Harvard School of Public Health

Dynamic Control of Laboratory Ventilation Rates

Demand Controlled Ventilation with Environmental Health & Safety Considerations

Laboratory Airflow Exchange Rates Standards and Guidelines

Federal Register - OSHA	p. 484	4-12 ACH
Prudent Practices	p. 192	6-12 ACH
ASHRAE Handbook	p. 13.8	6-10 ACH
NFPA 45 section A-6-3.2	p. 45-26	4-8 ACH
NIH Design Policy & Guidelines section D.7.10	p. 17	6 ACH

Industrial Ventilation – *ACGIH p.7-5:

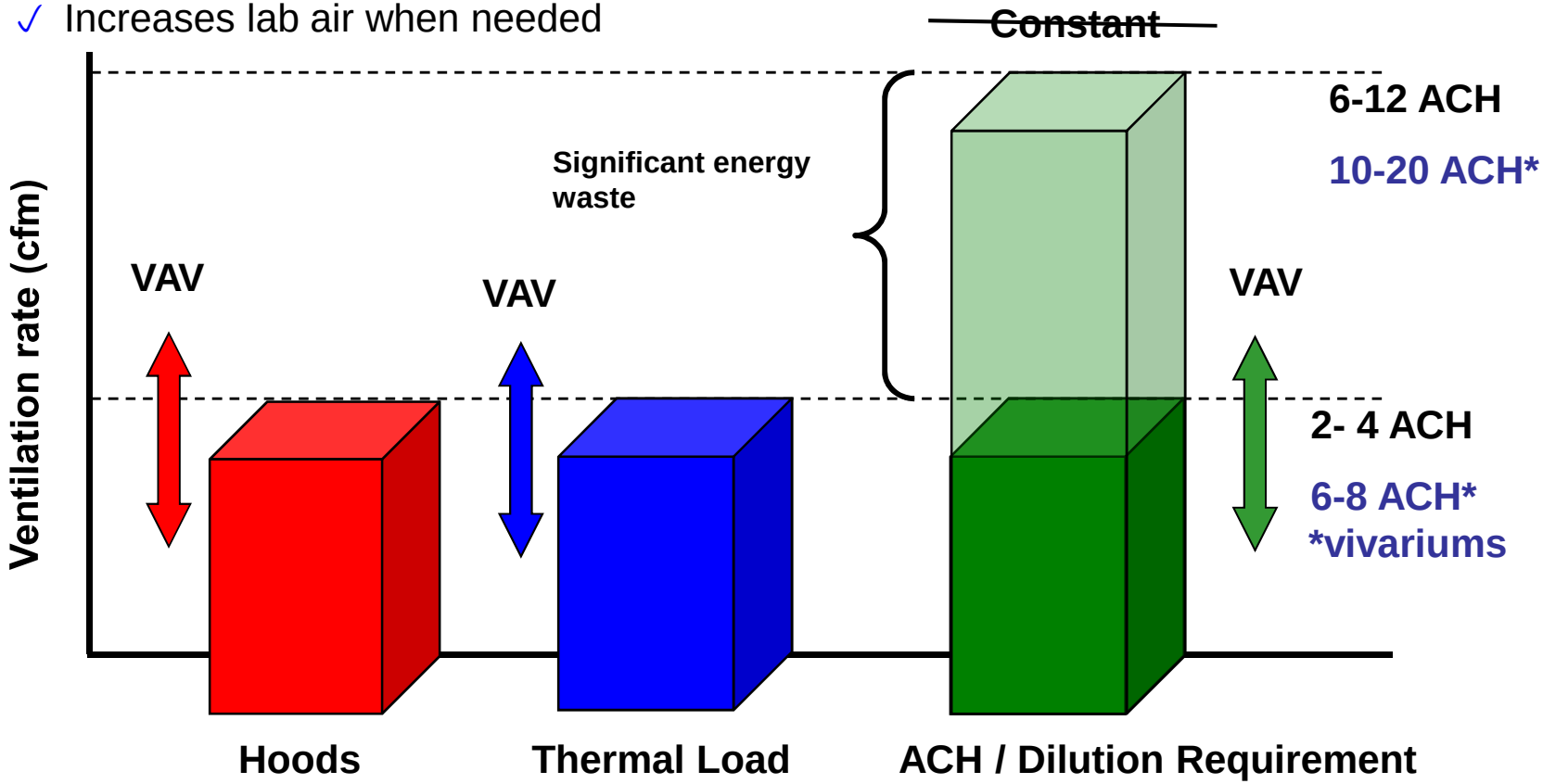
"Air changes per hour' or `air changes per minute' is a **poor** basis for ventilation criteria where environmental control of hazards, heat, and/or odors is required. The required ventilation depends on the problem, not the size of the room in which it occurs."

*American Conference of Governmental Industrial Hygienists (ACGIH), Industrial Ventilation, A Manual of Recommended Practice, 23rd Edition, 1998

Concept: Dynamic Control of Lab ACH Rates

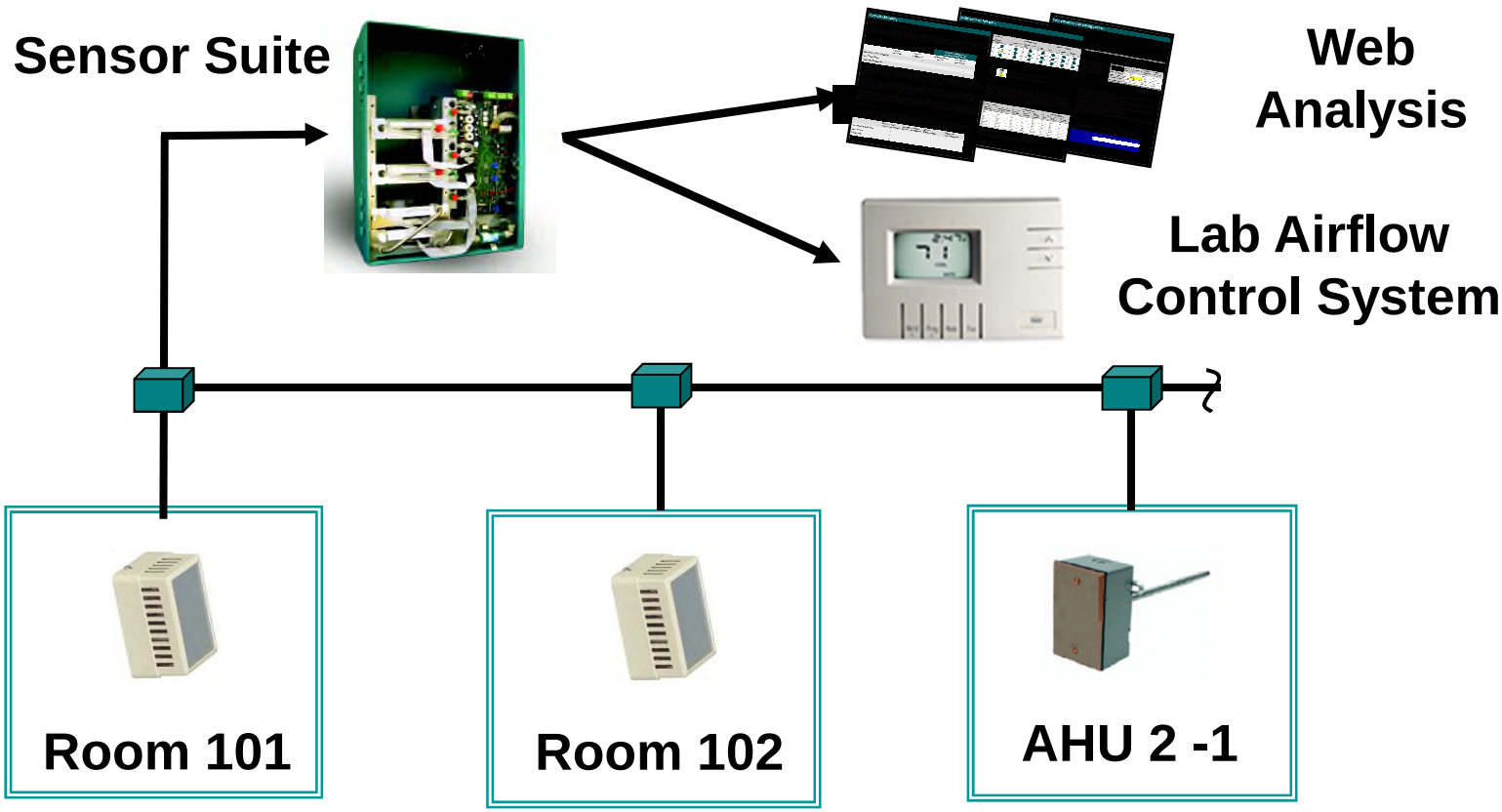
Lab Multi-parameter DCV: Dynamic control of min. ACH

- ✓ All three factors affecting lab airflow are varied based on IEQ
- ✓ No benefit to dilute clean air with clean air (100% O.A.)
- ✓ Increases lab air when needed

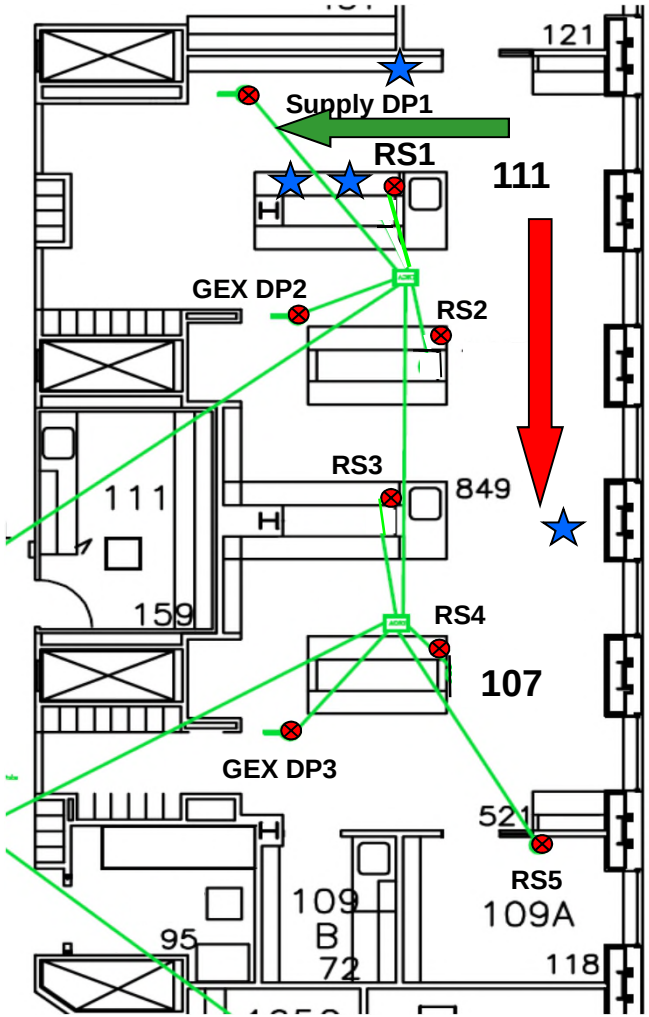


System Concept: Multiplexed Sensing

- Routes multiplexed air samples to central sensors
  - Integrated into lab airflow controls for monitoring & control
  - Web based monitoring and expert system analysis



FXB 1st Floor Case Study



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Monitored Parameters:

- Temperature & RH
- PID TVOC
- Particles
- CO2
- Lab ventilation control signals & override status
- Supply & total Exhaust airflow volume

Test Materials:

- Rubbing Alcohol (Isopropyl alcohol) - CF= 6
- Acetone - CF=1.1
- 40 to 400 nm salt particles

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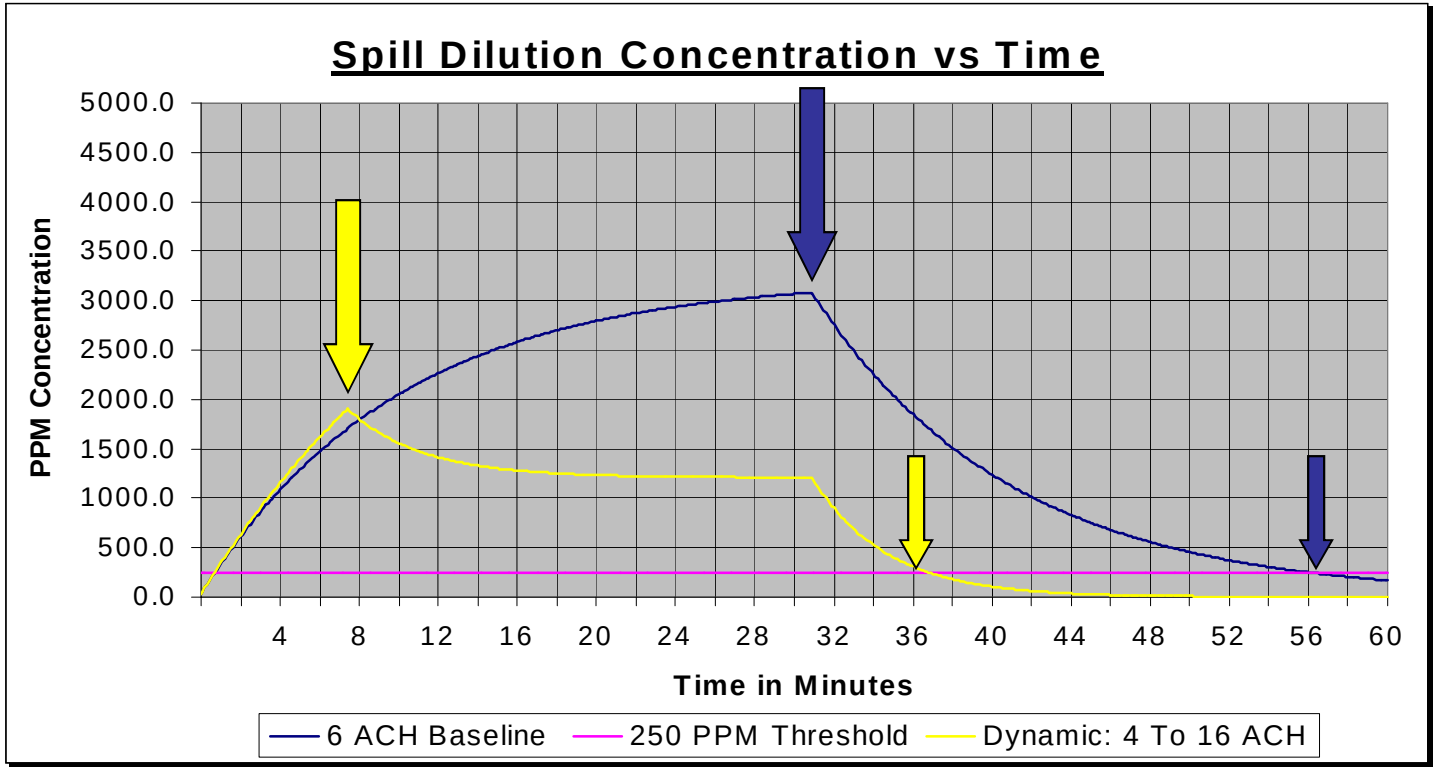
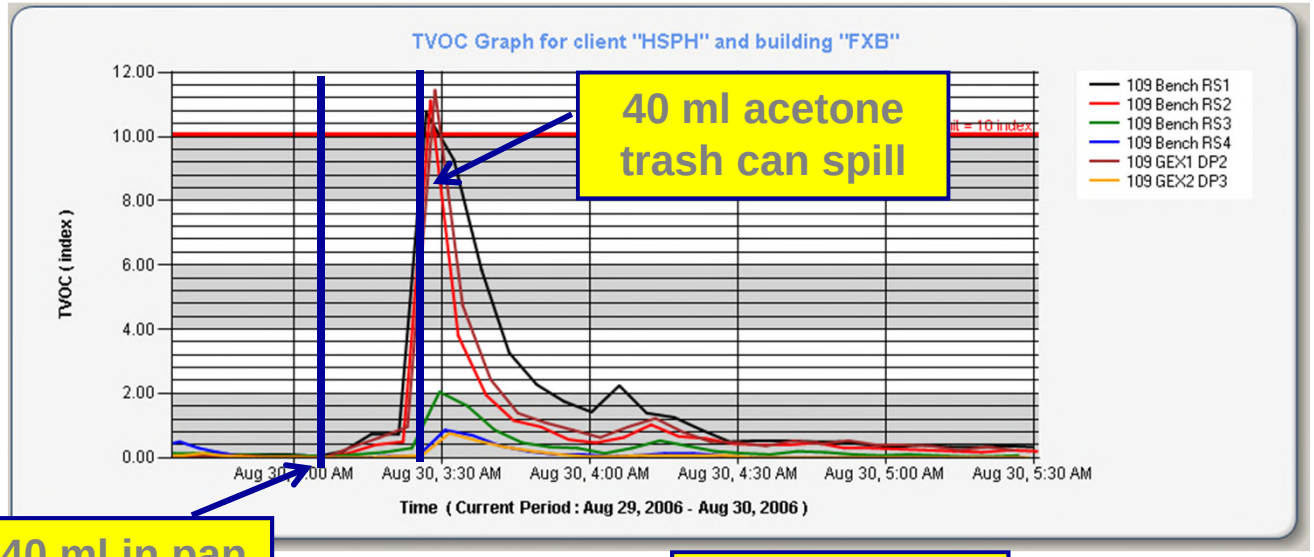
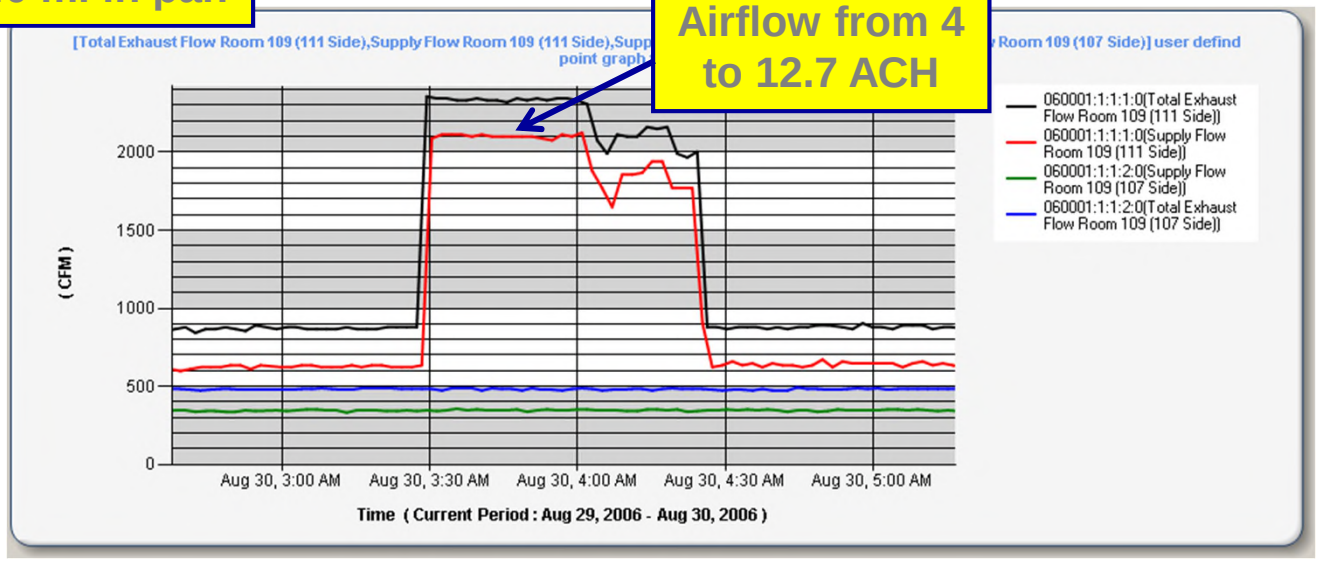


- After vaporized, dynamic system hits 1/3rd TLV in 6 vs. 31 min
- After 1 hour Dynamic control has dropped level to .53 PPM
- After 1 hour, 6 ACH system is at 169 PPM or 320 times higher

FXB 1st Floor Case Study





FXB 1st Floor Case Study

Annual Savings $15,442; SPB = 2.6 Yrs

Floor No.	Area (SF)	Ceiling Height (Ft.)	Volume (CU. FT.)	Base Min. ACH CFM Annual $	Proposed Occ. Min. ACH CFM	Proposed Un-Occ. Min. ACH CFM	Occ. CFM Reduction & Cost M-F: 7 – 19	Un-Occ. CFM Reduction M-F: 19 – 7 Sat & Sun	Annual Savings ($)
1	2,728	11	30,010	6.5 3,246 $26,278	4 2,001	2 1,000	1,245 $5,443	2,246 $5,394	$15,442

Site kBTU Energy Reduction = 609,241 or 59%

HU Laboratory Scale-up

HU Labs account for 16% of Total SF
and 39% of Energy Consumption

Campus	SF	Lab SF	Lab Ceiling Height	Lab Volume CU FT
Cambridge	17,163,427			
HLC	2,857,293			
Total:	20,020,720	3,203,315	9’	28,829,837

HU Annual Lab Savings ($ & Site KBTU's)

	Base Case @ 6 ACH 24Hrs/Day * 365	Occupied @ 4 ACH M – F: 7 a.m. to 7 p.m.	Un-Occupied @ 2 ACH Sun & Sat & Holidays M-F 7 p.m. to 7 a.m.	Savings
Ventilation CFM	2,882,984	1,921,989	960,995	N/A
Steam kBTU's	559,659,846	109,293,291	54,646,670	395,719,885
CHW kBTU's	239,787,481	72,661,740	36,330,887	130,794,854
Electricity kBTU's	124,427,574	27,748,307	13,874,160	82,805,107
Total Site kBTU's	923,874,901	209,703,337	104,851,717	609,319,846
Annual Cost	$23,339,058	$5,227,625	$2,613,814	**$15,497,619**

Site kBTU's % Reduction = 66%

Equals

26% Campus-Wide Site Reduction