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Charting a Course to Energy Independence

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Controlling Energy Use in Laboratory HVAC

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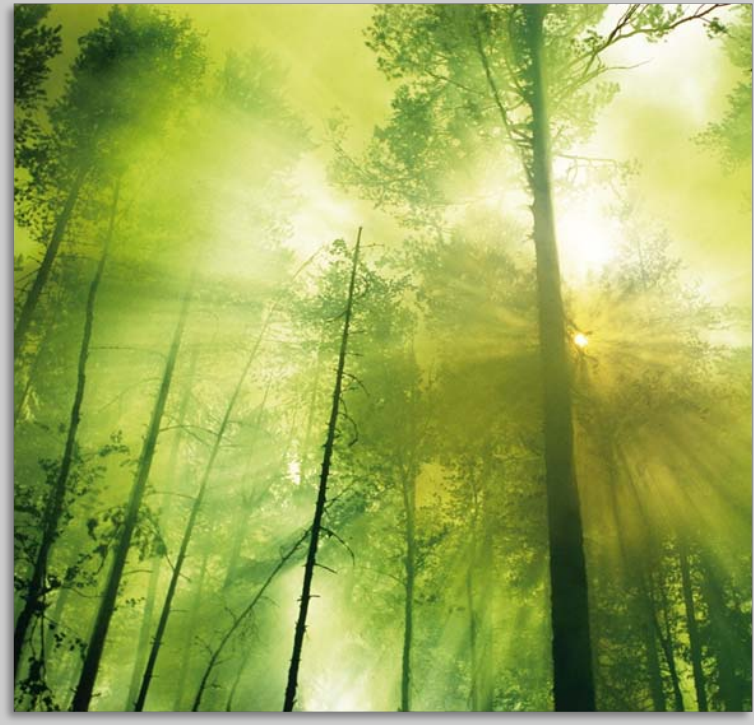
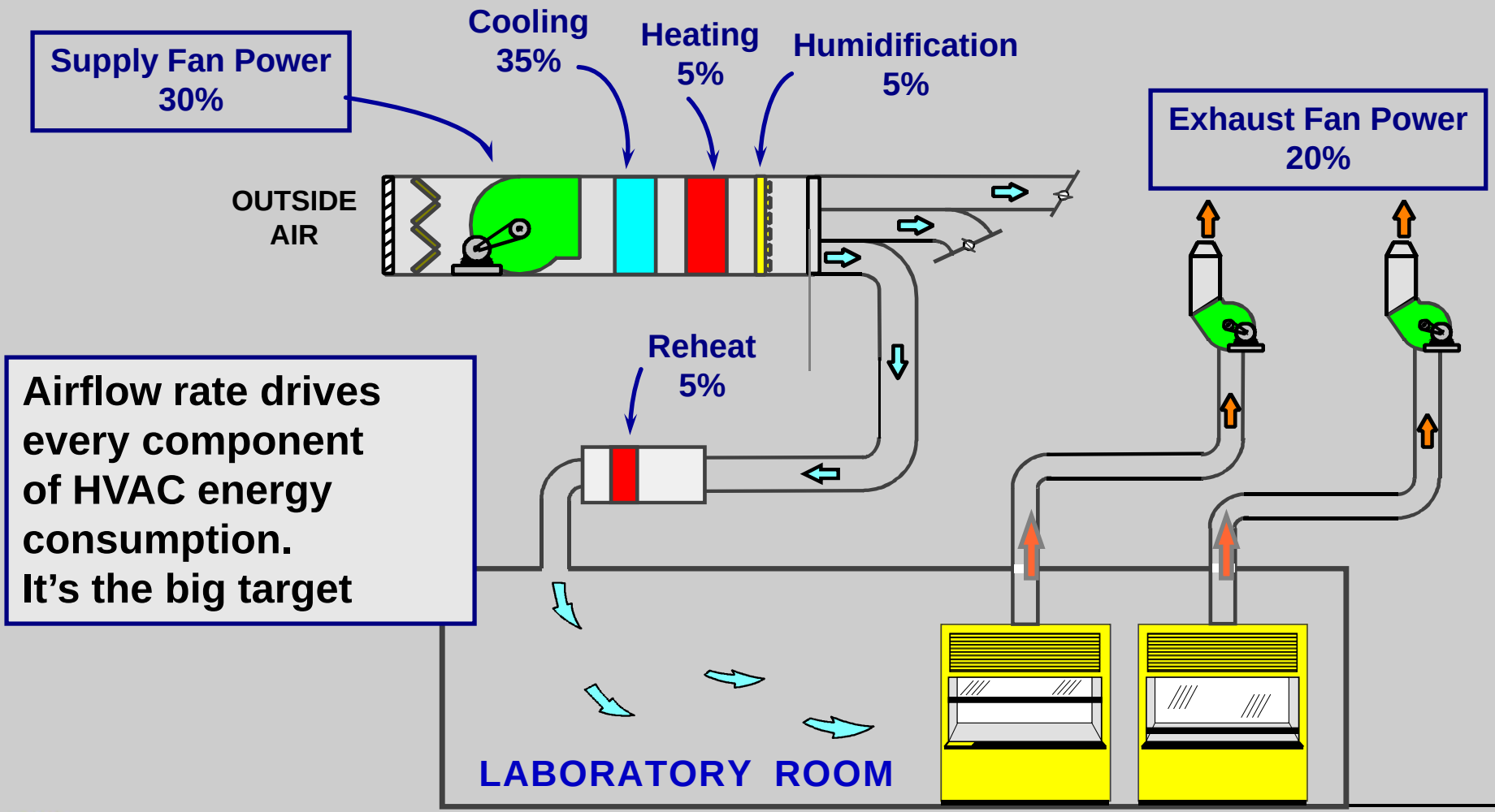
Controlling Energy Use in Laboratory HVAC

- Reducing Energy Use
  - Reduced Airflow
  - Low Pressure Ventilation
  - Efficient Heating and Cooling Processes
- Commissioning
- Ongoing measurement



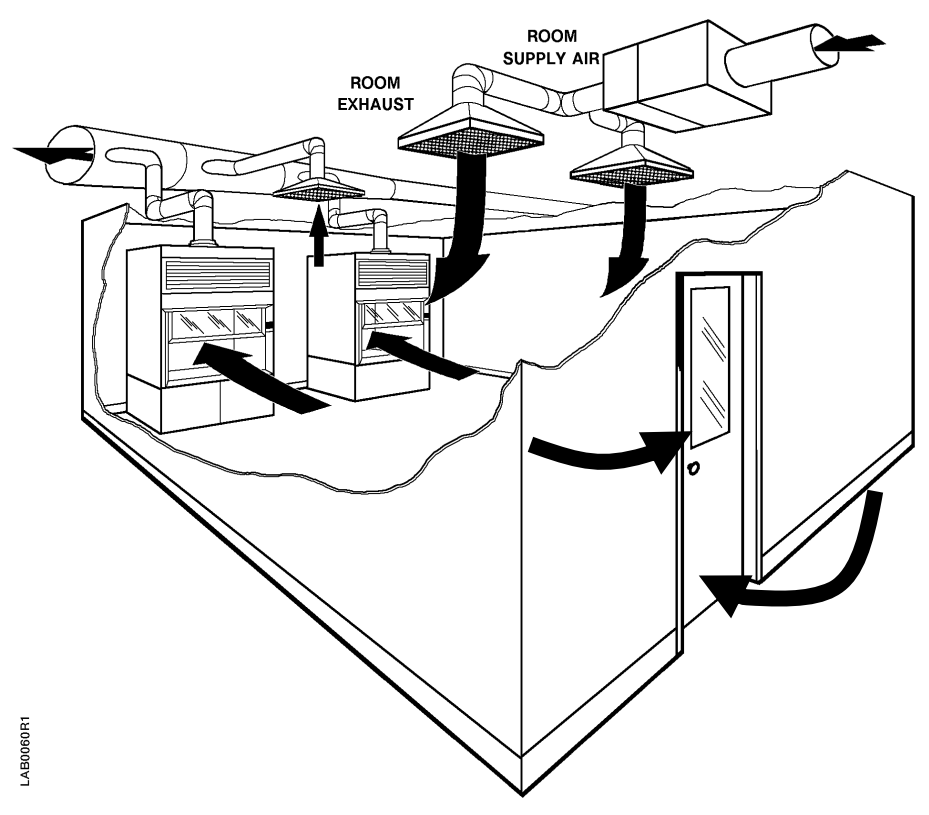
Where Does the Energy Go?



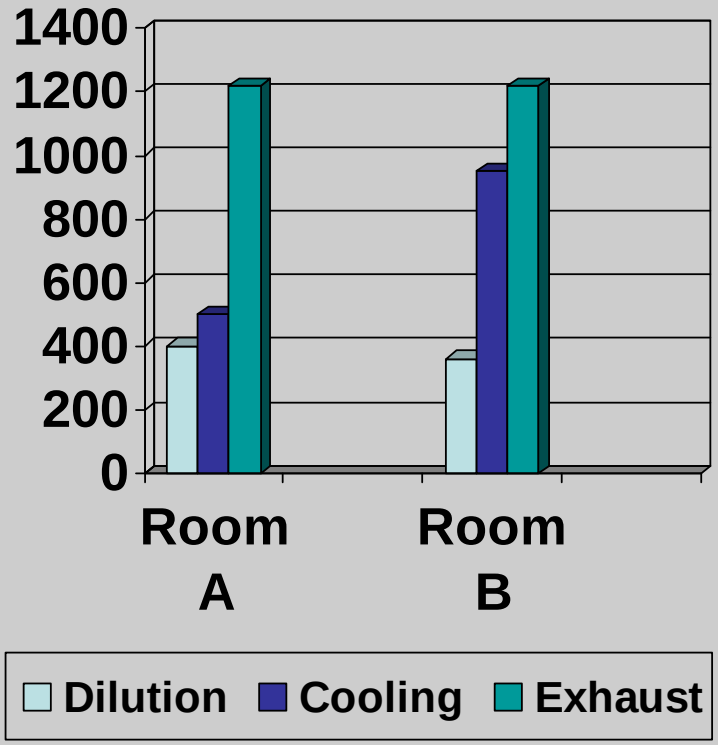
Airflow rate drives every component of HVAC energy consumption.
It's the big target

Lab Room Air Flow Rates

- Room air flow rates set by 3 demands
  - Enough to balance exhaust devices
  - Enough to handle thermal loads
  - Enough to dilute and remove contaminants



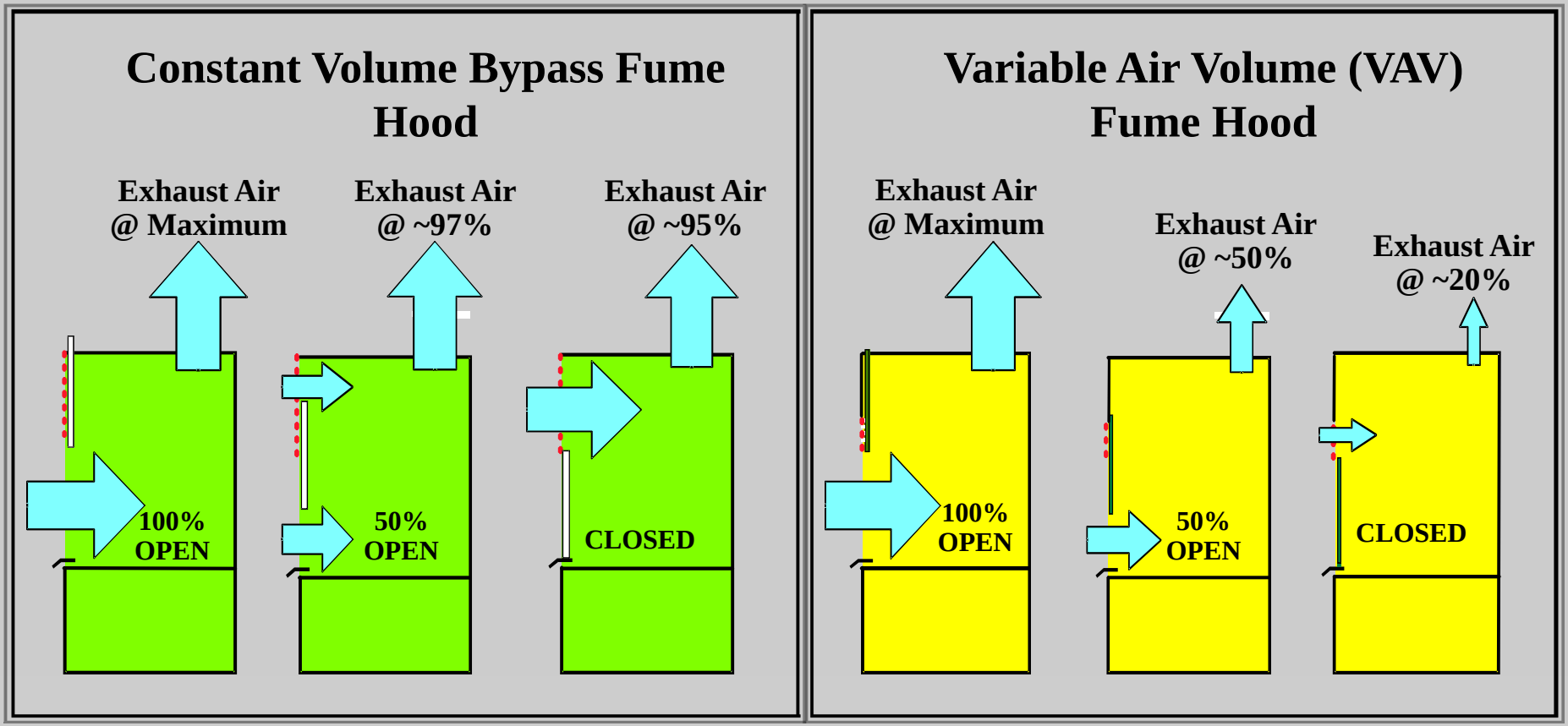
Reducing Lab Room Air Flow



- 3 demands evaluated room by room and moment by moment
- To reduce flow rate:
  - Ask which one is critical
  - Ask which one will be critical after improvement

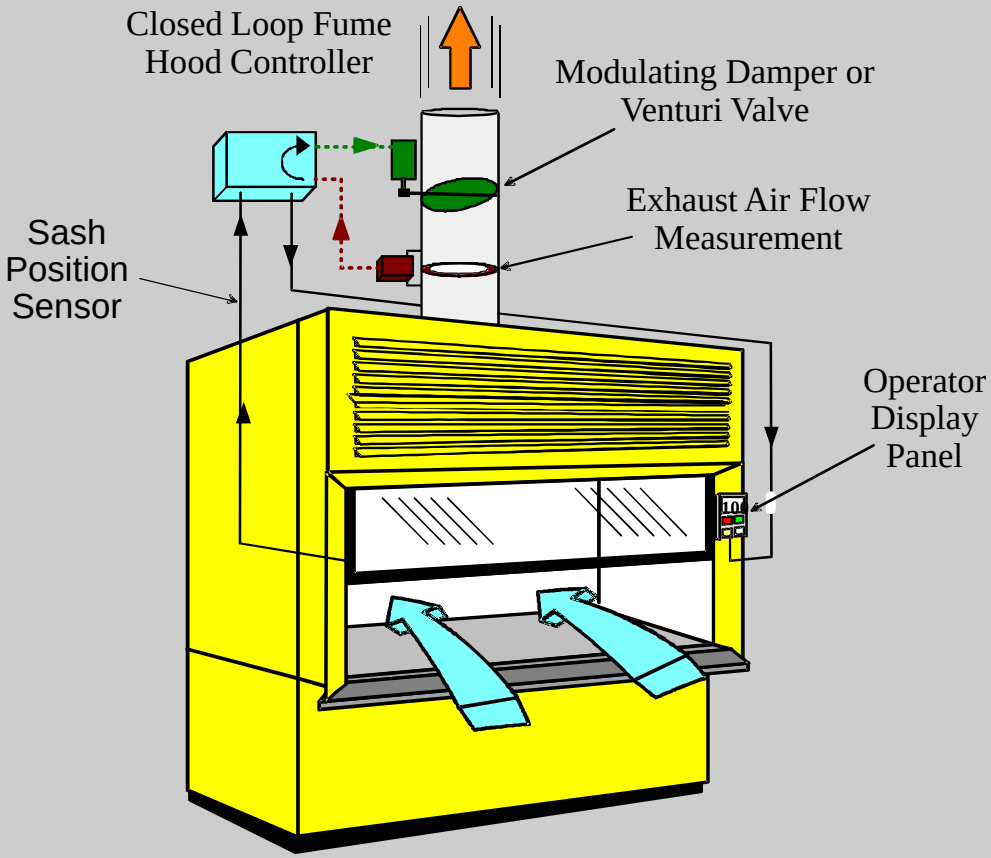
Variable Hood Flow

VAV Fume Hood Controls



VAV Face Velocity Control

- ☑ **Constant Average Face Velocity**
- ☑ **20% Minimum Exhaust Airflow**
- ☑ **Operator Annunciation of Unsafe Conditions**
- ☑ **Connected to BAS Network**



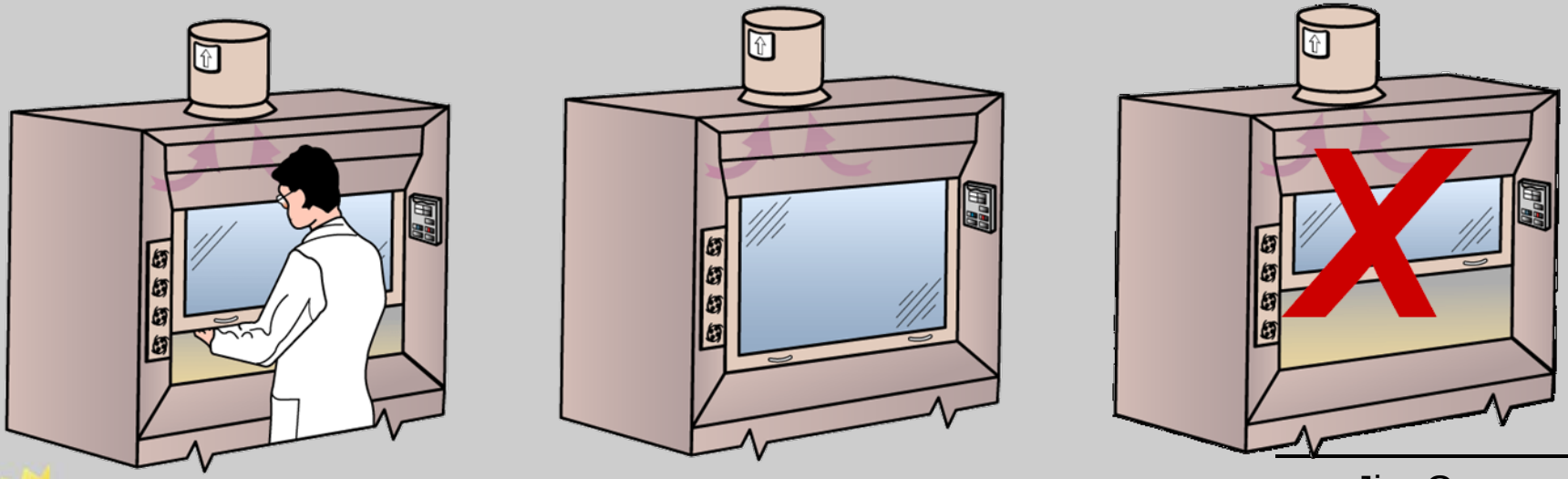
FUME HOOD CONTROL ALGORITHM

Open Area = Height X Width + Fixed Opening

Exhaust Set Point = Open Area X Face Velocity

Sash Management

- Anecdotes of sophisticated systems that don't save energy
- Promise of VAV is lost if lab users leave sashes open



Sash Management

- Great chance to bring together safety and energy management
- Sash Left Open, Worker Absent is UNSAFE!
  - American Industrial Hygiene Association
  - National Fire Protection Association
  - Scientific Equipment and Furniture Association
  - American Conference of Governmental Industrial Hygienists

Sash Management

- Training Resource: Laboratory Safety Incidents Sorted by Key Instruction Concept
  http://www2.umdnj.edu/eohssweb/aiha/accidents/lesson.htm

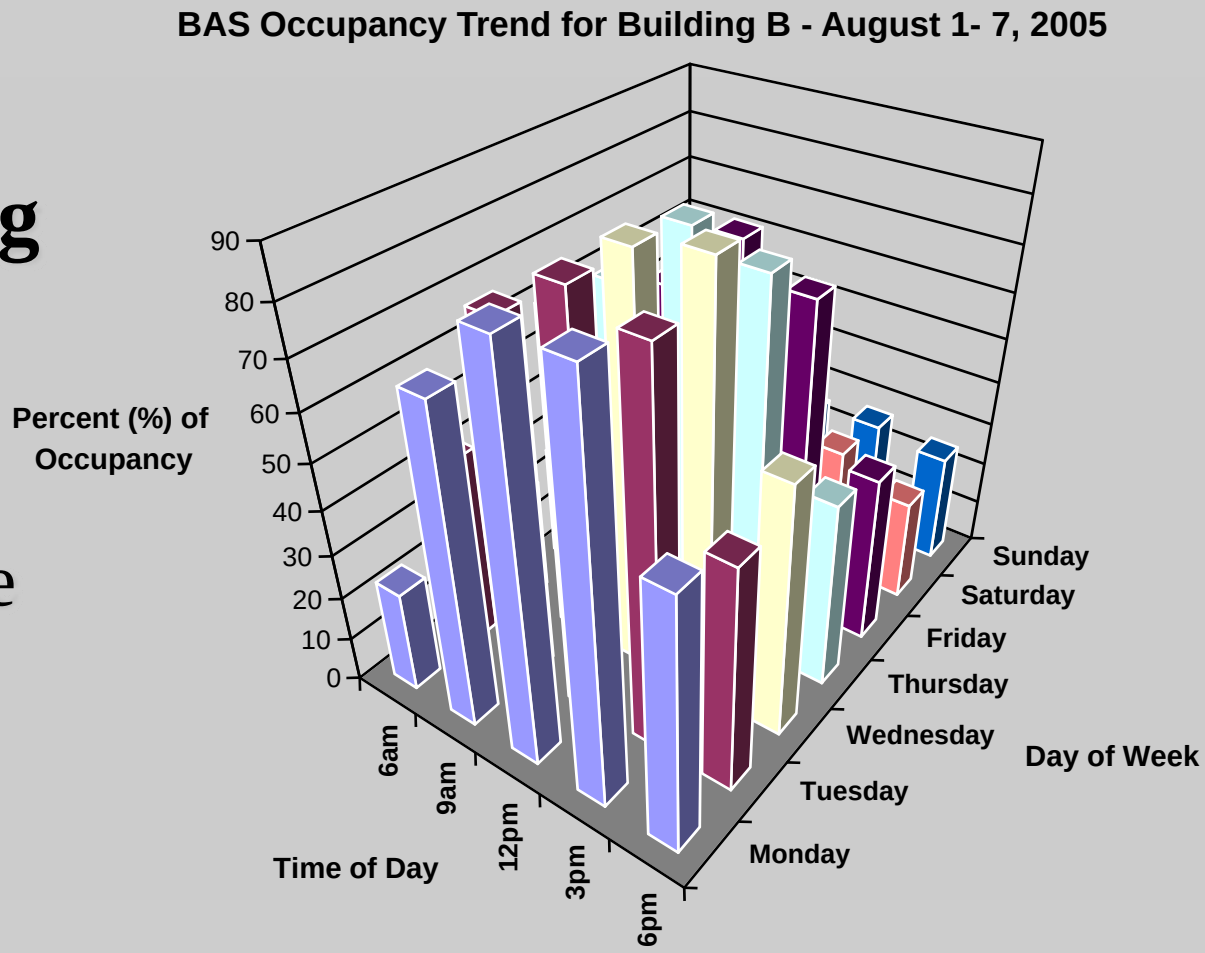
Sash Management

- Programs to improve operation combine education, tracking, reporting and reminders
- More info:
  - Siemens Technology Report: *Green Lab Facilities*
  - Labs21 Best Practice Guide: *Metrics and Benchmarks for Energy Efficiency in Laboratories*

Results at Research Triangle Park

Monitoring and reporting results:

Reduced 30% non-compliance down to 5%



Setting Back Ventilation

- Setback Room Airflow Based On Occupancy
  - If dilution sets the flow for the room, consider reduction for the unoccupied periods
  - Depends on how EH&S views the hazard
  - Depends on how the space is used
  - Works well where occupancy is predictable
  - Requires indication in the room

Setting Back Ventilation

- More info in the I2SL Electronic Library: "Constant Flow, Variable Flow, and All the Space Between" http://www.i2sl.org/elibrary/index.html

Reducing HVAC Energy Use

Reduced Airflow

Low-pressure Ventilation

Efficient Thermal Process

Low Pressure Ventilation

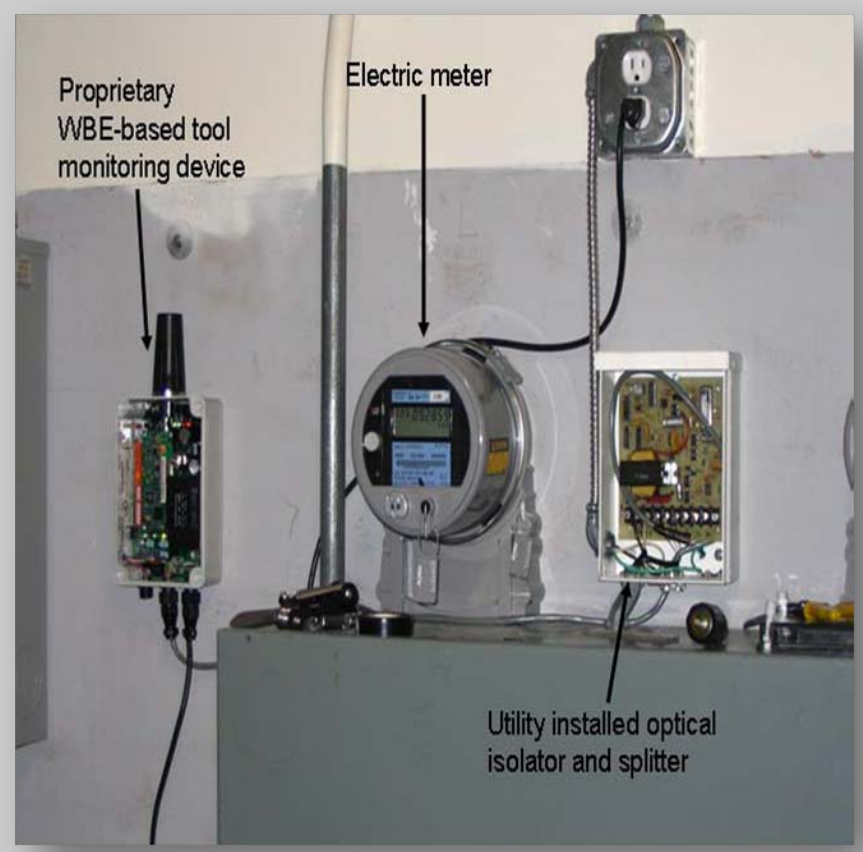
- Fans consume power proportional to flow and pressure
- Don’t waste energy pushing air through small holes
- Design low-pressure systems
  - Select components with low pressure losses
  - Labs21 Best Practice Guide: Low-pressure-drop HVAC Design for Laboratories

Low Pressure Ventilation

- Operate at low pressure: reset duct pressure
  - Vary duct pressure to match load
  - ASHRAE Energy Standard (90.1) requires it
  - Proven energy saver: ASHRAE Handbook, Applications 2007, pp 46.7
  - Labs21 Case Study: Fred Hutchinson Cancer Research Center

Measurement & Verification

- Measurement verifies goals are achieved
- Power meters and sub-meters to record consumption
- Logging and analysis equipment reports results

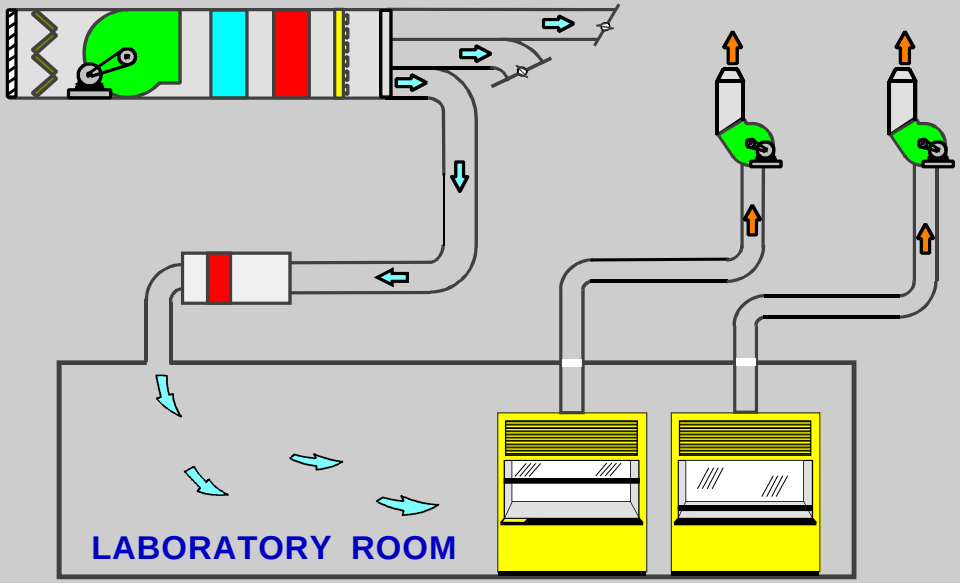


Tracking Energy Consumption

- Lab HVAC system uses:
  - fan power
  - chilled water
  - hot water
- Calculate cost of conditioned air
- Calculate cost of moving air

Where is the “Point Of Use”?

- Exhaust system
  - draws electricity at the fan motor
  - uses energy in rooms at the hoods
- Hot water system
  - burns gas at the boiler
  - uses energy at reheat coils



Which Should You Measure?

- Meter utility consumption to assess and track energy use
- Monitor functional use to understand and manage

Utility	Use	Cost
Steam	705 MLBS	$
Hot water	42844 MBTU	$
Ch water	1728 MBTU	$
Supply Air	188,002 MFT3	$
Exhaust Air	149,023 MFT#	$
Electricity	27783 kWh	$

Summary

- Lab HVAC energy reductions focus first on air flow rates ...
- Second, on system efficiency
- Energy management depends on metering energy consumption and ...
- Monitoring physical energy use