

BREATHING LIFE INTO NEW AND OLD BUILDINGS: DESIGNING FOR INDOOR AIR QUALITY

DEVENS ECO-EFFICIENCY CENTER


April 12, 2013

David W. Bearg, PE

LIFE ENERGY ASSOCIATES


A stylized, layered mountain range graphic in shades of teal and blue, located in the bottom right corner of the slide.

OPTIONS FOR IMPROVING THE HEALTH OF INDOOR ENVIRONMENTS

- 1) THE GEOMETRY OF AIR FLOW
THROUGH OCCUPIED SPACES
 - 2) USE OF ENERGY RECOVERY
VENTILATION
 - 3) ASSESSING VENTILATION
PERFORMANCE
- 
- A stylized, dark teal silhouette of a mountain range is located in the bottom right corner of the slide, partially overlapping the bottom edge of the text area.

YOU CAN'T MANAGE
WHAT YOU DON'T
MEASURE !!!

WHAT DO YOU WANT TO
MANAGE? and
WHAT DO YOU MEASURE?

A stylized, dark teal silhouette of a mountain range is located in the bottom right corner of the slide, partially overlapping the text area.

MANAGEMENT NEED FOR MEASUREMENT

- ◆ **VENTILATION EFFECTIVENESS**

- ◆ **MOISTURE CONTROL EFFECTIVENESS**


Measure: Carbon Dioxide Concentrations

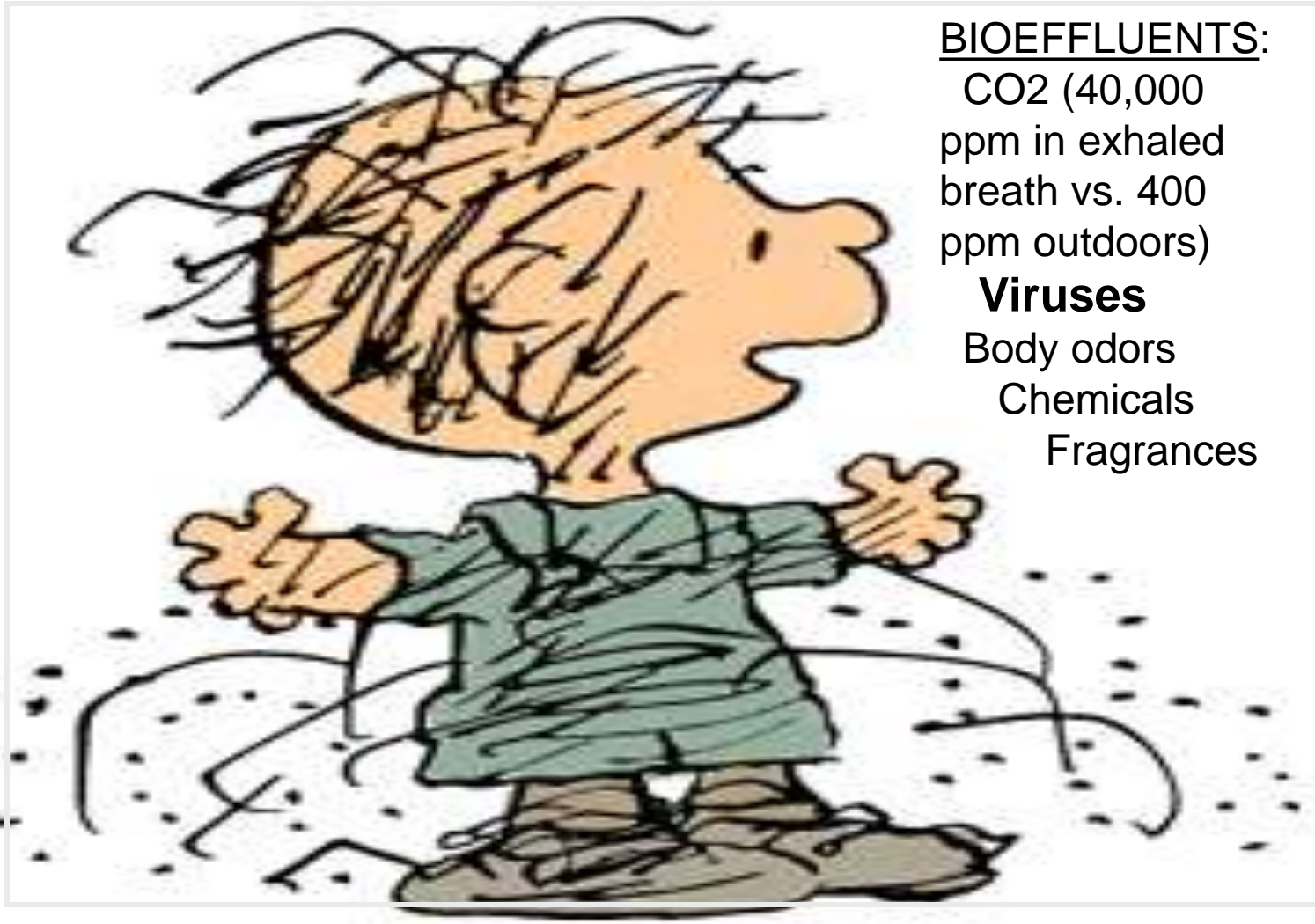
Measure: Dew Point Temperatures

A stylized, dark teal mountain range graphic is located in the bottom right corner of the slide, partially overlapping the text area.

Why Monitor Carbon Dioxide

Its concentrations over time reflect the dynamic interaction among the amount of VENTILATION provided and the people: their numbers, their duration of occupancy, and their activity level.

A stylized, dark teal silhouette of a mountain range is located in the bottom right corner of the slide, partially overlapping the text area.



BIOEFFLUENTS:

CO₂ (40,000
ppm in exhaled
breath vs. 400
ppm outdoors)

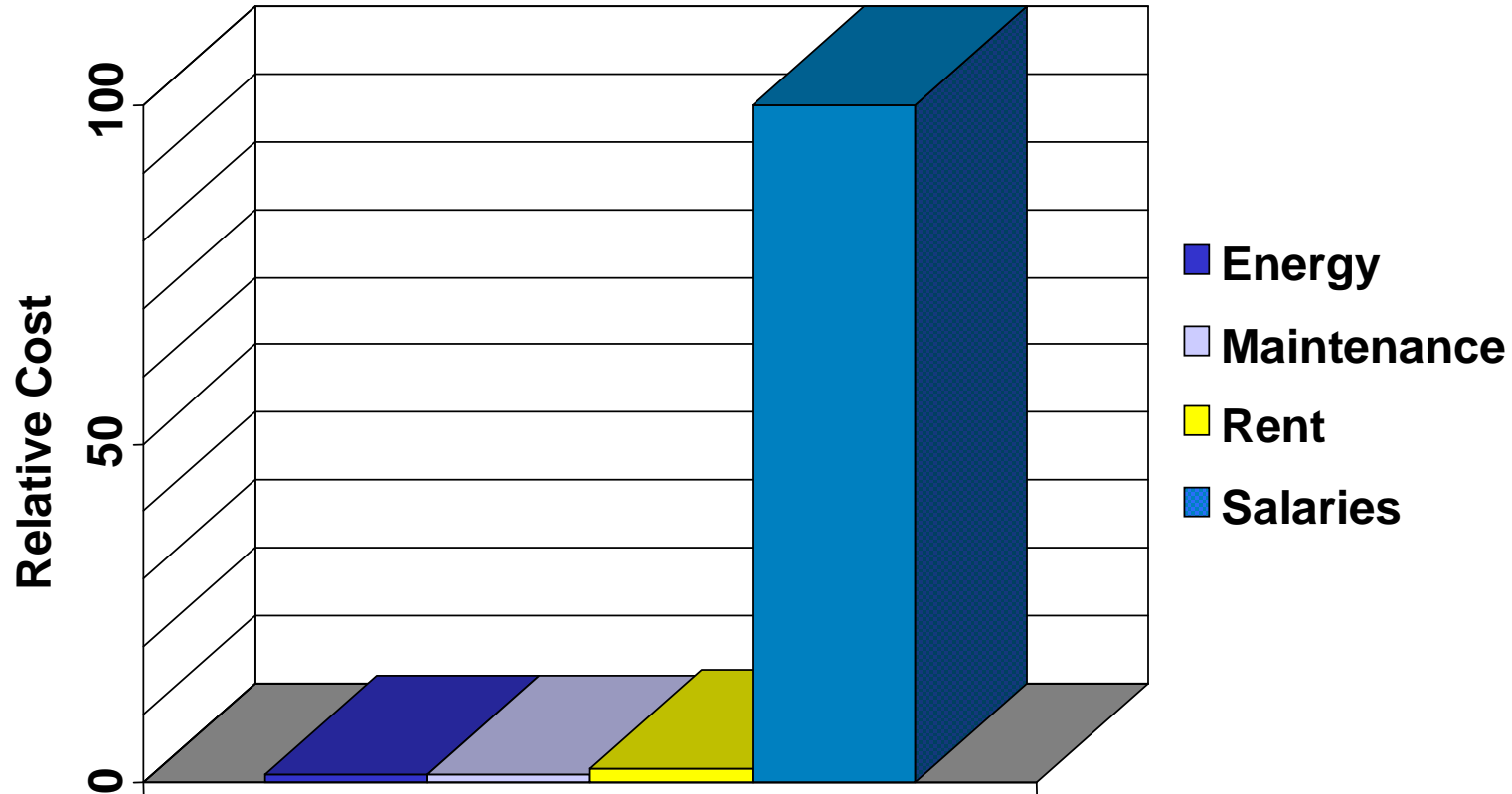
Viruses

Body odors

Chemicals

Fragrances

Importance of the people and productivity:



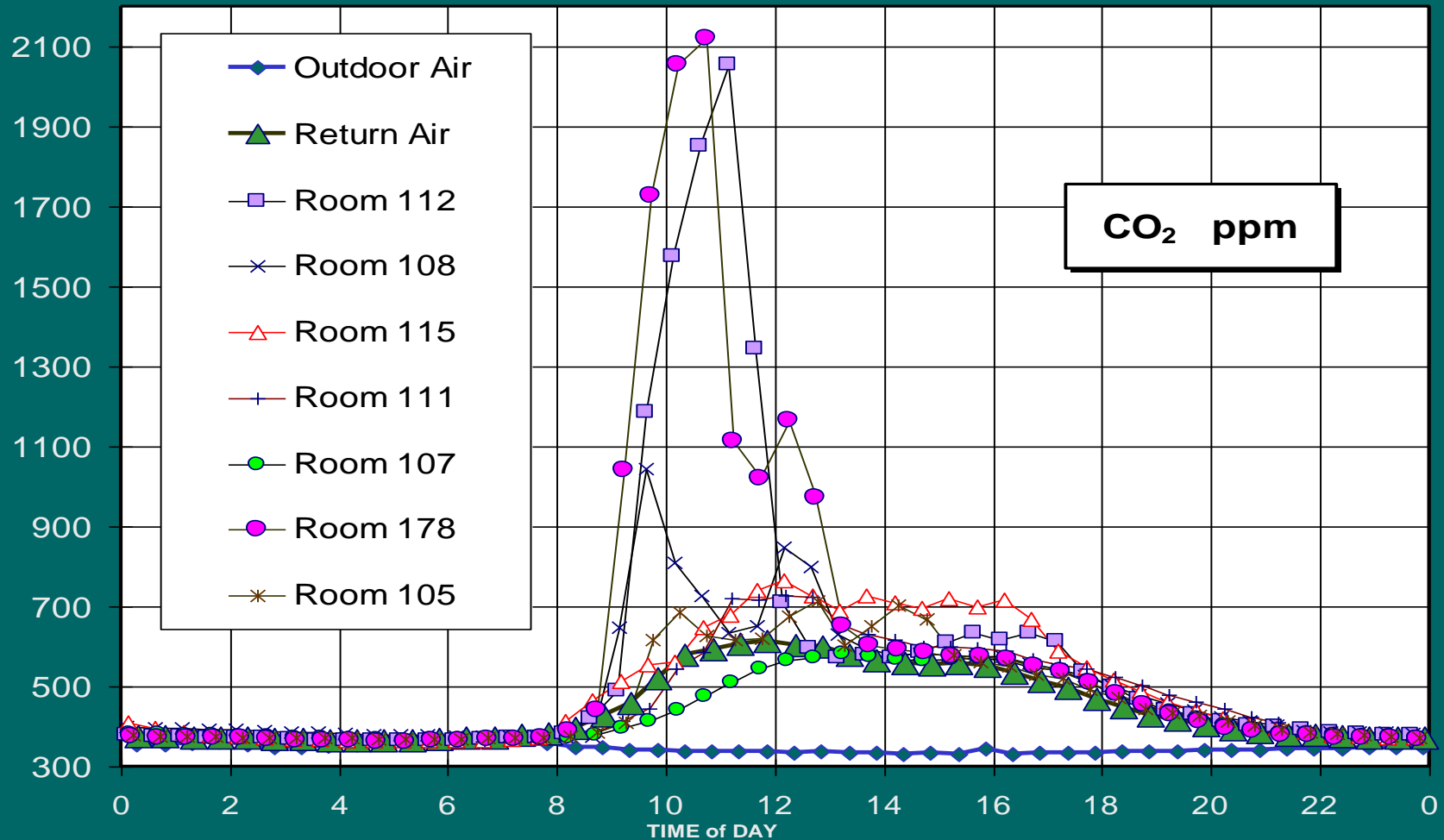
PEOPLE COSTS GREATLY EXCEED ENERGY COSTS

PITFALL TO AVOID: Return Air Monitoring

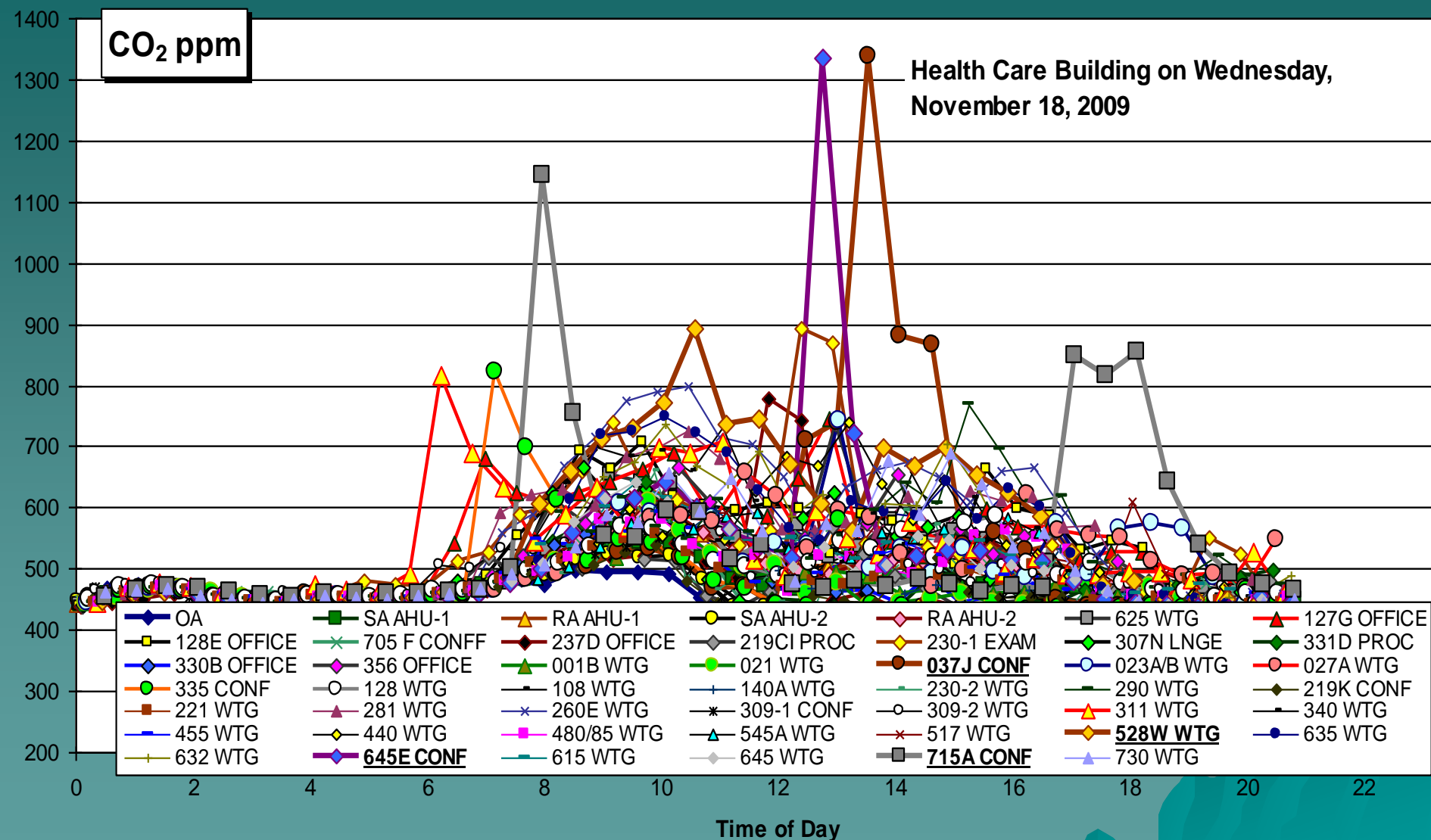
MONITORED OFFICE BUILDING "CS"

Locations served by AHU #2, July 2, 1997


IAQ DATAGRAPH



VAV BOXES SLOW TO OPEN => DEGRADED IAQ



DIAGNOSTIC FEEDBACK ON BUILDING OPERATION FROM CO₂ MONITORING

1. ASSESSMENT OF VENTILIATION DELIVERED TO THE OCCUPANTS: IDENTIFICATION OF DEFICIENCIES
 2. ASSESMENT OF DCV PERFORMANCE
 3. IDENTIFICATION OF POTENTIAL ENERGY SAVINGS
 4. ASSESSMENT OF OVERNIGHT PURGE
 5. ASSESSMENT OF %OA IN THE SA
- 
- A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, extending from the right edge towards the center.

MYTH: CO₂ SENSORS DON'T NEED CALIBRATION VERIFICATION

Logging and Review of Data Needed to Assess Performance



Figure 1.1-A

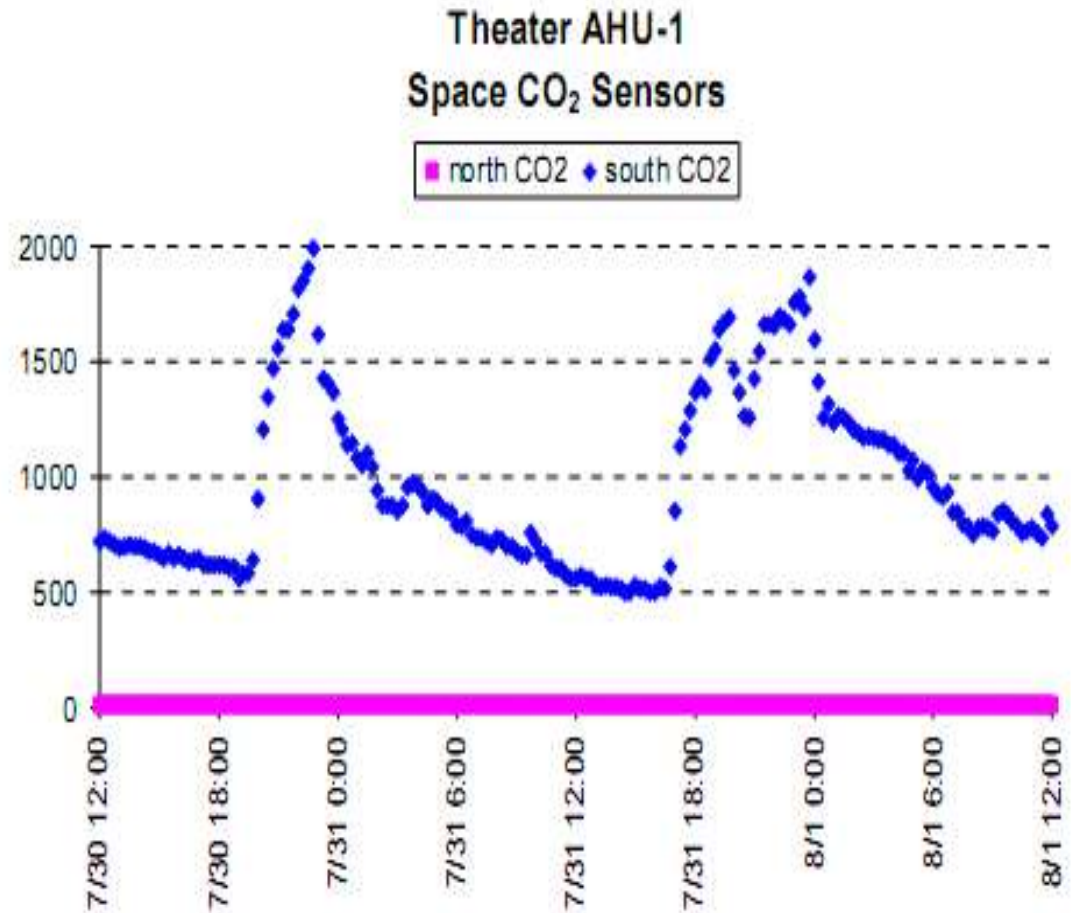
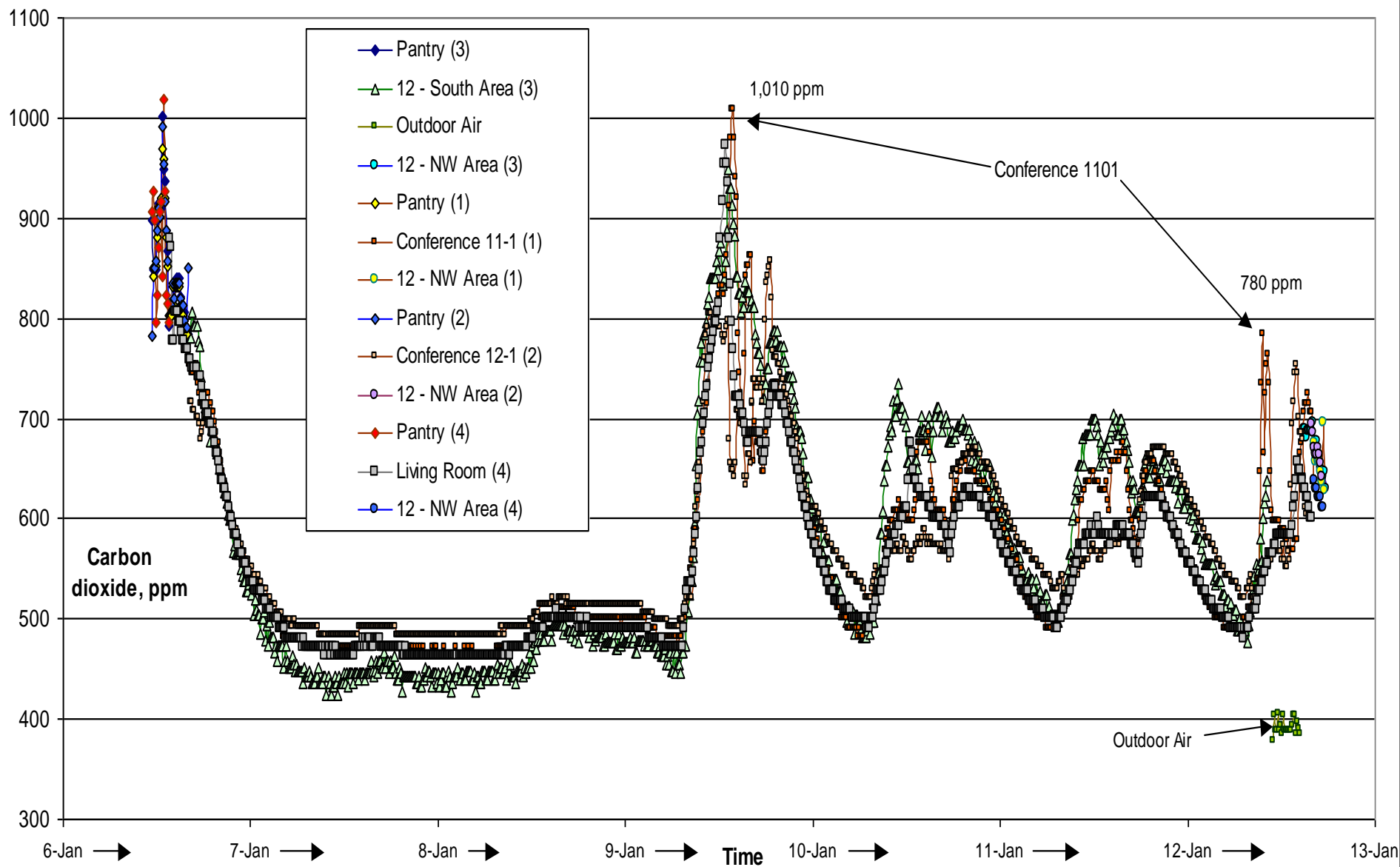
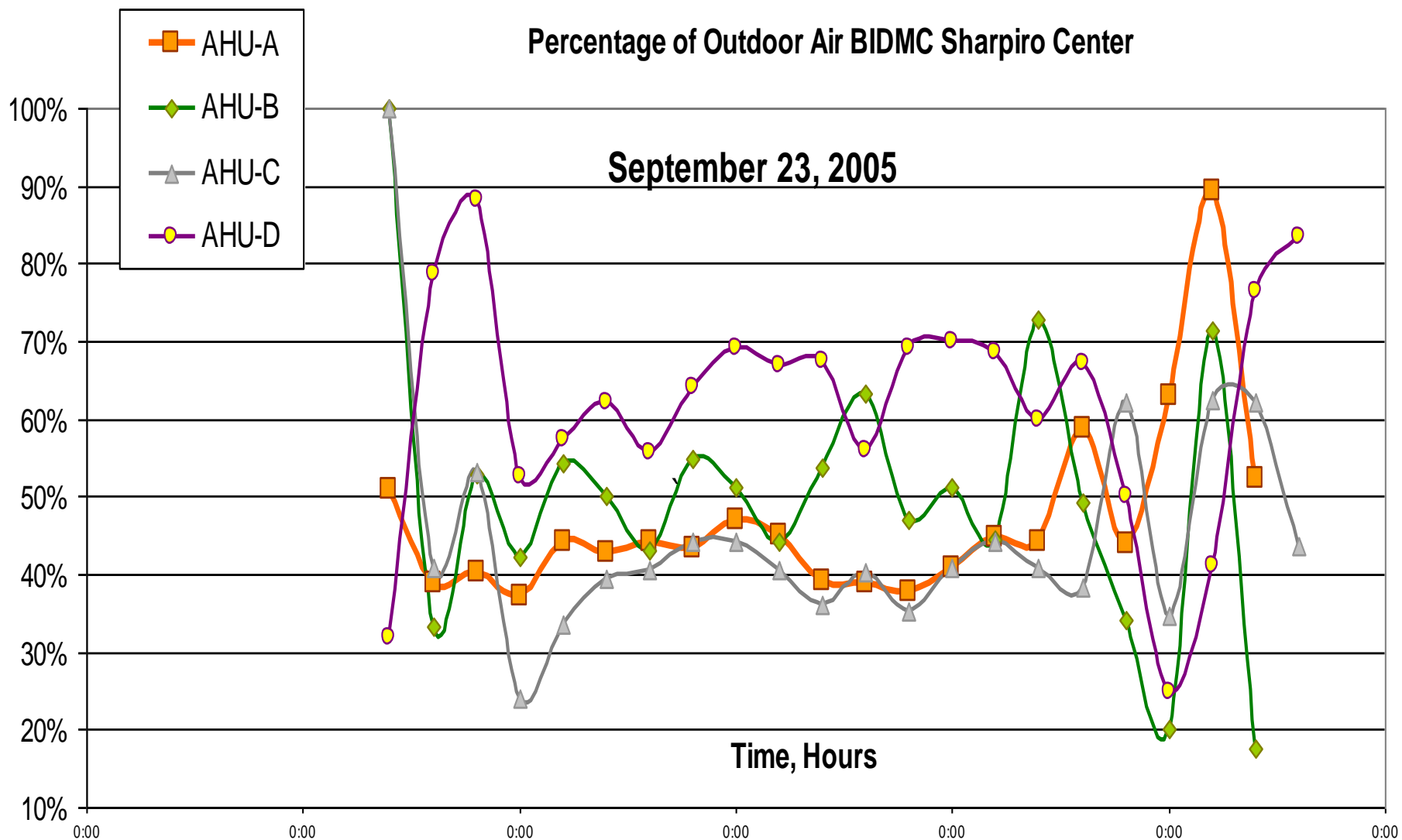


Figure 1.1-B

Incomplete Overnight Purge of Air Contaminants



Calculation of % of OA for each AHU from the SA, RA, and OA data



VENTILATION RATES IN EXCESS OF THE MINIMUMS LISTED IN ASHRAE Std 62 ARE NEEDED FOR A HEALTHY INDOORS

Underventilation cuts into the profit of employers!

In one study: Reduced absenteeism achieved with higher ventilation = \$480 per employee, BENEFIT

Cost of increased ventilation = \$80 per employee

NET BENEFIT = \$400 PER EMPLOYEE

Risk of Sick Leave Associated with Outdoor Air Supply Rate,
Humidification, and Occupant Complaints

Milton, Glencross and Walters

Indoor Air 2000; 10: 212-221

\$6 returned for every \$1
invested in increased
ventilation rates


Building Energy Use Trends:

1. Thermal envelopes are becoming more efficient (more insulation & less air leakage).
2. Lighting strategies are becoming more efficient (Daylighting).
3. Lower pressure drop HVAC designs are more efficient (increased cross-section of filter banks).
4. Plug loads are decreasing.
5. Conditioning outdoor air for ventilation is becoming a larger percentage of total building energy use.

Why Monitor Dew Point

**Reducing Risk & Uncertainty in
HVAC Operation by assessing
MOISTURE MANAGEMENT
PERFORMANCE**

**Poor Moisture Management can
waste energy and degrade
IAQ.**

A stylized, layered mountain range graphic in shades of teal and blue, located in the bottom right corner of the slide.

Monitoring of dew point:

Diagnostic feedback on –

Dehumidification performance,

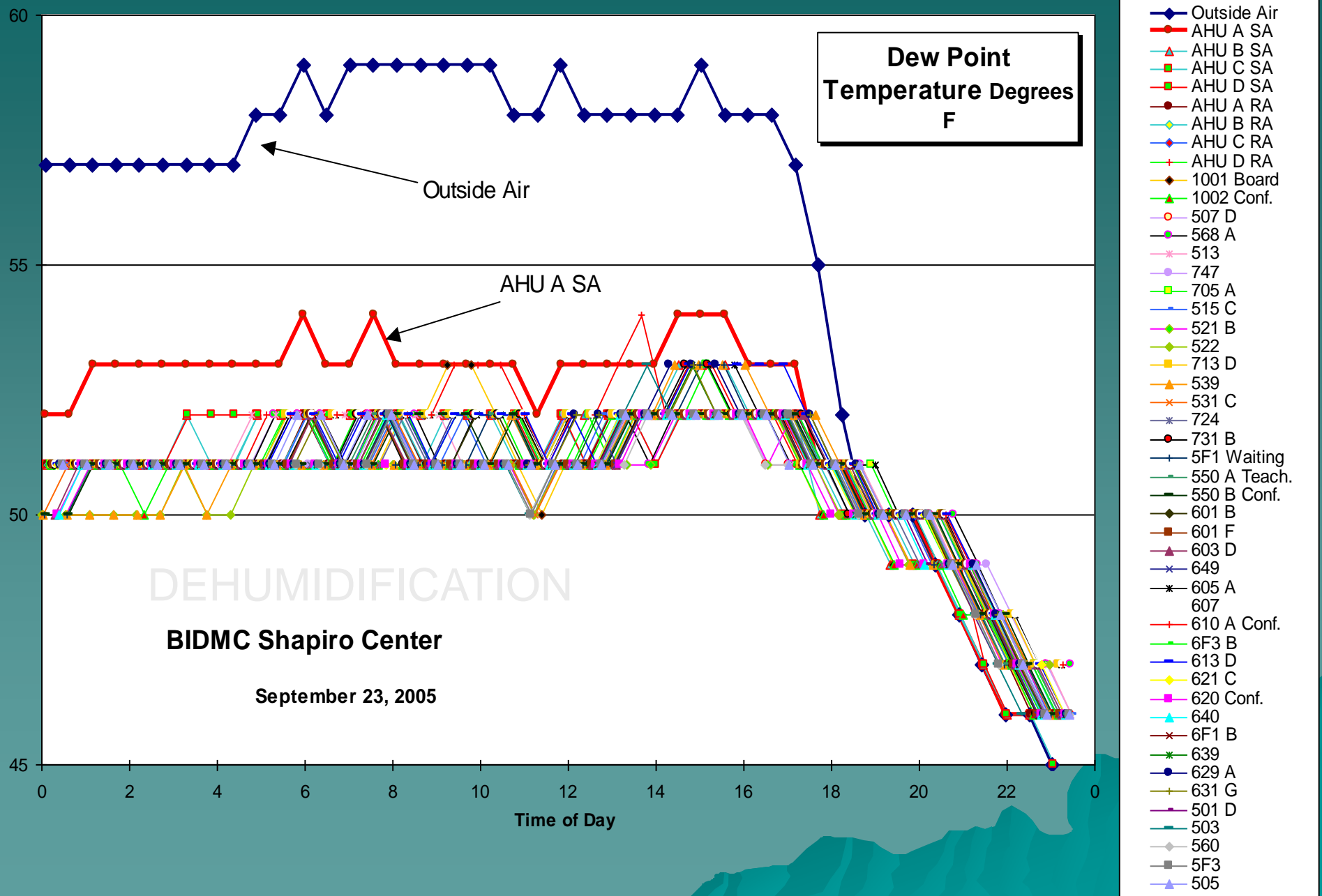
Humidification performance,

Presence of interior moisture leaks or
moisture intrusions through the
building envelope,

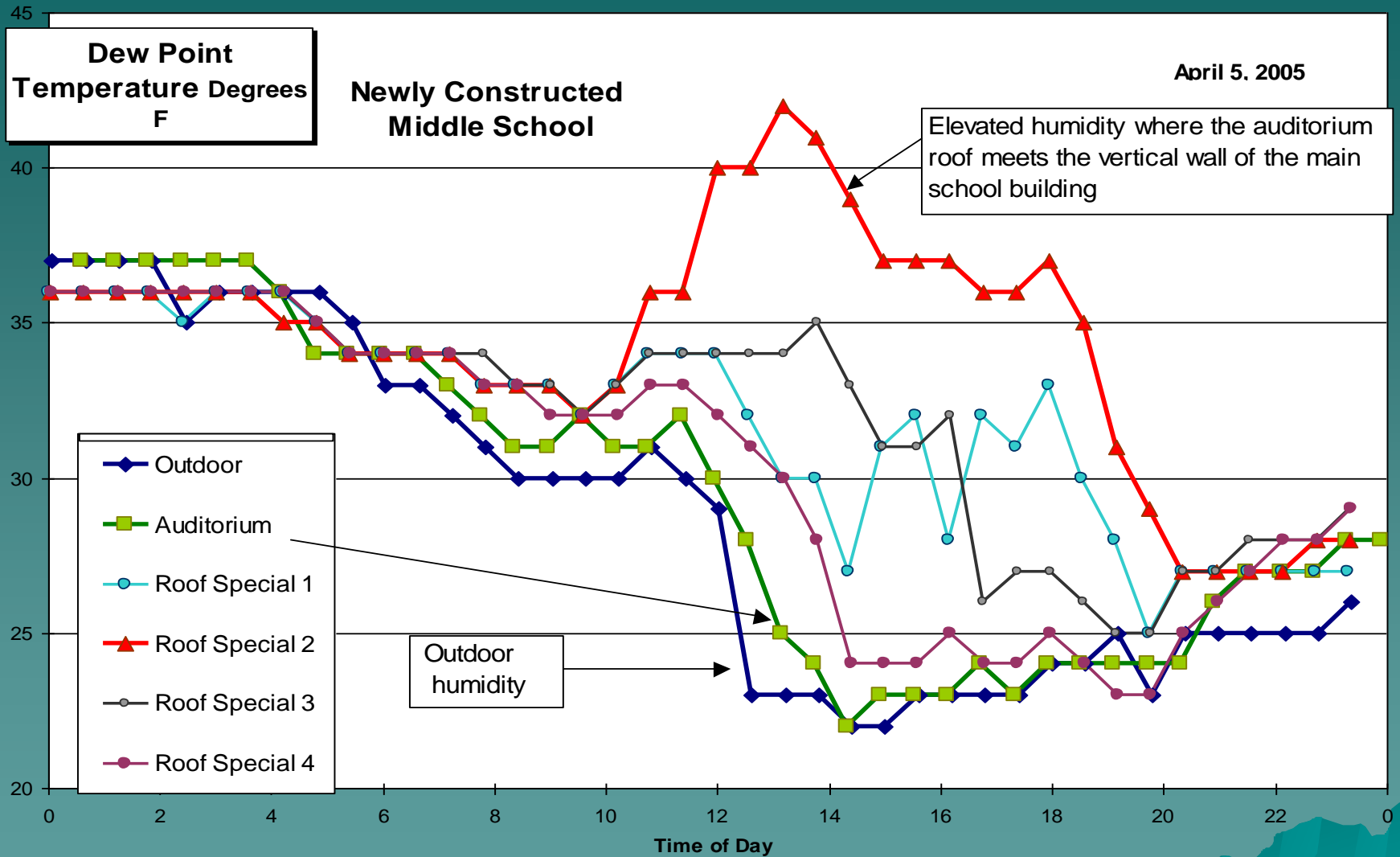
=> Balancing IAQ with Energy Use

A stylized, dark teal mountain range graphic is located in the bottom right corner of the slide, partially overlapping the text.

HVAC Monitoring, Accuracy & Confidence: Shared-Sensor Approach



Moisture Management & IAQ: Water Intrusion Evaluation



IMPROVED MANAGEMENT OF THE INDOOR ENVIRONMENT

◆ VENTILATION EFFECTIVENESS

◆ MOISTURE CONTROL EFFECTIVENESS

Measure: Carbon Dioxide Concentrations

Measure: Dew Point Temperatures

A stylized, layered mountain range graphic in shades of teal and blue, located in the bottom right corner of the slide.