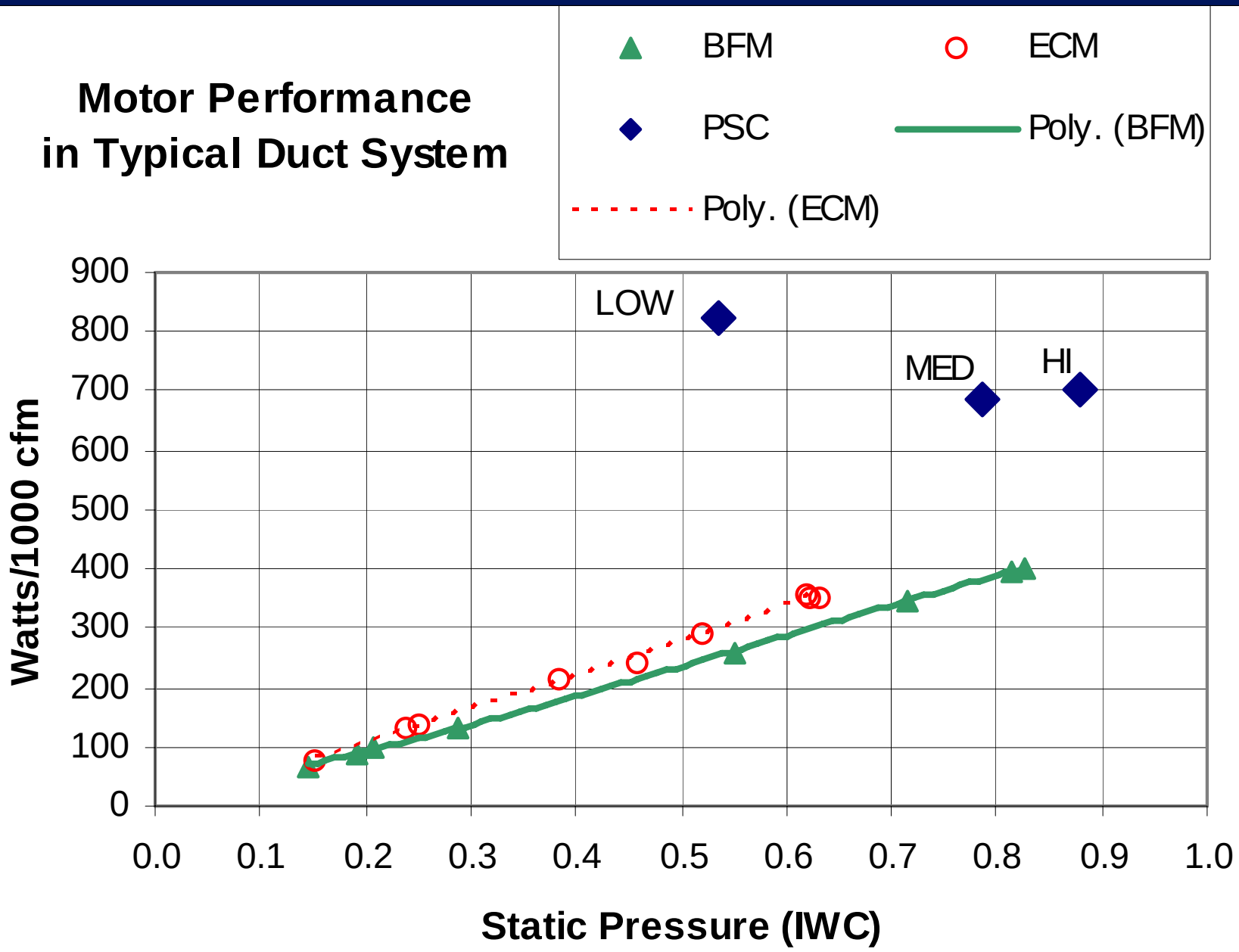
1.478 Watts

What will we use to supply less than 2 Watts of air movement?

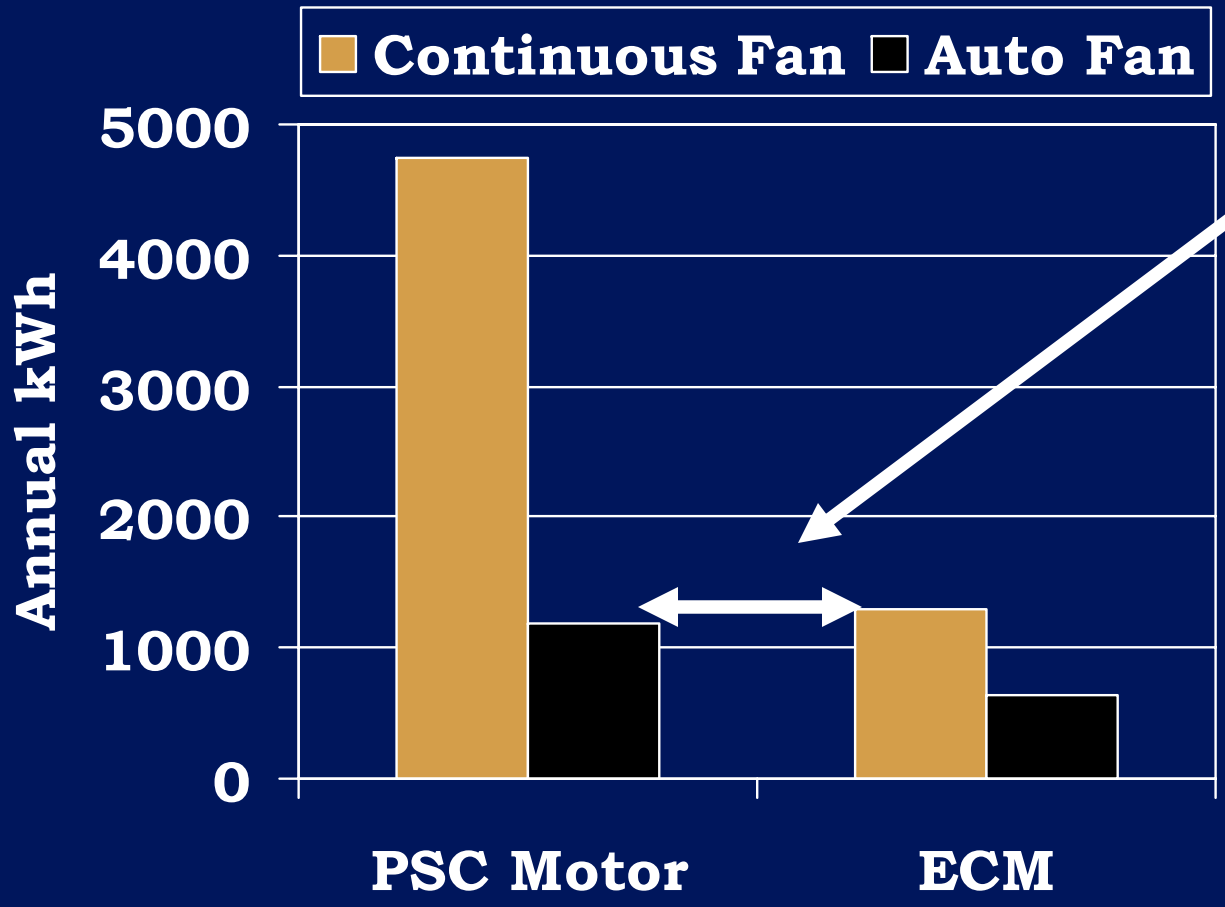


Conditions – Air Flow Resistance




Motor Performance
in Typical Duct System
BFM
ECM
PSC
Poly. (BFM)
Poly. (ECM)
LOW
MED
HI
Watts/1000 cfm
900
800
700
600
500
400
300
200
100
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Static Pressure (IWC)

Why not just add an Brushless Permanent Magnet Motor and Continuous Fan?



An ECM uses as much power running continuously as a PSC motor does running on Auto
(Scott Pigg, Wisconsin Study)

Its "Too Easy"

- Many people want to do nothing – or as little as possible.
- "The Market" will not take care of this issue.
- What about the ducts?
- What about the air handler fan motor?
- What about the air handler design?
- What about the building materials?
- What about the quality of the installation?
- What about combustion appliances?
- What about house vented fireplaces?

Reasons for Mechanical Ventilation

- Indoor Pollutants:
  - Moisture
  - Odors
  - VOCs
  - NOX
  - CO
- Outdoor Pollutants:
  - Ozone
  - CO
  - Particulates
  - NOX
  - Moisture

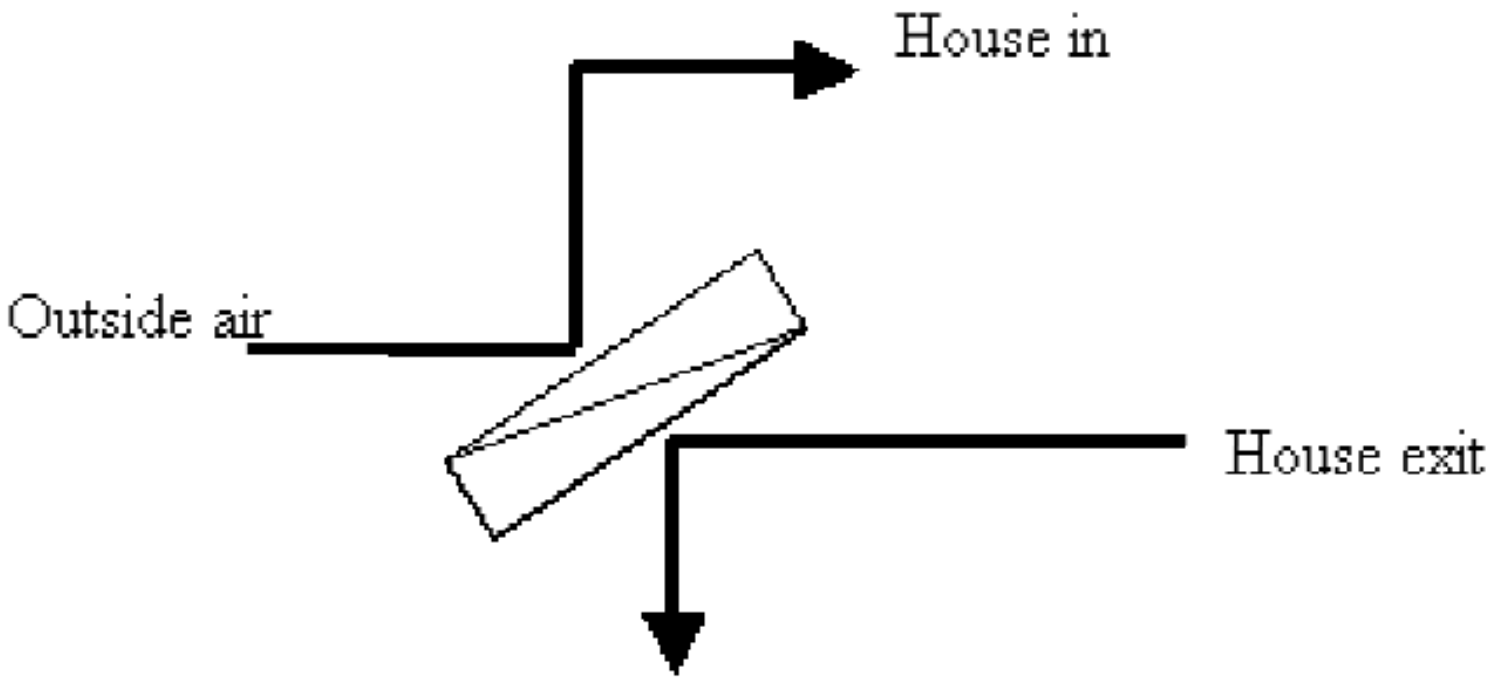
How Much Ventilation does an 80 CFM Fan Add?

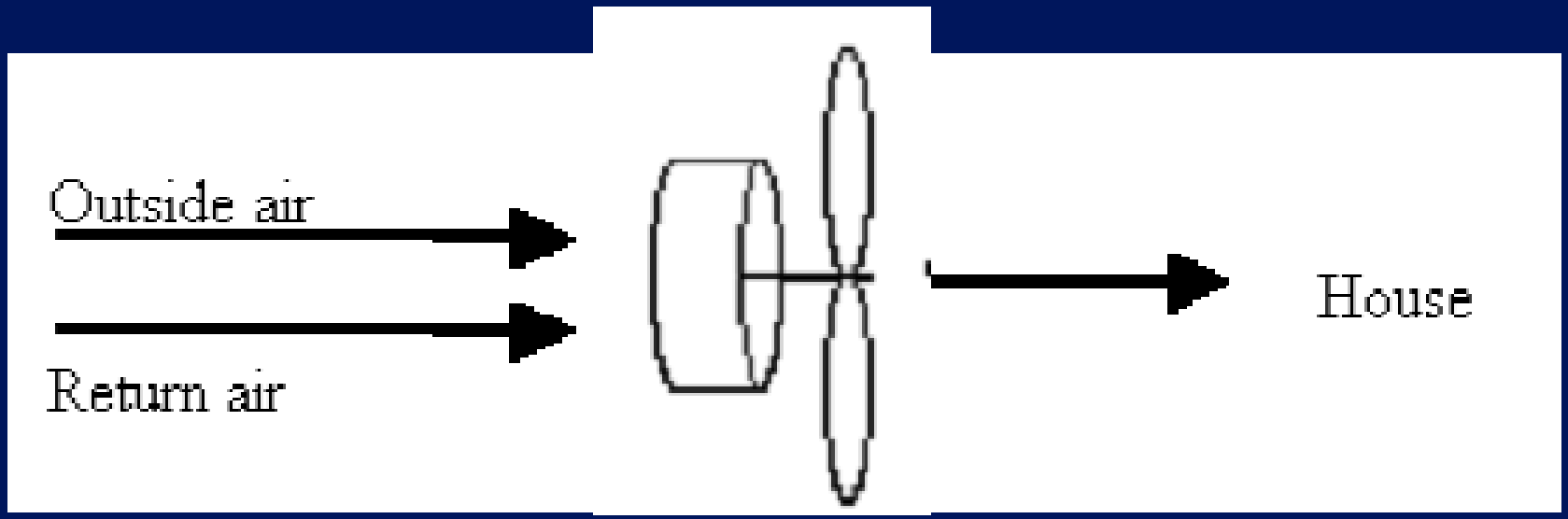
1. If there is no infiltration, it adds 80 CFM
2. If there is less than 80 CFM of infiltration, it will make take the ventilation above 80 CFM
3. If it is a balanced system, it adds 80 CFM
4. In all other cases it will add less than 80 CFM (about 40 CFM)

SYSTEM TYPES

- Balanced System
  - Can have HRV
- Exhaust System
  - E.g. Bath Fan Upgrade
  - Care in Humid Climates
- Supply System
  - E.g. Integrated with Air Handler
  - Care in Cold Climates

Design 1	Energy Recovery Ventilator			
	Balanced System		Double Ventilation Flow	
Location	Chicago	Charlotte	Chicago2	Charlotte2
Percent of Sens Load	6%	8%	13%	16%
Percent of Latent Load	17%	18%	34%	36%



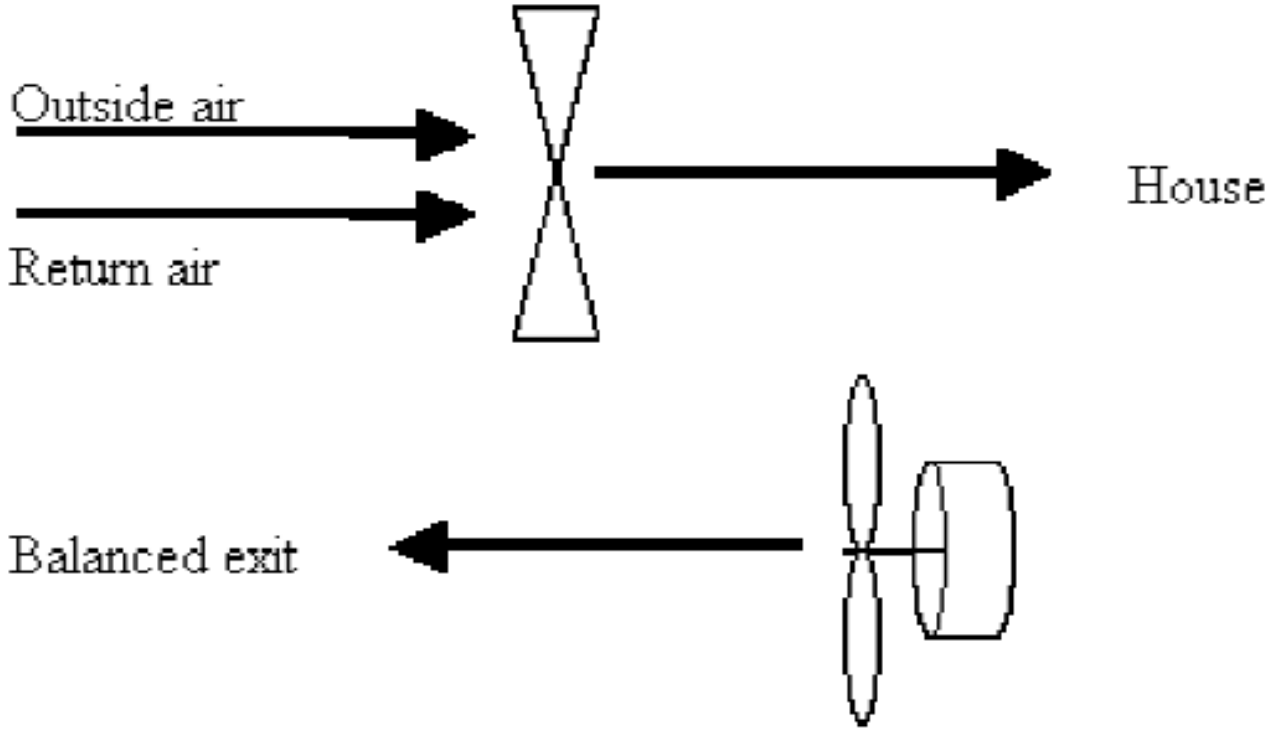


1. High Performance House
2. Reduced Pollutant Sources
3. Sealed Ducts
4. High Efficiency Fan and Motor
5. Cycle Controller

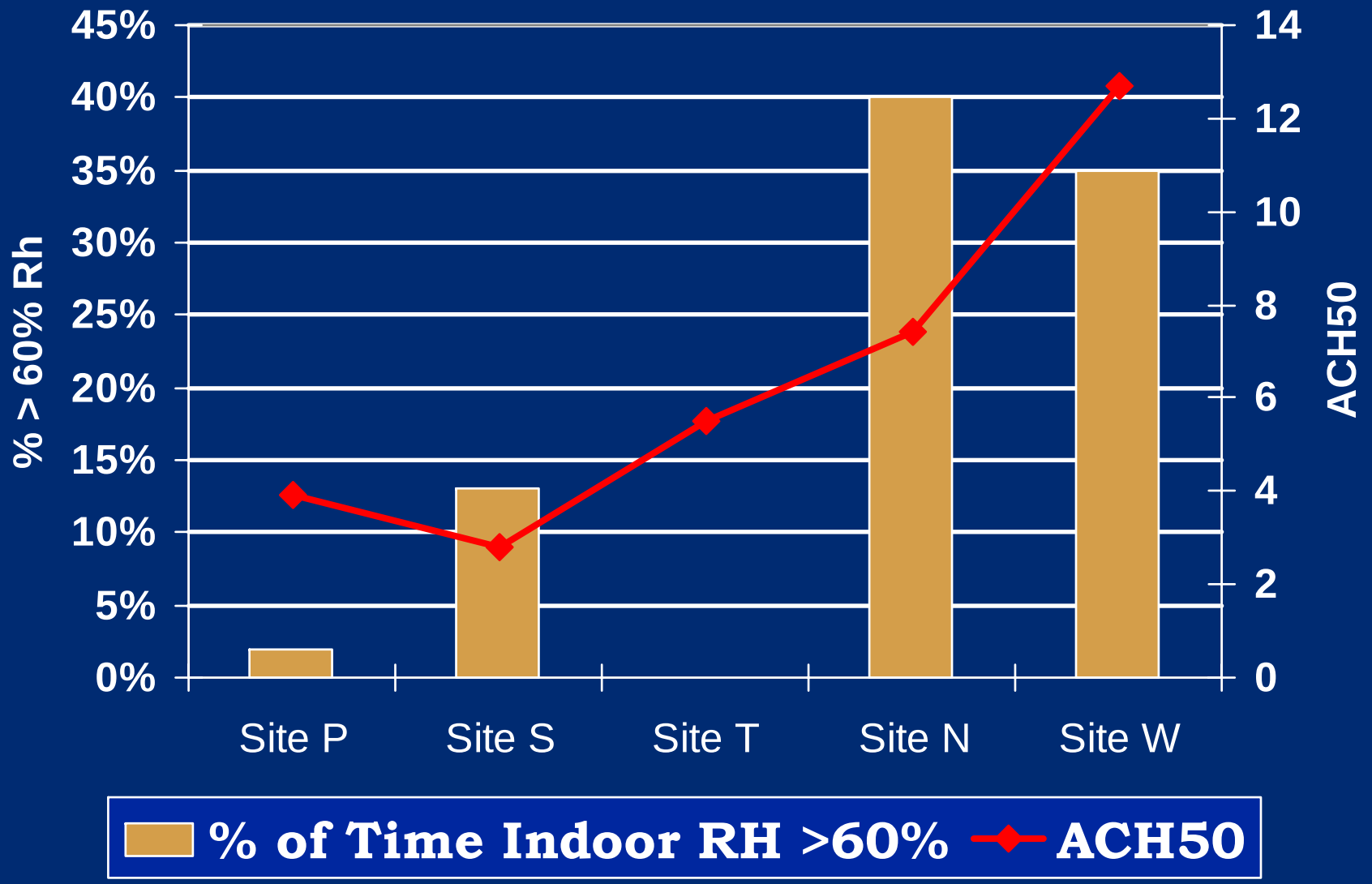
Design 6

Feed Outside Air Mixed with Return Air Directly to Small AC Evaporator

	Balanced		<u>Supply Only</u> Double Ventilation Airflow	
Location	Chicago	Charlotte	Chicago2	Charlotte2
Percent of Sens Load	159%	134%	156%	127%
Percent of Latent Load	93%	81%	117%	101%



Indoor Humidity



Use an ECM Motor on a Low Resistance System