Field Verification of an Integrated Active Desiccant Hybrid Rooftop at a Georgia School

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Hybrid Rooftop in Georgia School

Outline

- Site description and background
- Retrofitting description
- Desiccant hybrid features
- Performance data after retrofit
- Conclusions

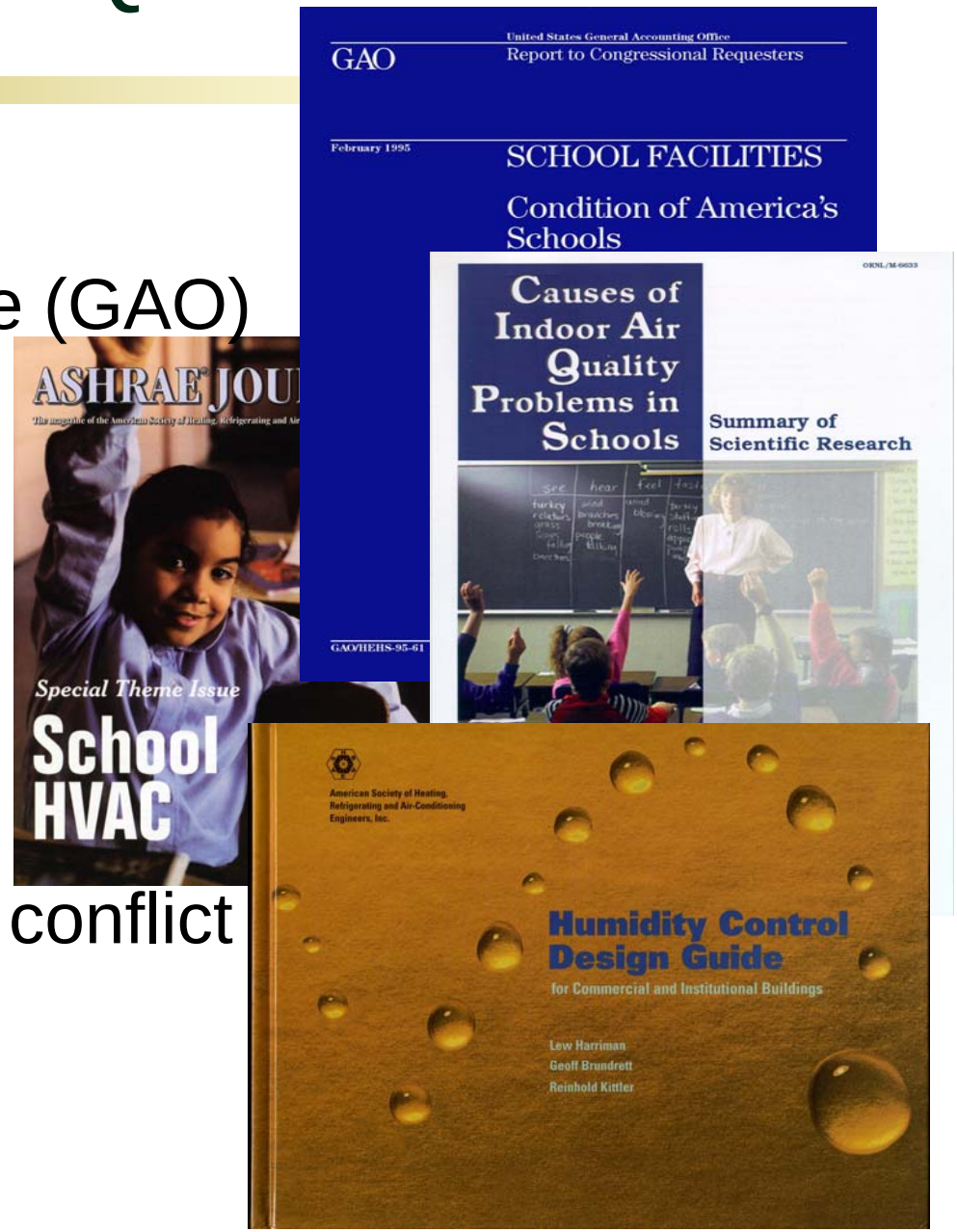
Hybrid Rooftop in Georgia School

Objectives and Scope

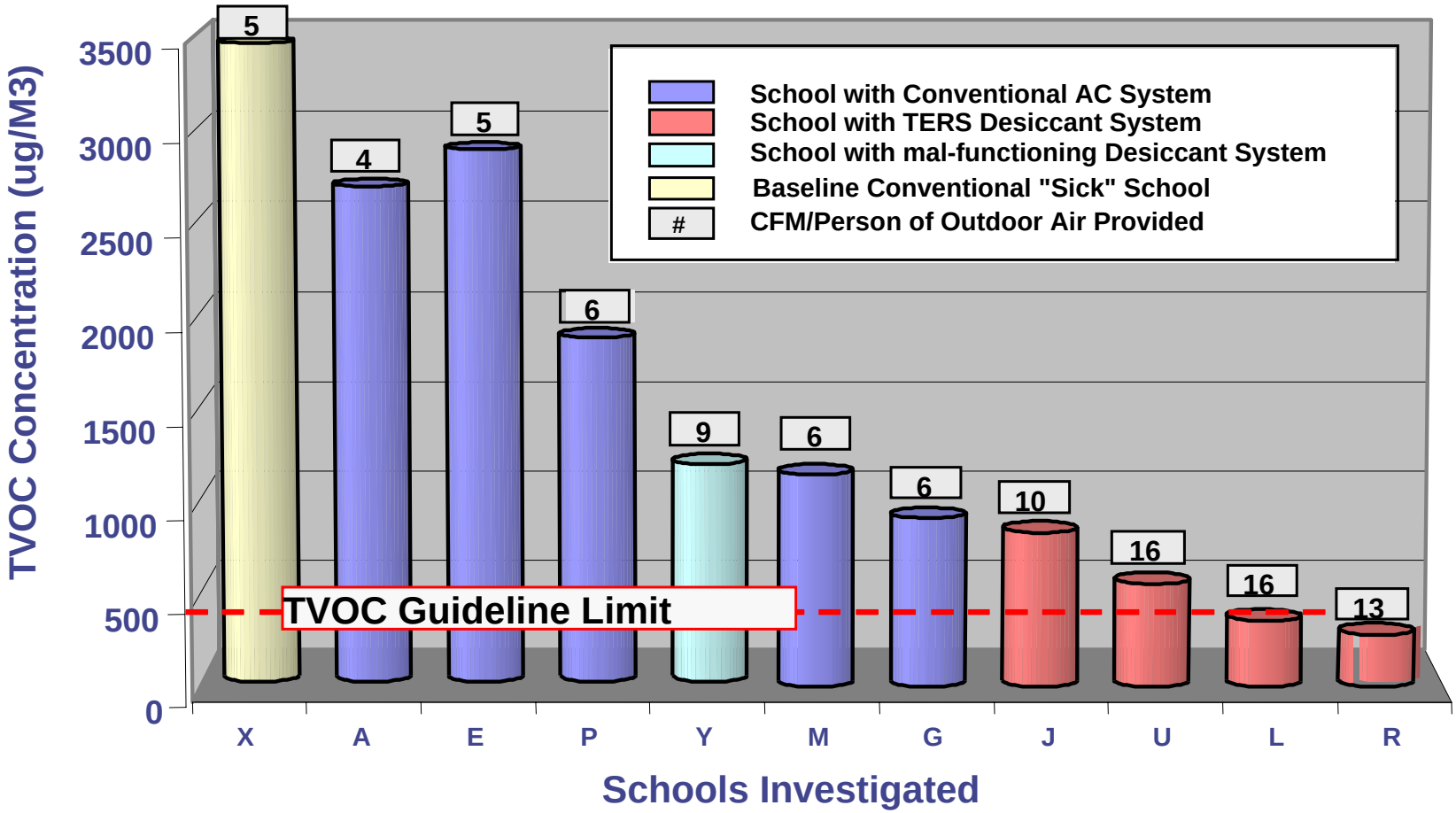
- Apply new Dedicated Outdoor Air System (DOAS)/ VAV Total Conditioning System to school with known IAQ problems
  - Document IAQ improvements after retrofit
  - Track energy use
  - Track economics

Ventilation/IAQ in Schools

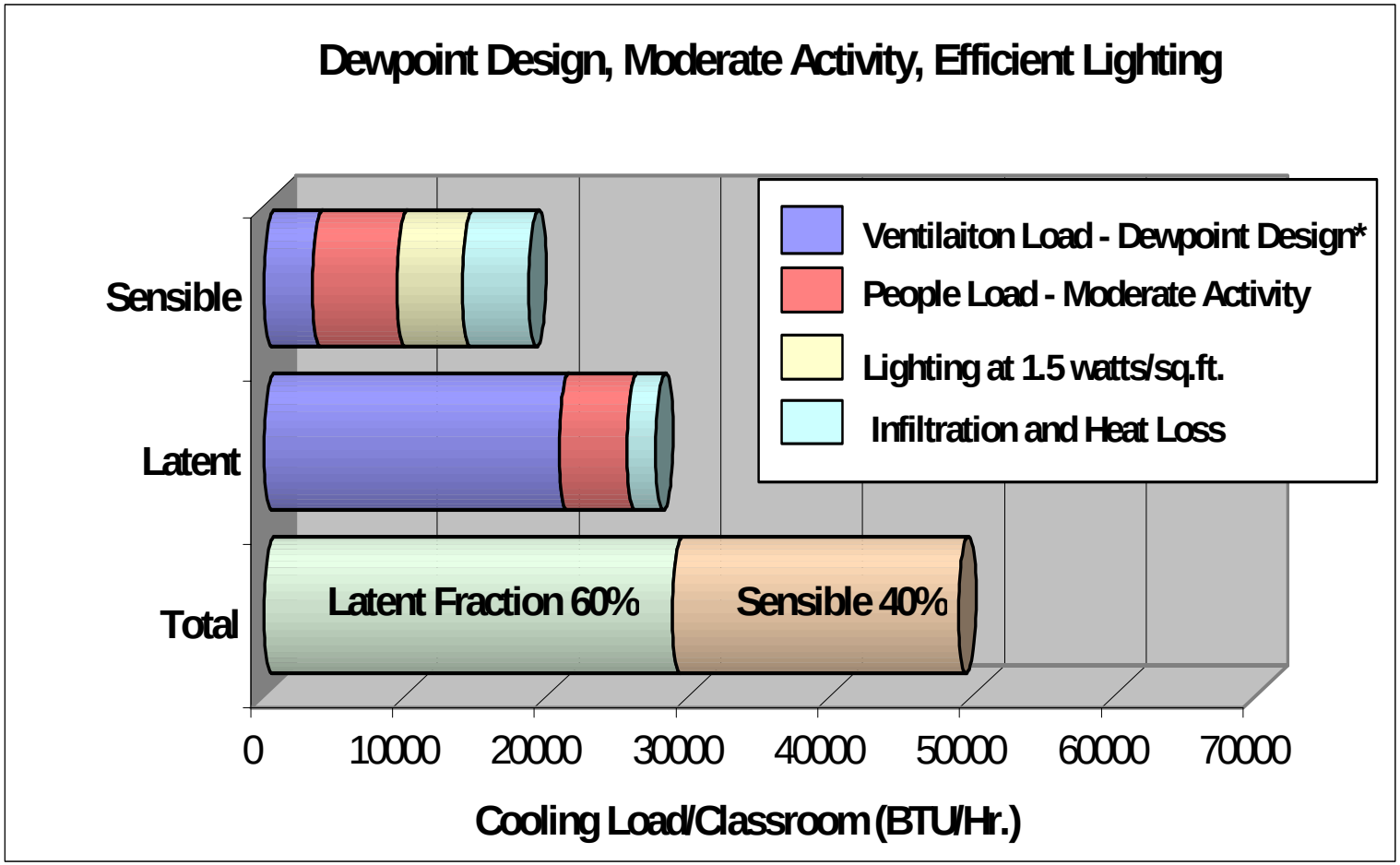
- Gov't Accounting Office (GAO) report
- Other research studies
- Economics/Right thing conflict



Ventilation & IAQ Link



What's the Problem?



Retrofit School

Old HVAC System Description

- 15-years old
- High Capacity rooftop system with VAV boxes serving 19 zones
  - Classrooms - Hallways - Storage rooms
- No zone reheat (economy)
- IAQ complaints
  - Outside air cut off (periodic discomfort)
  - Room dehumidifiers installed

Retrofit School

Old HVAC System Description

- **System selected supplied 62°F air at required OA ventilation rates**
  - **Satisfied temperature, but 80% RH**
  - **Outdoor air dampers closed**

- **After, system supplied 55 °F air air**
  - **Humidity improved**
  - **Overcooled at minimum VAV setting**
  - **Mold**
  - **Room dehumidifiers**

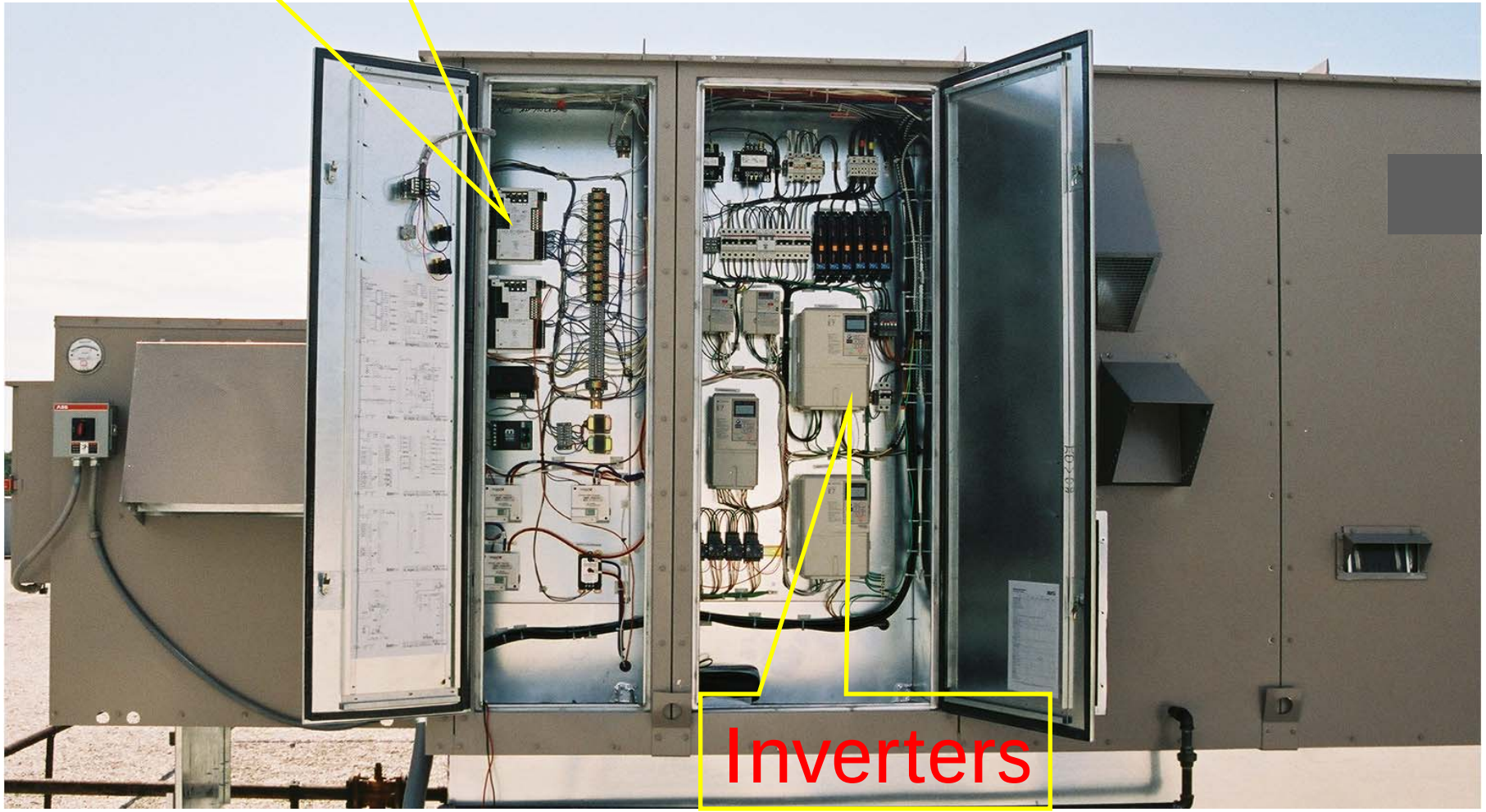
Old, 30-ton Rooftop

Retrofit Unit Being Installed

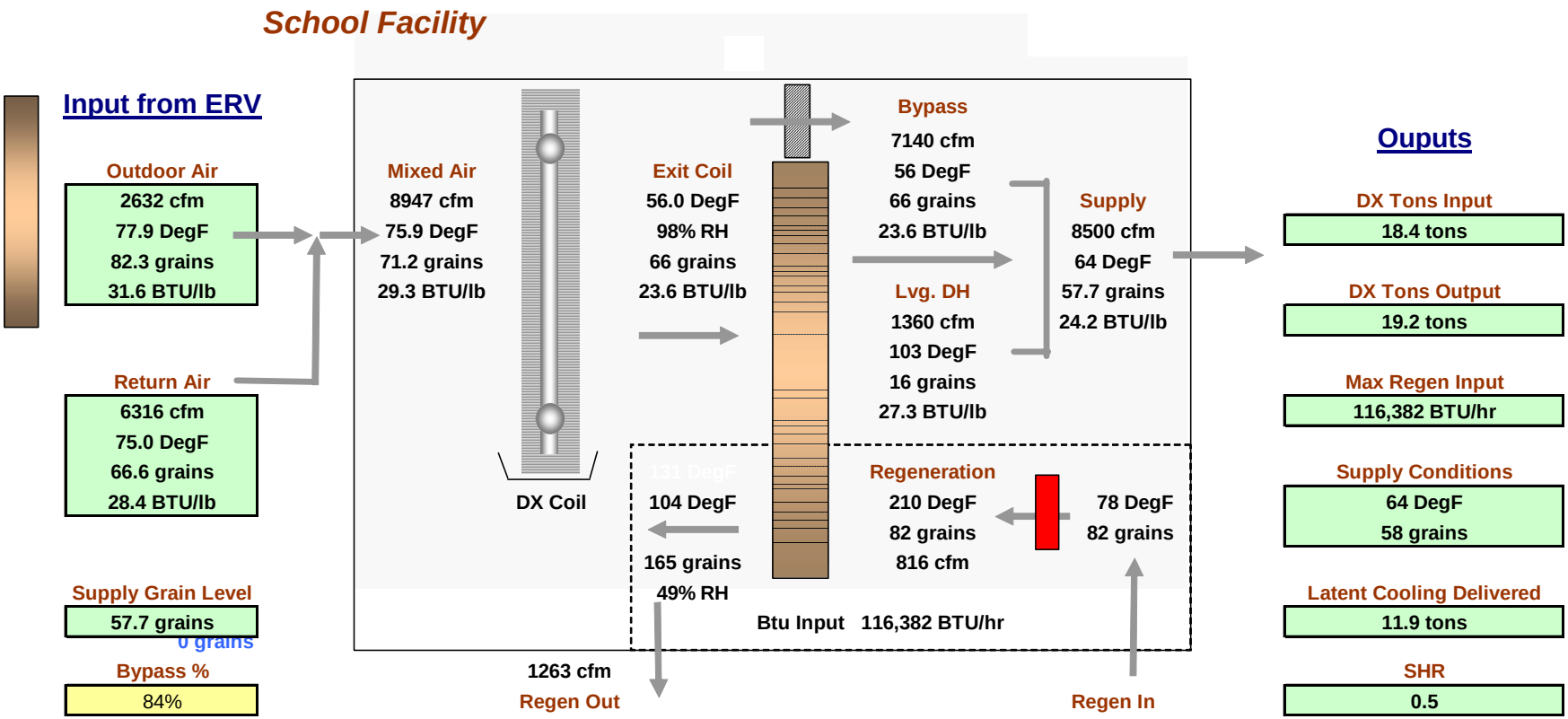
Retrofit Unit fitted with Energy Recovery Ventilator (ERV)

Vapor-Compression — Active-Desiccant Hybrid Design

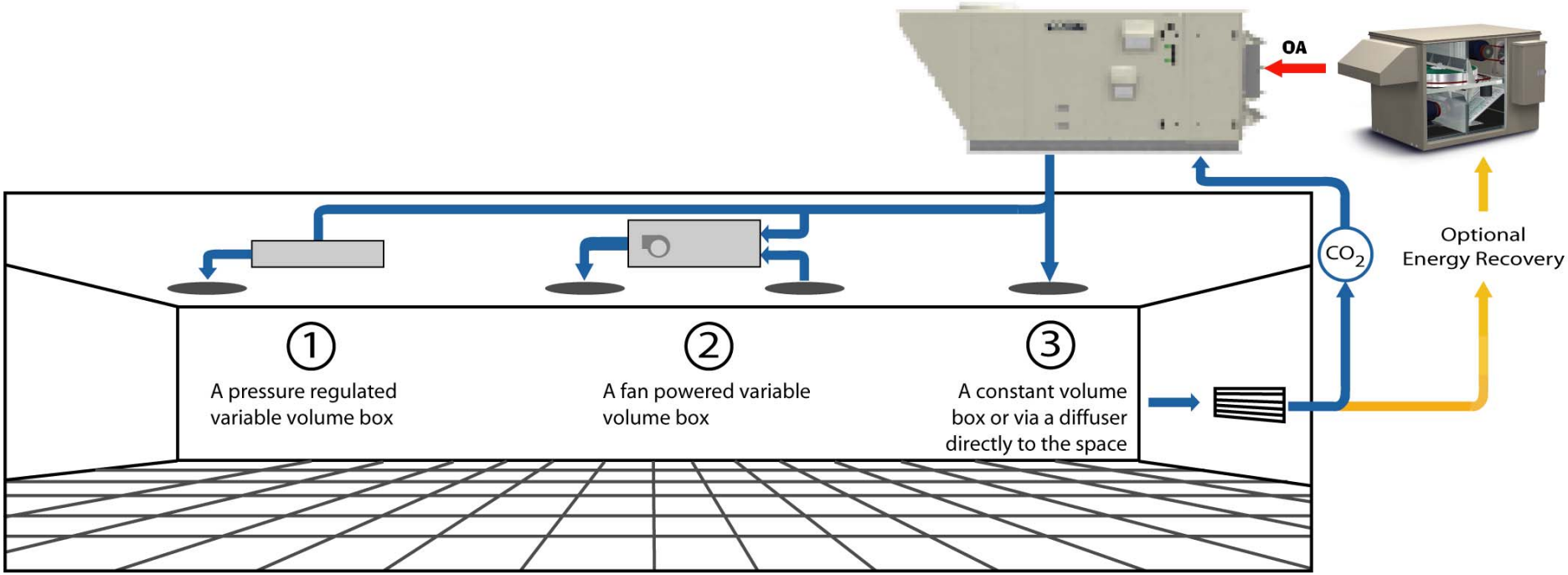
Controls/Inverters Panel



Schematic of Hybrid System at Part-Load Conditions



Hybrid Rooftop used as VAV:Total Conditioning System



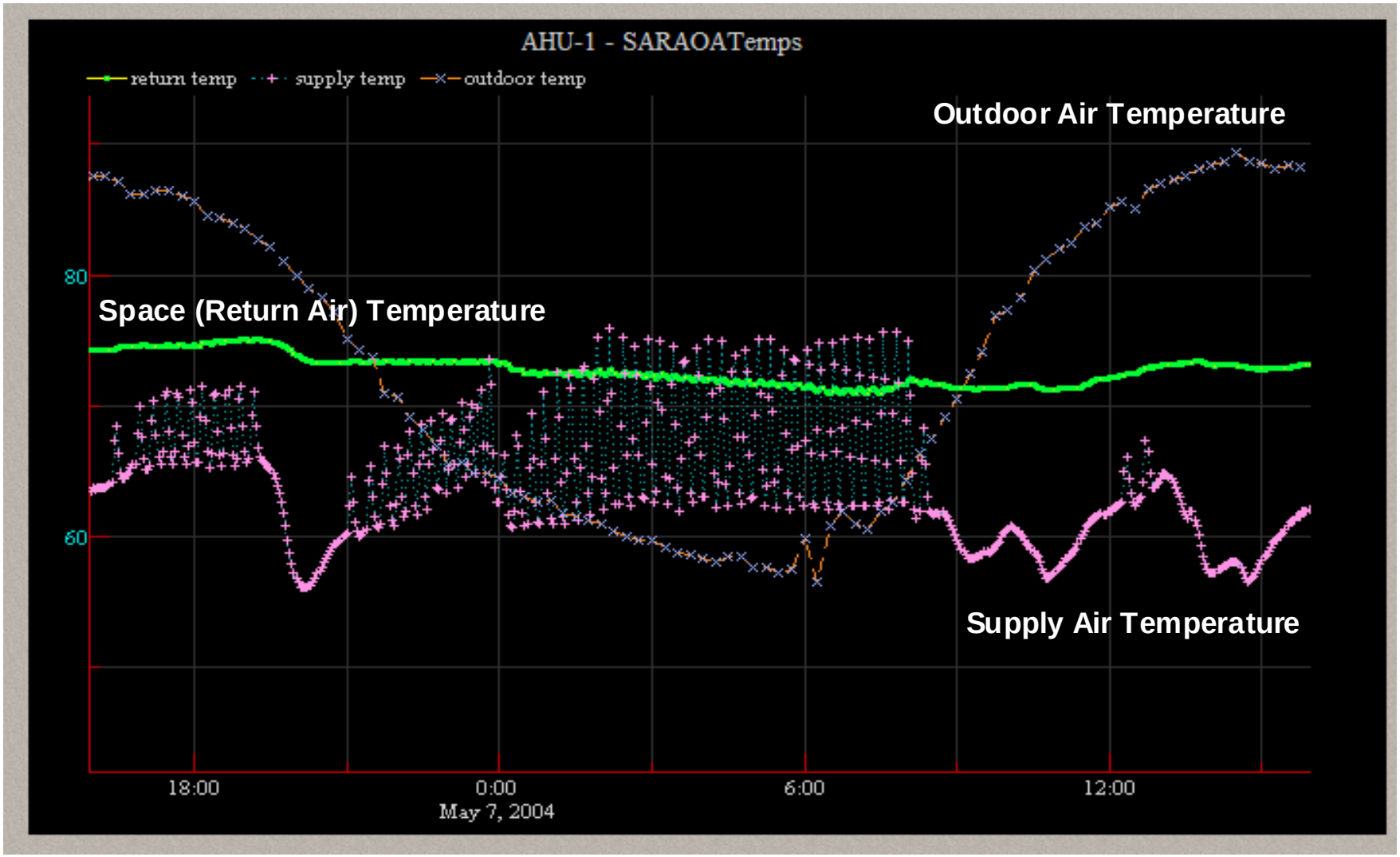
Benefits of Hybrid Approach

- **Lowest cost retrofit that solves site's problems**
- **Low operating costs**
  - **Low dew point air at high coil temperatures**
  - **Exceptional EER cooling - inverter driven**
  - **High thermostat setting - low humidity**
  - **"Desiccant-Only" operation on cool/humid days**
  - **Real-time, continuous performance monitoring**
- **Classroom IAQ Maintained**
  - **Recommended ventilation rate**
  - **Precise humidity control**
- **Happy/Healthy students and teachers**

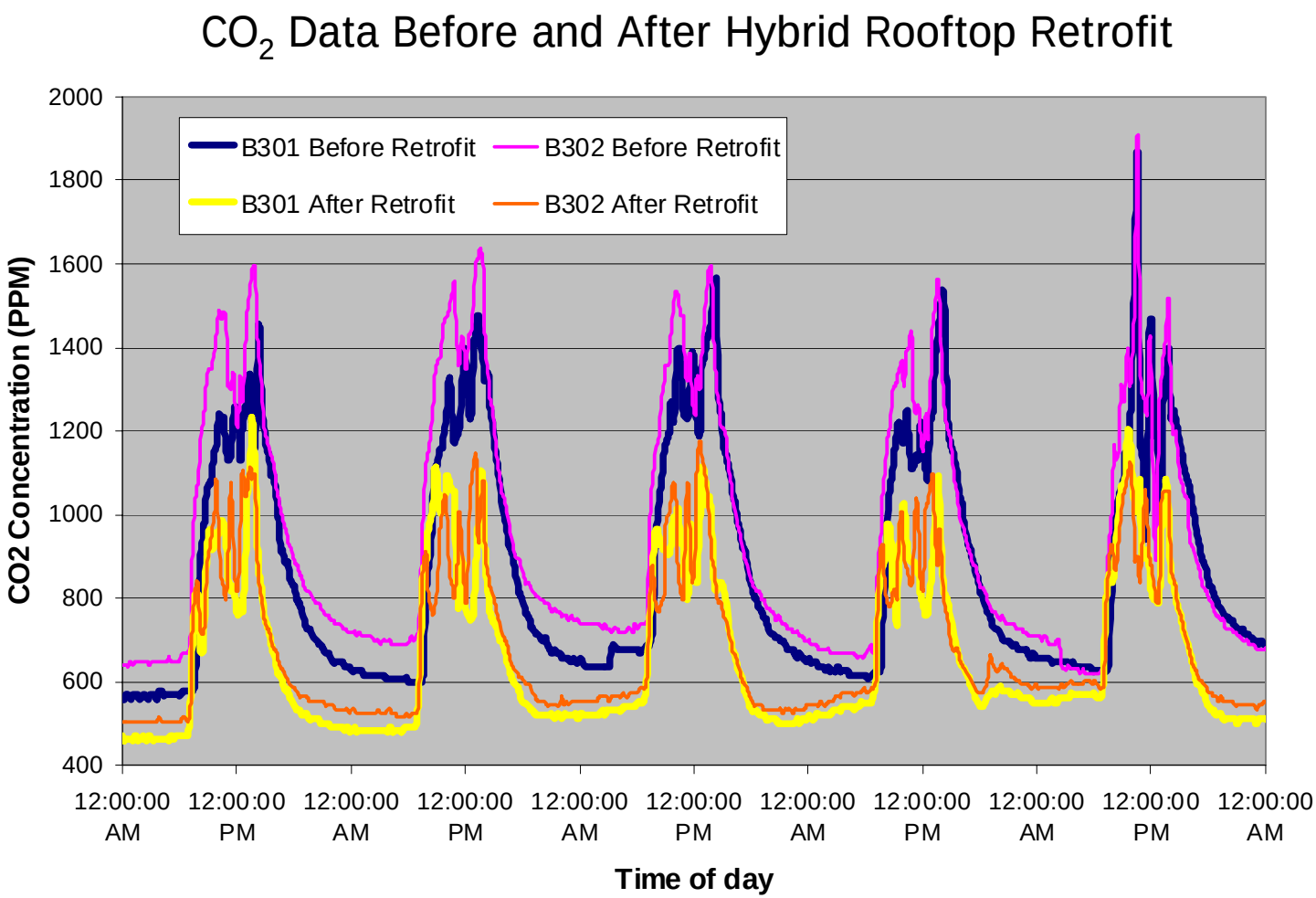
Dedicated Outdoor Air Systems Comparison

	IADR	Packaged System	Packaged System with Reheat
Sensible load required Latent load required SHR	143,600 BTU/Hr 187,078 BTU/Hr 0.43	143,600 BTU/Hr 187,078 BTU/Hr 0.43	143,600 BTU/Hr 187,078 BTU/Hr 0.43
Sensible load delivered Latent load delivered SHR	141,814 BTU/Hr 187,078 BTU/Hr 0.43	278,640 BTU/Hr 96,198 BTU/Hr 0.74	141,814 BTU/Hr 187,078 BTU/Hr 0.43
Space humidty peak load Space humidity part load	50% 50%	80% 79%	50% 50%
Space temperature needed to reach occupant comfort	75.9 DegF	70.9 DegF 71.1 DegF	75.9 DegF
Tons needed for latent load Reheat energy required Regeneration energy	23.8 tons 0 BTU/Hr 134,851 BTU/Hr	30.0 tons (Tons typically installed) Humidity Conditions Not Met with this standard selection!	48.9 tons 133,428 BTU/Hr 0 BTU/Hr

Hybrid Heating Performance



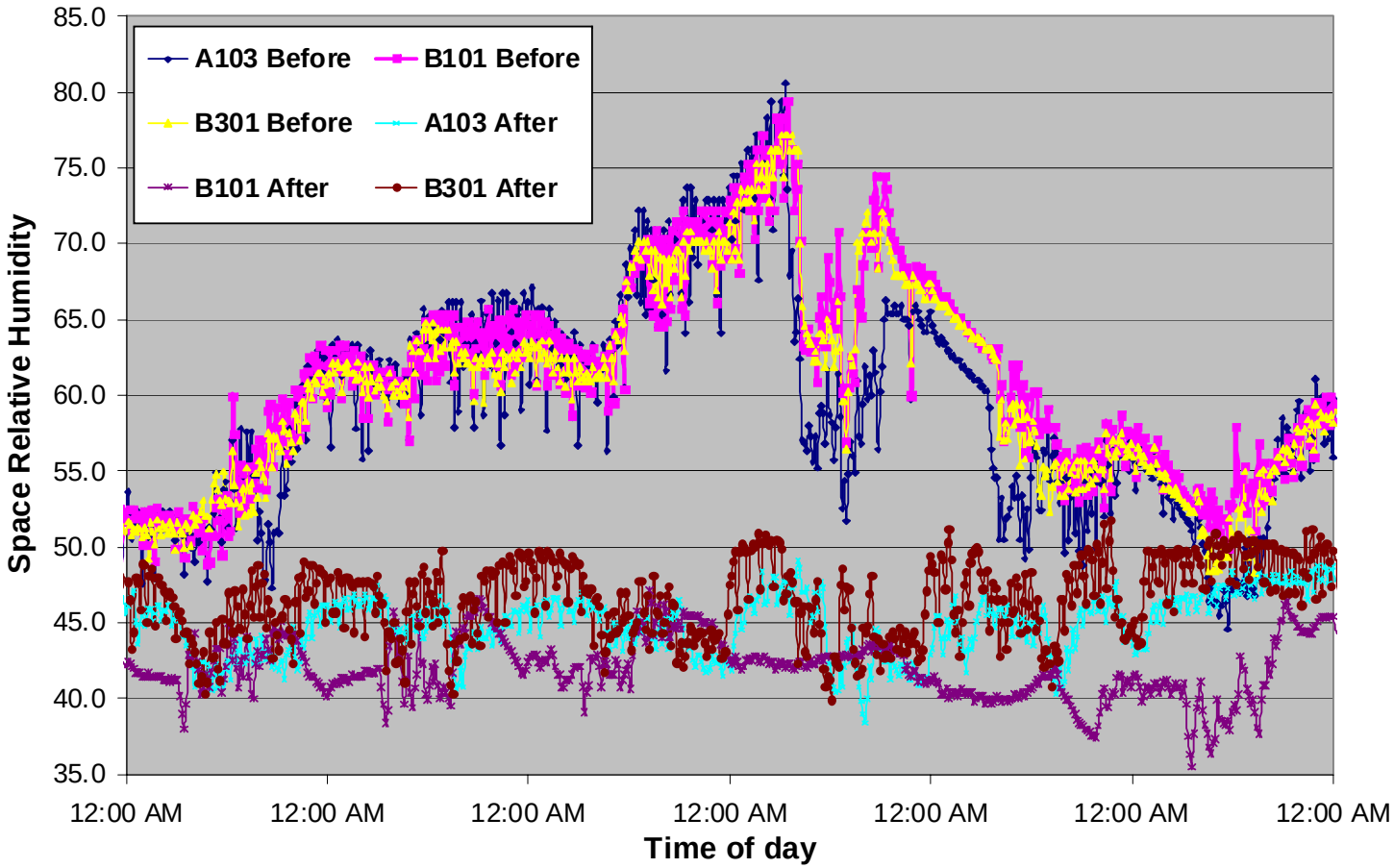
Improved Ventilation Performance with Hybrid



Before (October) and After (May) with similar outdoor air temperature and humidity levels

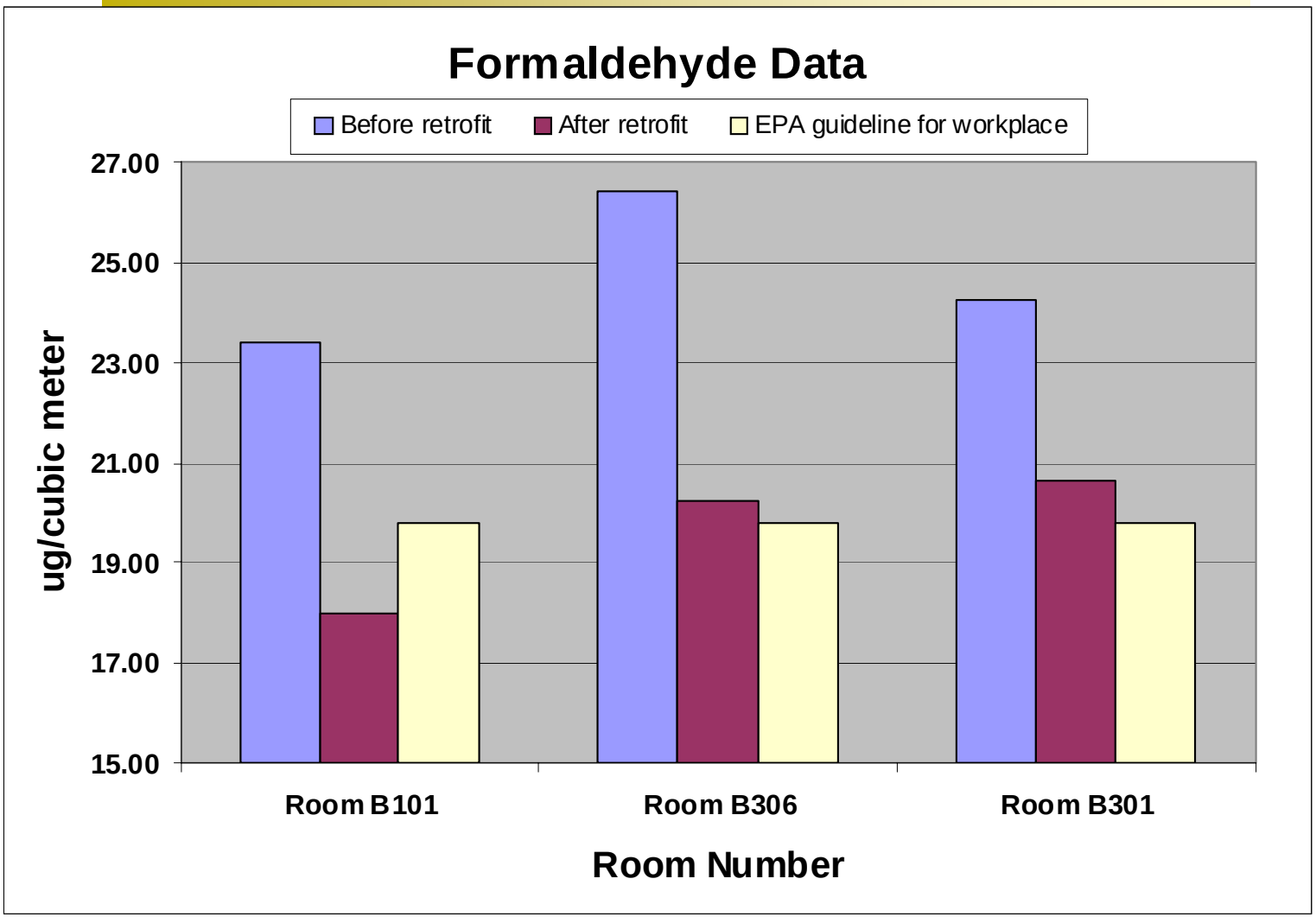
Before and After Humidity Data

Typical Space Relative Humidity Before and After Hybrid Rooftop Installation Retrofit

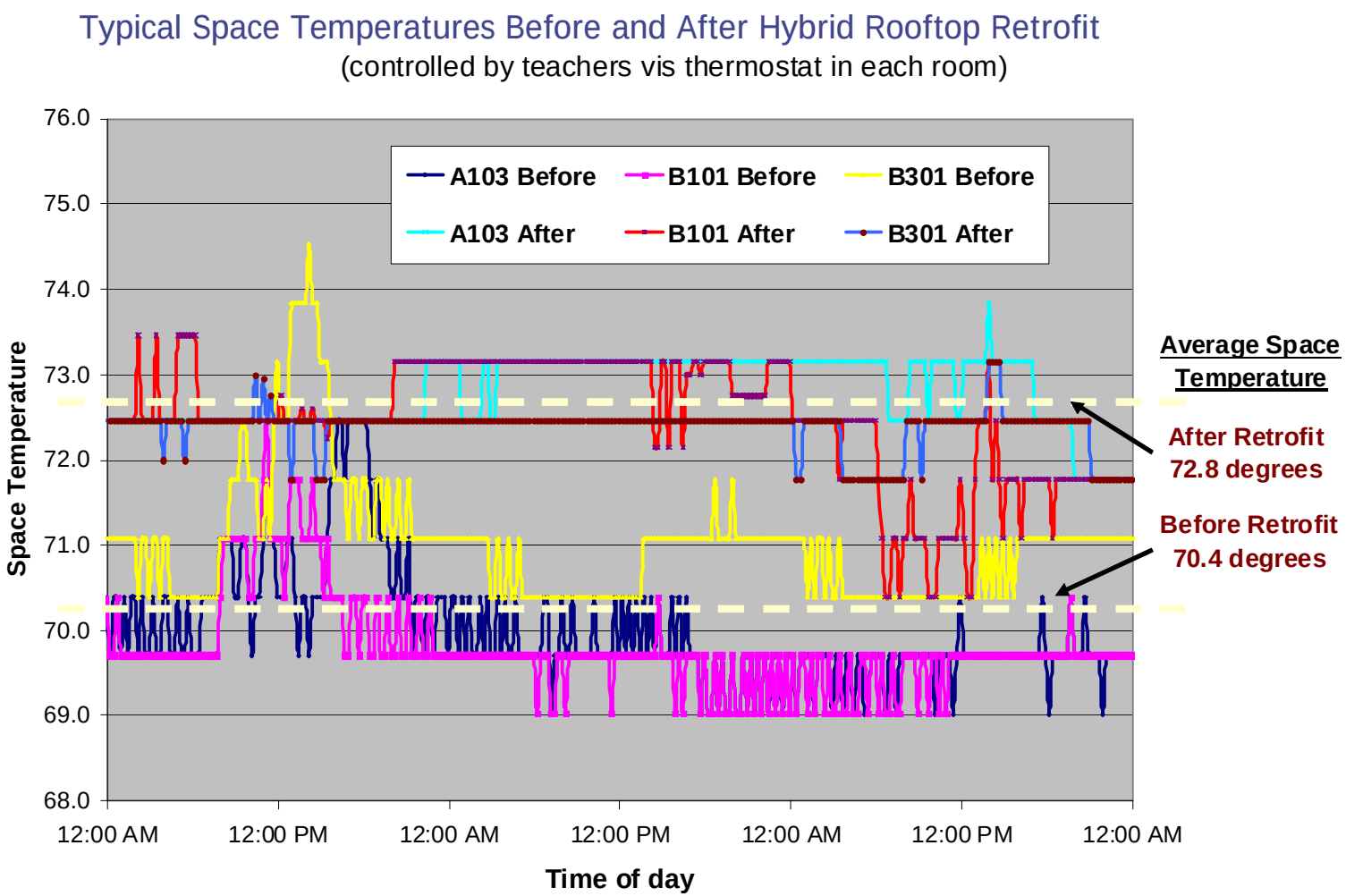


Before (October) and After (May) at similar outdoor air humidity levels

School IAQ Data

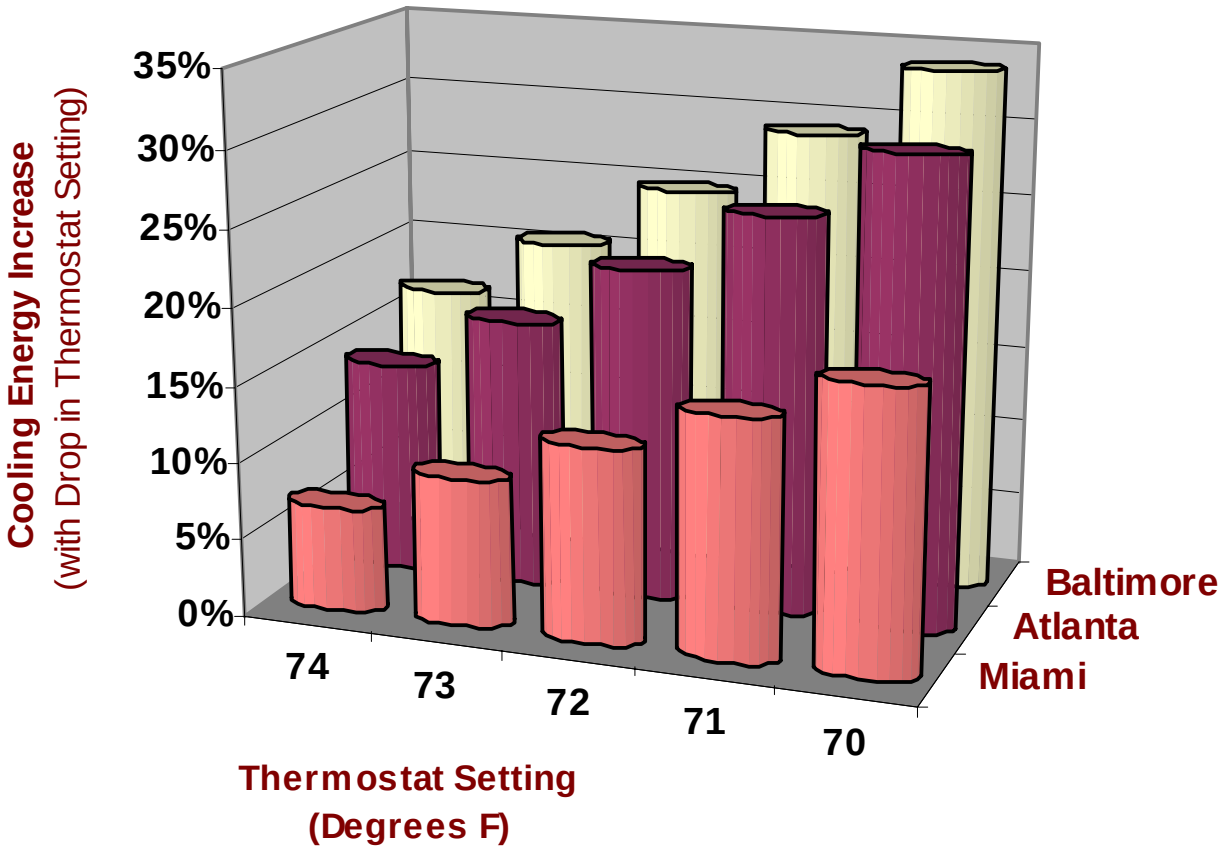


Before and After Thermostat Settings



Cooling Energy Sensitivity to Thermostat Settings

Typical School Facility:
(165,000 SqFt., 32% Outdoor Air)



Conclusions

- **Very successful retrofit installation**
  - **Convenient retrofit**
  - **IAQ improvement**
  - **Ventilation compliance**
  - **Comfort/health improvement**
  - **Decreased operating costs (economy)**
- **Customer satisfaction**

Testimonial "Thank You" Letter -- October 15, 2004

- **From school's HVAC maintenance supervisor**

"…. Installed over one weekend……."

"… delivers required amount of outdoor air…."

"… excellent temperature and humidity control…"

"… energy consumption far less than that used by conventional packaged system replaced…"

"… IAQ improved significantly and now very acceptable…"

"… the teachers are very happy with the new system…"

"… pressured to address remainder of school…"