



**HEATING VENTILATING
& AIR CONDITIONING
FOR SCHOOLS**

Richard Lord

United Technologies – Carrier Corporation

HVAC AND SCHOOLS

- Most schools today include some type of heating, ventilating, and air conditions system
- The purpose of these systems are:
 - Conditioning of the air (cooling and heating)
 - Control of humidity (removal and addition of moisture)
 - Air purification (filtration and pollutant removal)
 - Ventilation
- They also provide other secondary functions;
 - Noise control
 - Energy management control
 - Diagnostics and communications
- HVAC is a major user of energy and studies have shown that commercial buildings use 65% of the nations electricity and account for over 36% of total energy usage so efficiency has a very important role

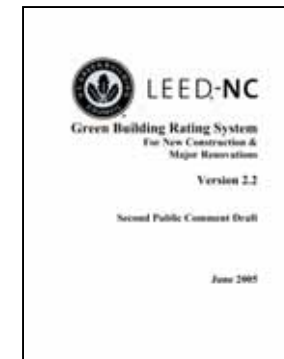
NEW INDUSTRY REQUIREMENTS/TRENDS

- In the next 5 years you will see significant changes in the building and HVAC industry regulations that will impact new school constructions and retrofit applications
 - Elimination of the all Chlorine bearing refrigerants by 2010 (HCFC's)
 - New federal minimum efficiency requirements in 2010 (5-15% increase)
 - Part load efficiency
 - System level efficiencies
 - Indoor and outdoor sound requirements
 - Ventilation requirements (ASHRAE 62.1)
 - Energy Policy Act of 2005
 - Green Building Initiatives
 - Moisture Control
 - System commissioning and maintenance
- We will still face a very cost driven industry where school funding is closely controlled.

GREEN BUILDING INITIATIVES

- New programs are being developed which encourage new and novel approaches to building construction like the LEED program

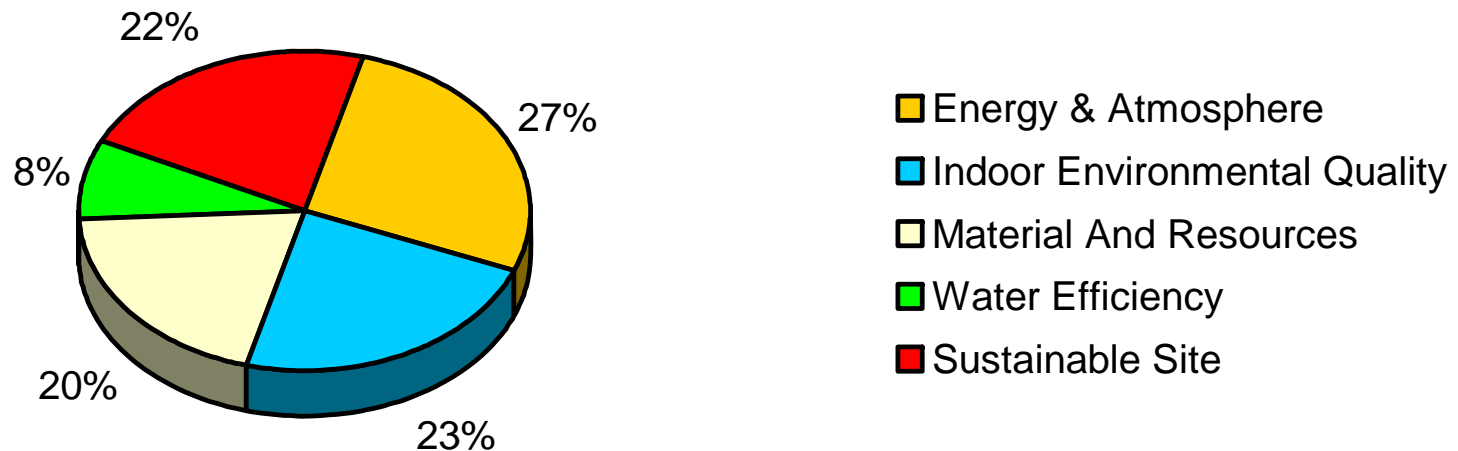
- Leadership in
- Energy and
- Environmental
- Design



- The LEED (Leadership in Energy and Environmental Design) Green Building Rating System® is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings using a point system.
- It is supported by the U.S. Green Building Council which representing all segments of the building industry

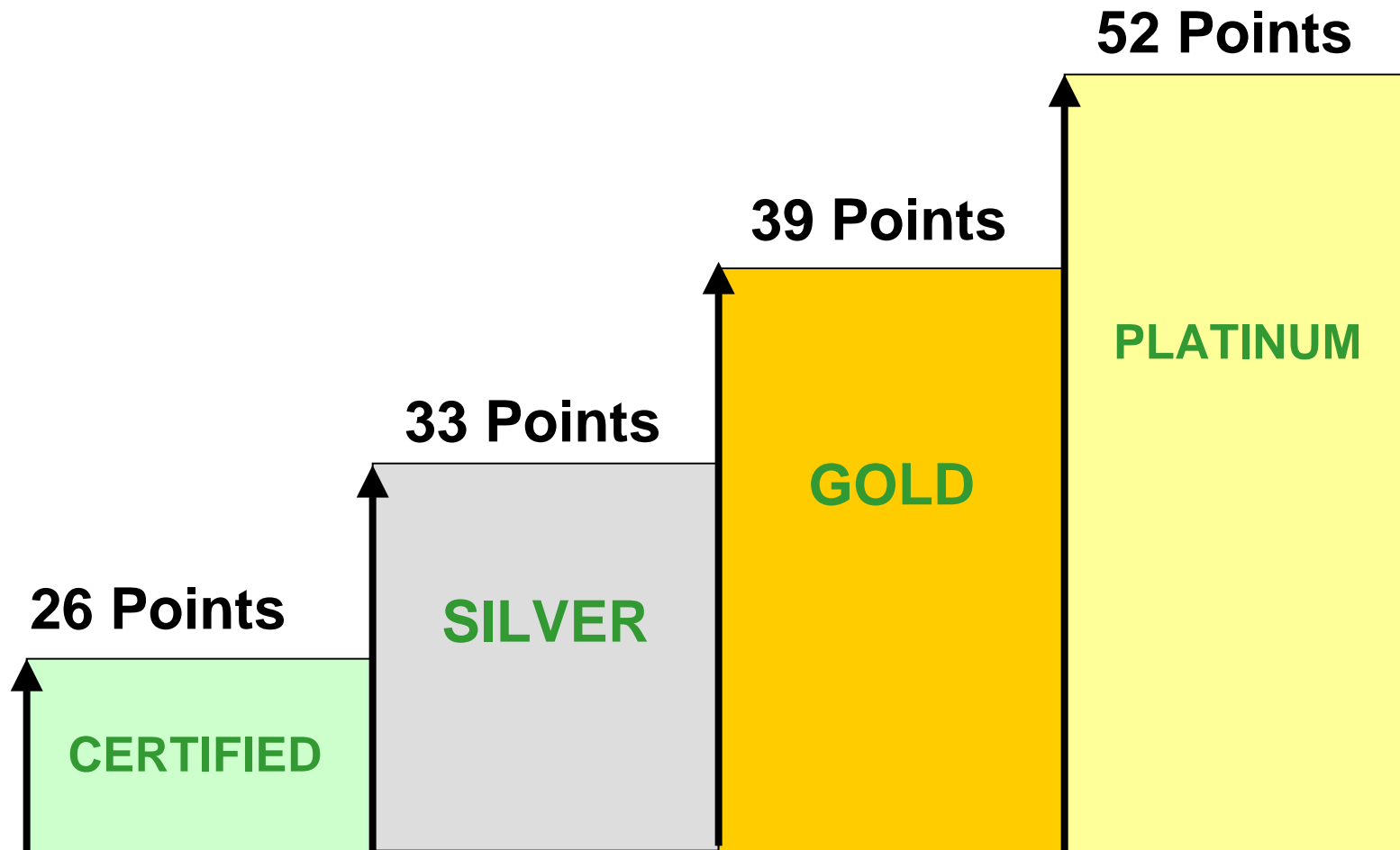
LEED PROGRAM CATEGORIES

- The chart shows the five categories evaluated in LEED certification, and the percentage of total possible points each category accounts for.
- HVAC-related categories (Energy & Atmosphere and Indoor Air Quality) account for half of the possible points. Energy & Atmosphere, which encompasses ASHRAE 90.1 compliance, is the largest of the categories.



LEED RATING SYSTEM

Four levels of certification



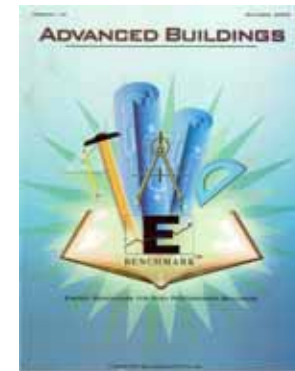
SYSTEM DESIGN APPROACH

- There are also many new guidelines and tools being developed to encourage approaching the development of high efficiency buildings at the system level

- ASHRAE Green Building Guidelines



- New Building Institute Advanced Building Design Guide



- New Energy Modeling tools like DOE2.2, Blast, Energyplus



SYSTEM DESIGN APPROACH

- Approaching the school design at the overall system level opens new opportunities to reduce Energy, use of resources, and to provide better comfort
- It requires close cooperation between all disciplines involved in building design and construction
- New Technologies being considered;
 - System level energy management
 - Remote diagnostics and monitoring
 - Hybrid systems (ERV combined with HVAC system)
 - Energy recovery and reuse
 - Daylighting
 - New Air distribution systems
 - Active shading
 - Improved air filters (particulate removal and VOC's)
 - Demand Ventilation

ADVANCED SCHOOL DESIGN EXAMPLE

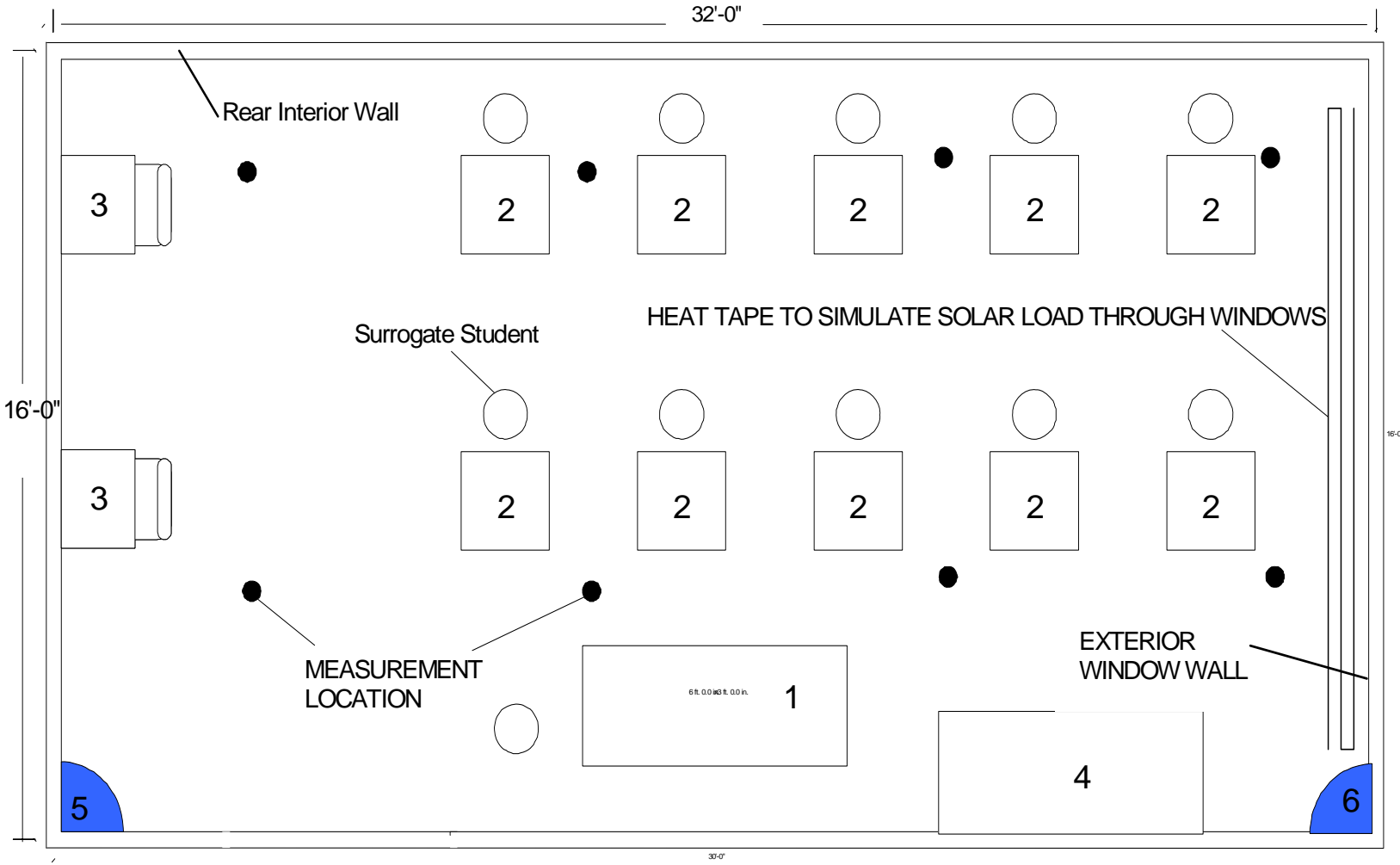


Advanced HVAC Systems for Improving Indoor Environmental Quality and Energy Performance of California K-12 Schools

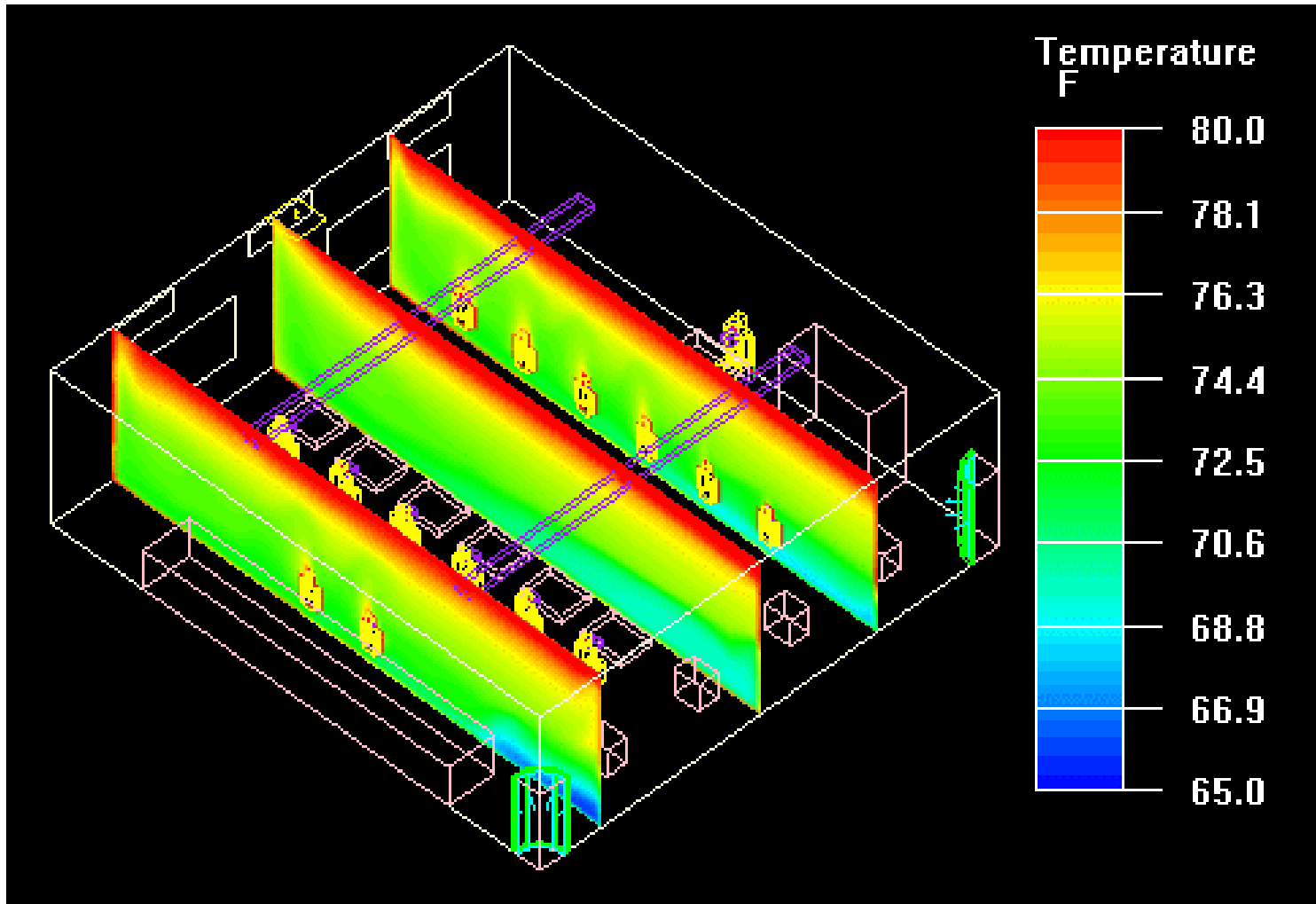
**Project 2: Thermal Displacement
Ventilation in Schools**



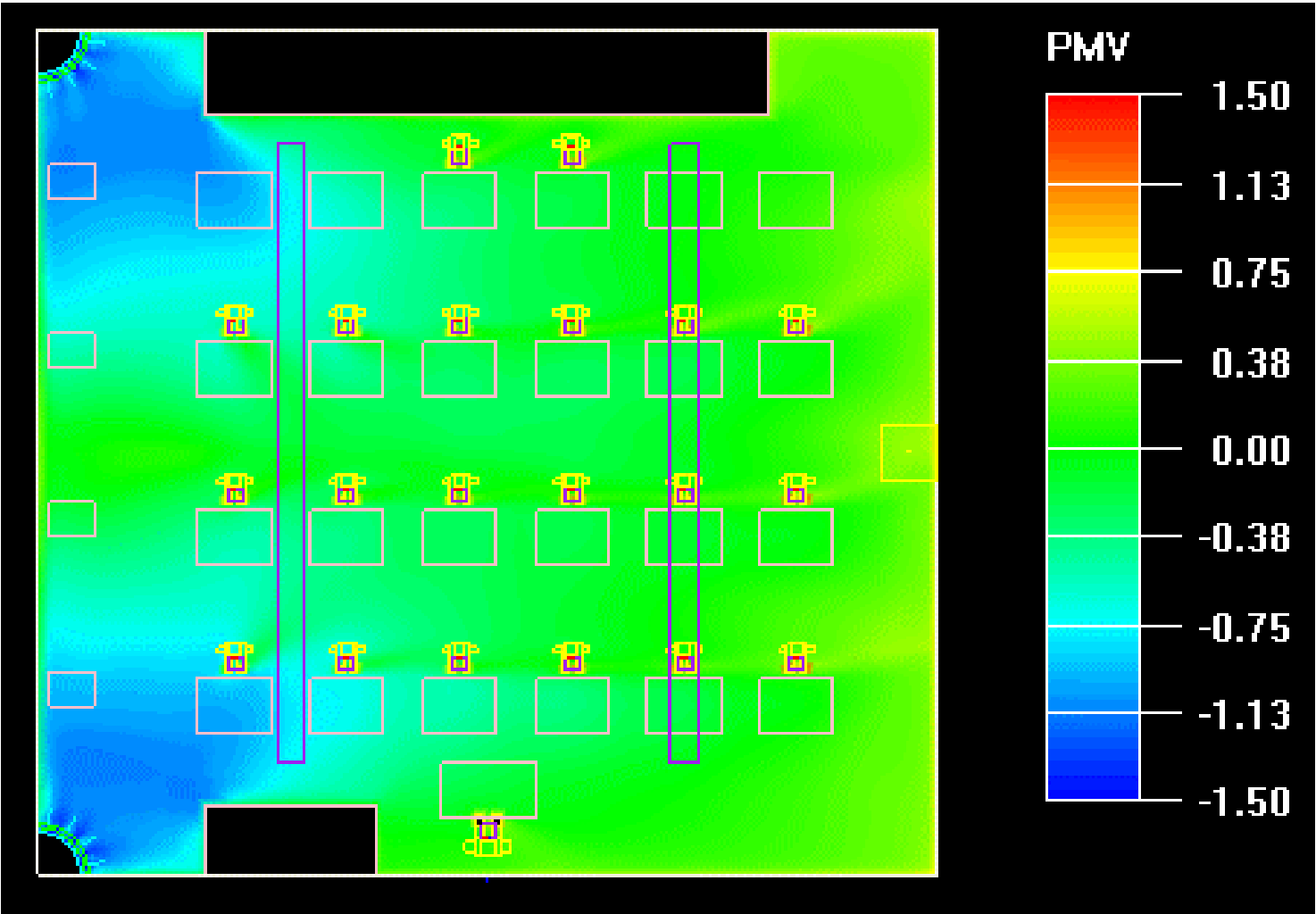
MOCKUP TEST LAB LAYOUT

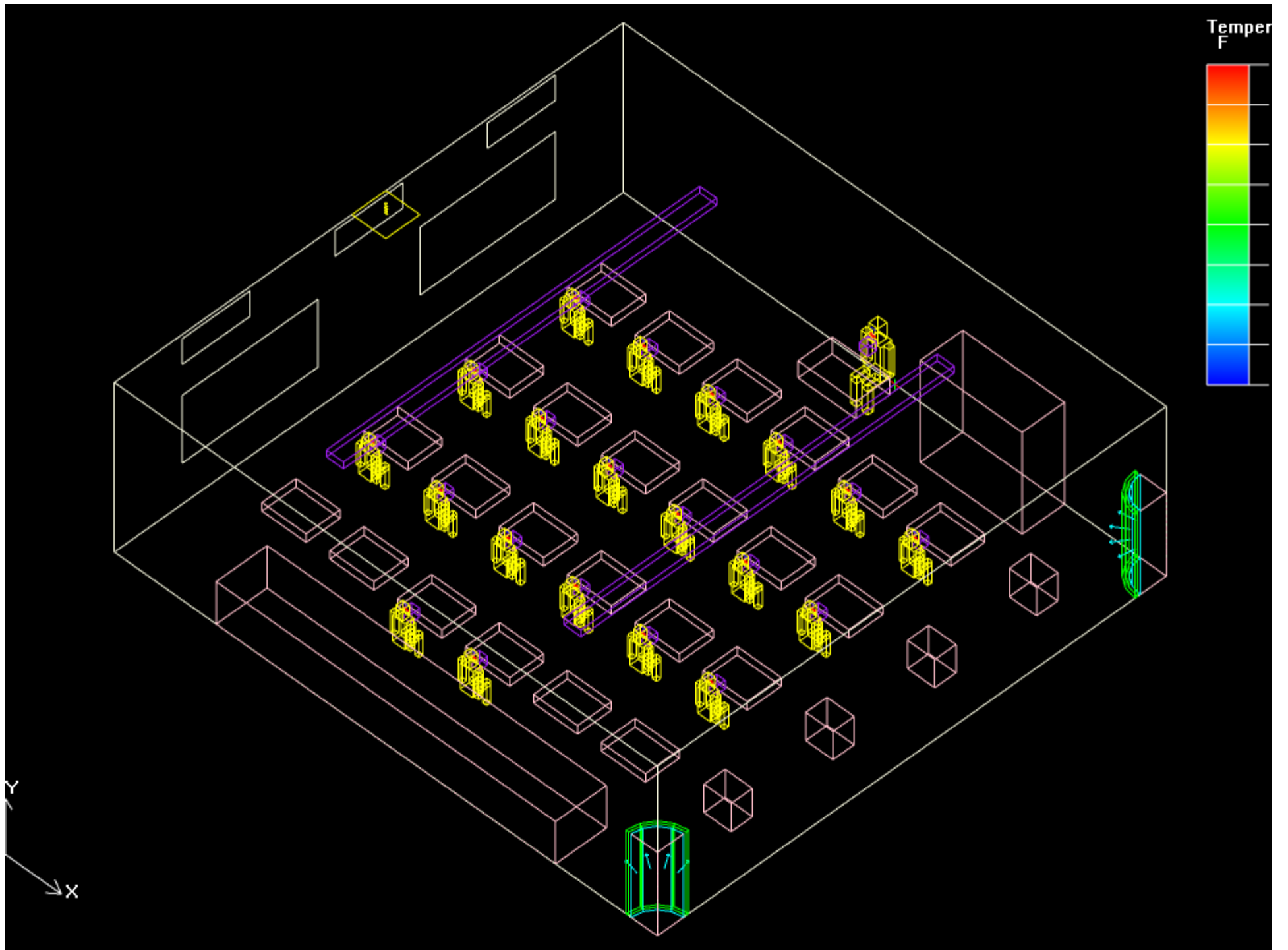


TEMPERATURE DISTRIBUTION MODELING

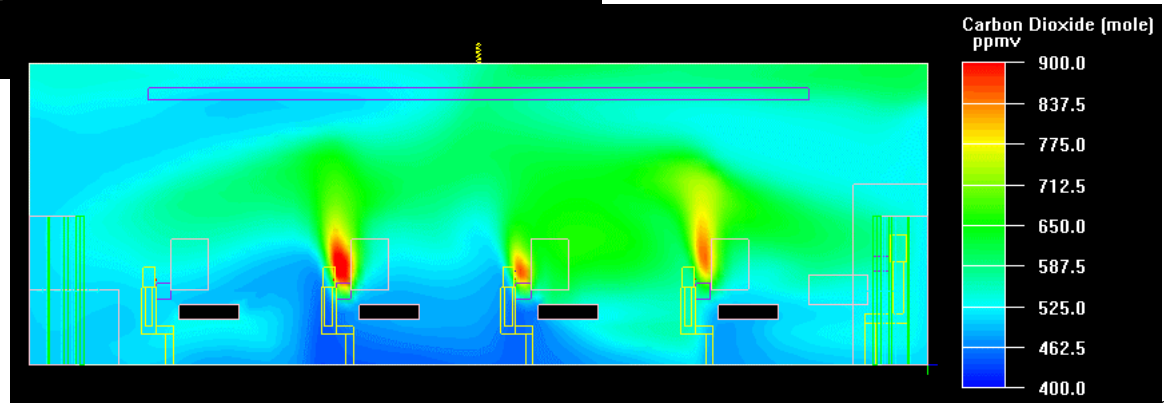
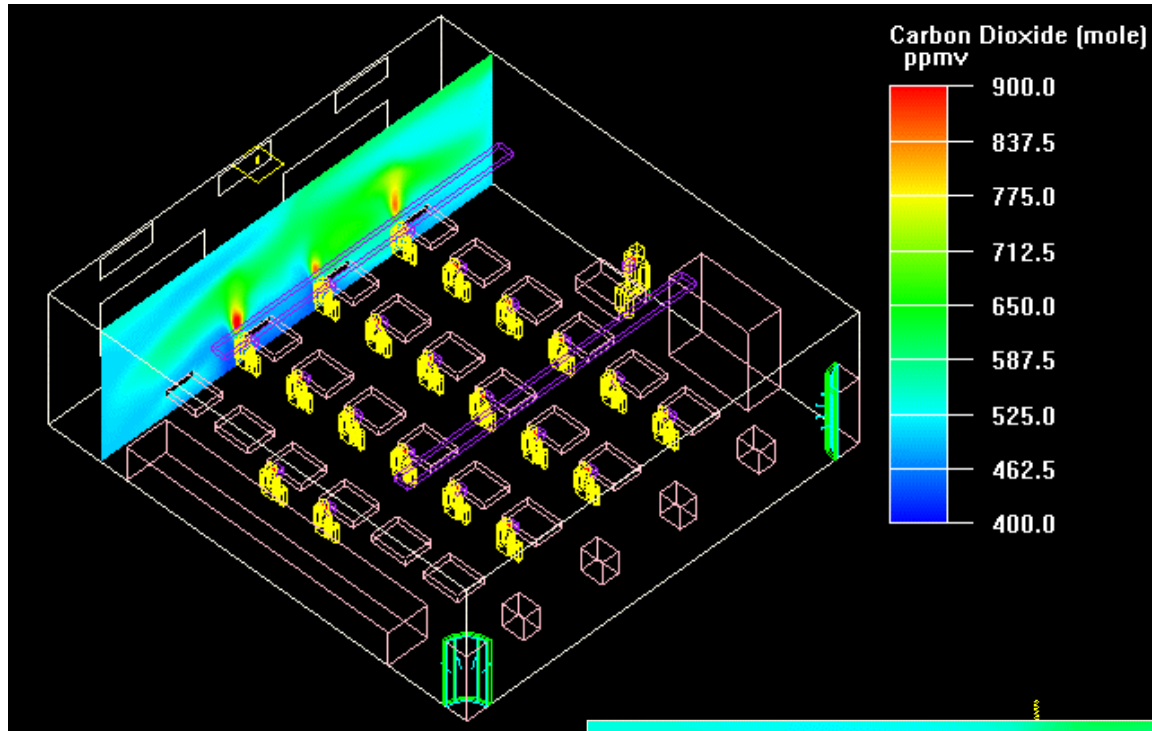


TEMPERATURE DISTRIBUTION MODELING





CO₂ MODELING

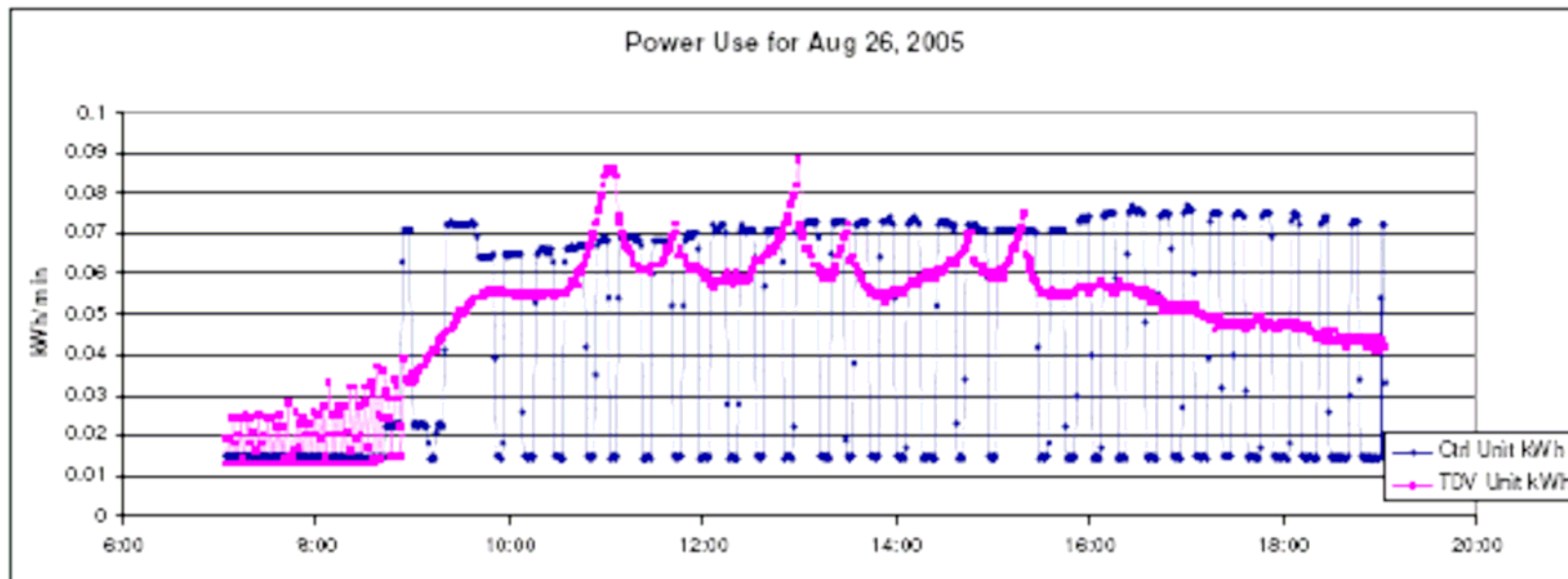


FIELD TRIAL TDV SYSTEM EVALUATION



REMOTE MONITORING AND CONTROL

- With electronics and the internet we now can monitor and control units remotely
- The following is an example of data obtained from the Kinoshita School that allows us to improve the control logic as well as monitoring energy and IAQ



QUESTIONS AND DISCUSSION