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Heat Recovery System Modeling for US Environmental Protection Agency Research Triangle Park, NC

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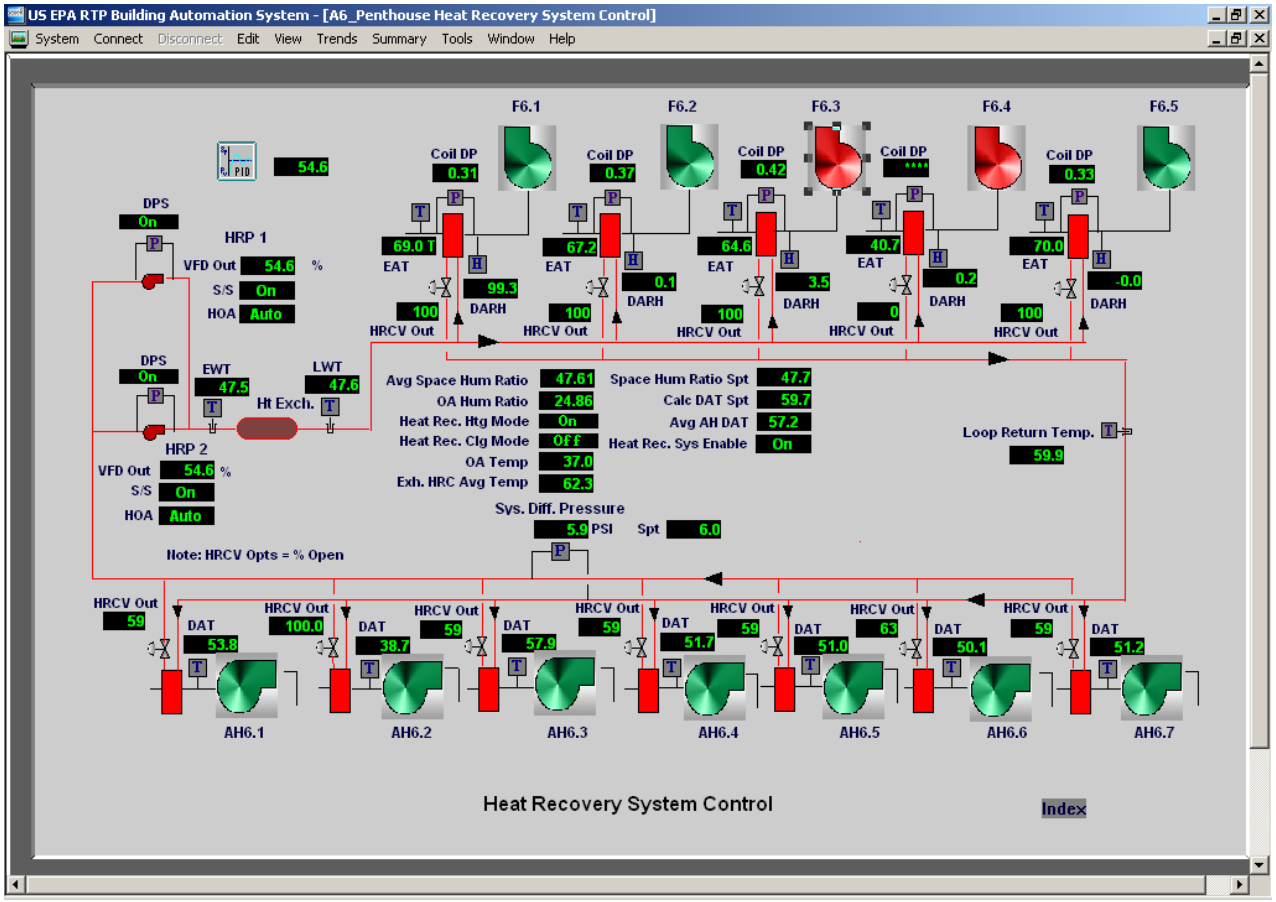
Agenda

- Heat Recovery System (HRS) Operational Overview
- Model Development & Benchmarking
- HRS Savings Analysis
- Recommendations & Results
- Future HRS Investigations
- Additional Analyses

Building ‘A’ Heat Recovery System



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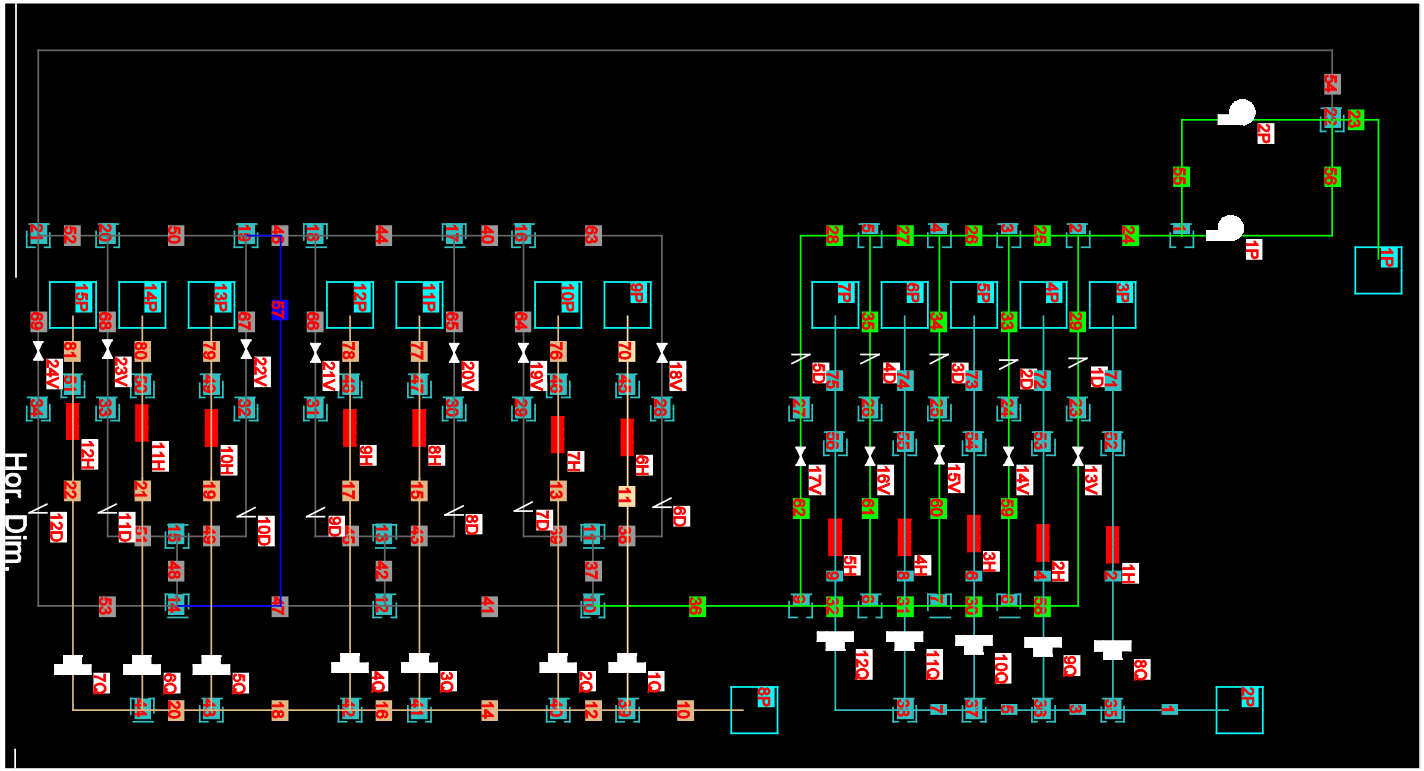
GOTHIC System Schematic



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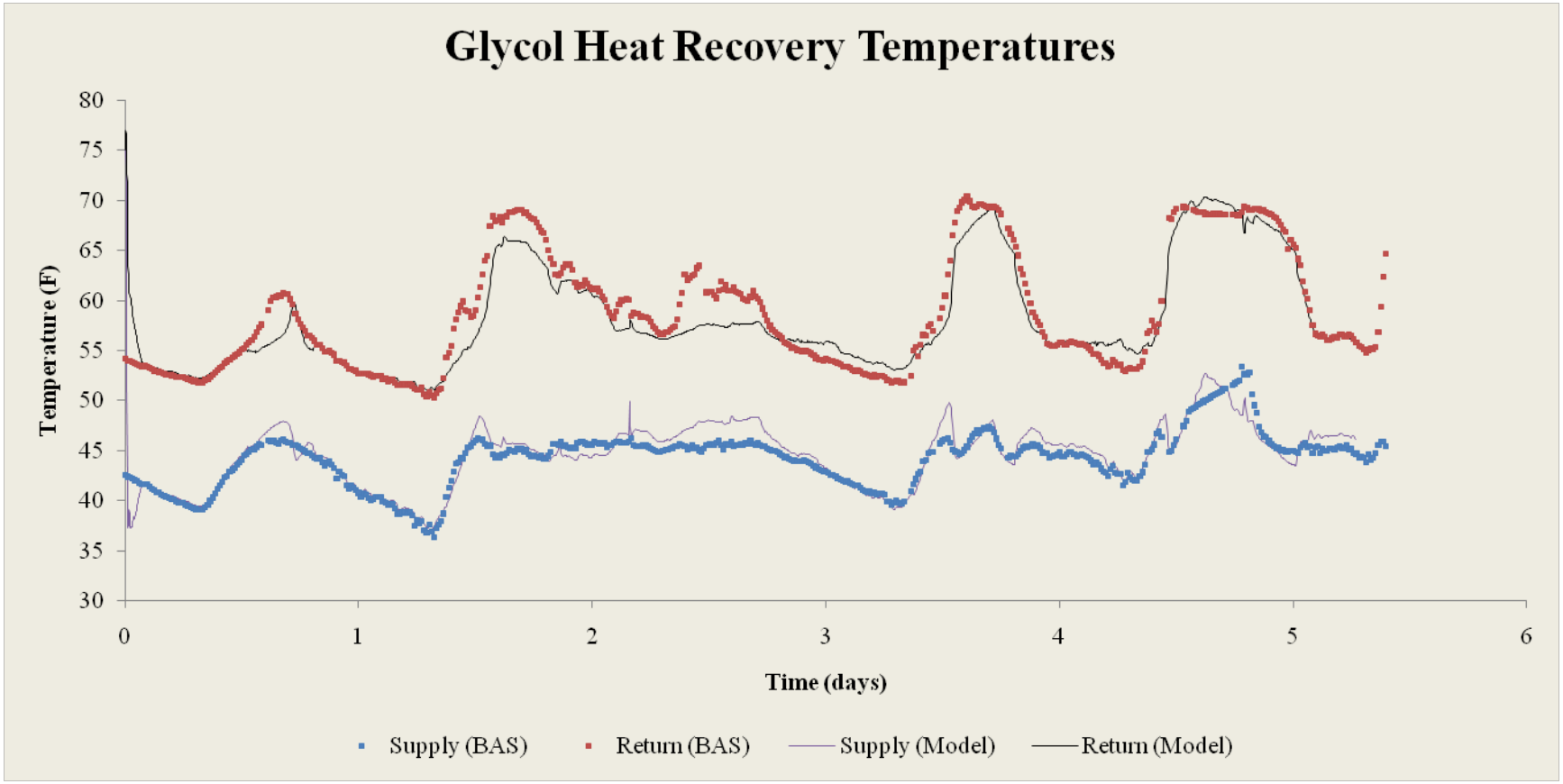
Fan Coil Benchmarking

System	Total Capacity (MBtu/hr)	Sensible Capacity (MBtu/hr)	Model Total Capacity (MBtu/hr)	Model Sensible Capacity (MBtu/hr)	Total Capacity Error (%)	Sensible Capacity Error (%)
Exhaust	1669	1514	1653	1515	-1.0	0.1
Supply	428	428	427	427	-0.2	-0.2

- Cooling coil model based on McQuay water cooling coil physical parameters
- Cooling Coil/Heat Exchanger separately benchmarked to within 1% of manufacturer data

HRS Benchmark Results



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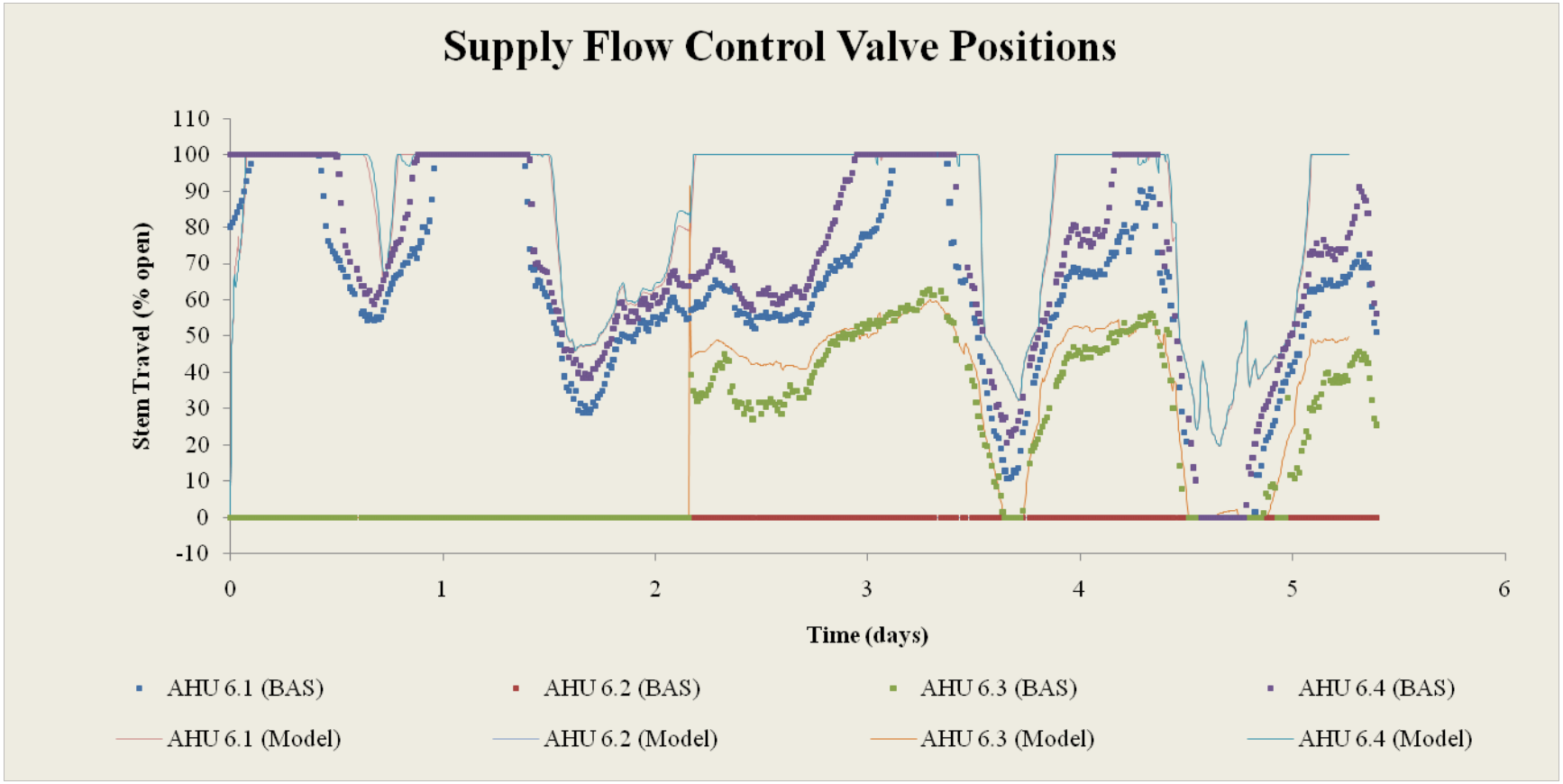
HRS Benchmark Results



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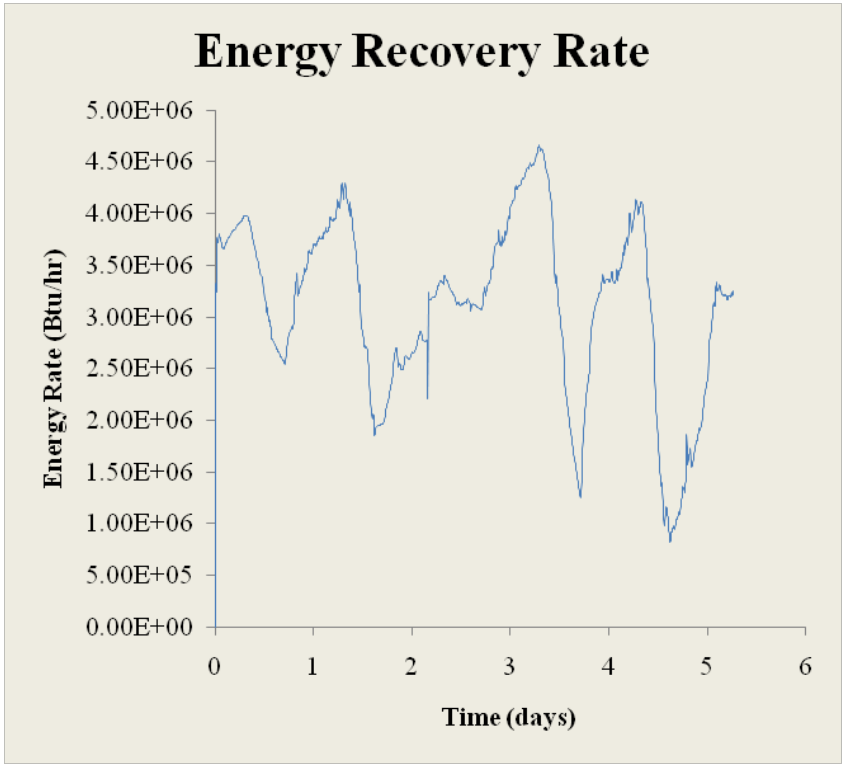
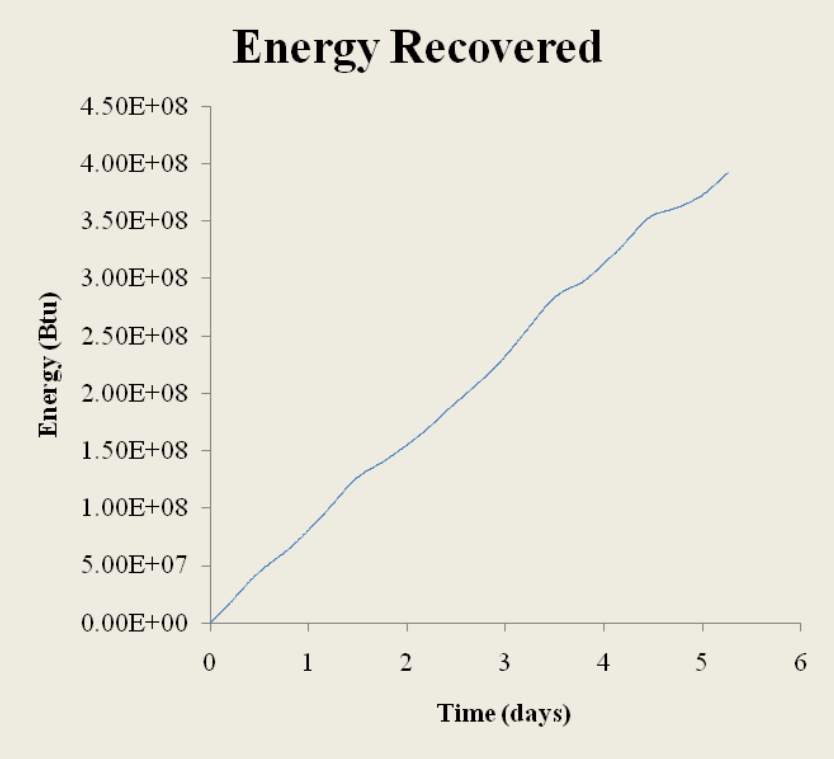
HRS Benchmark Savings





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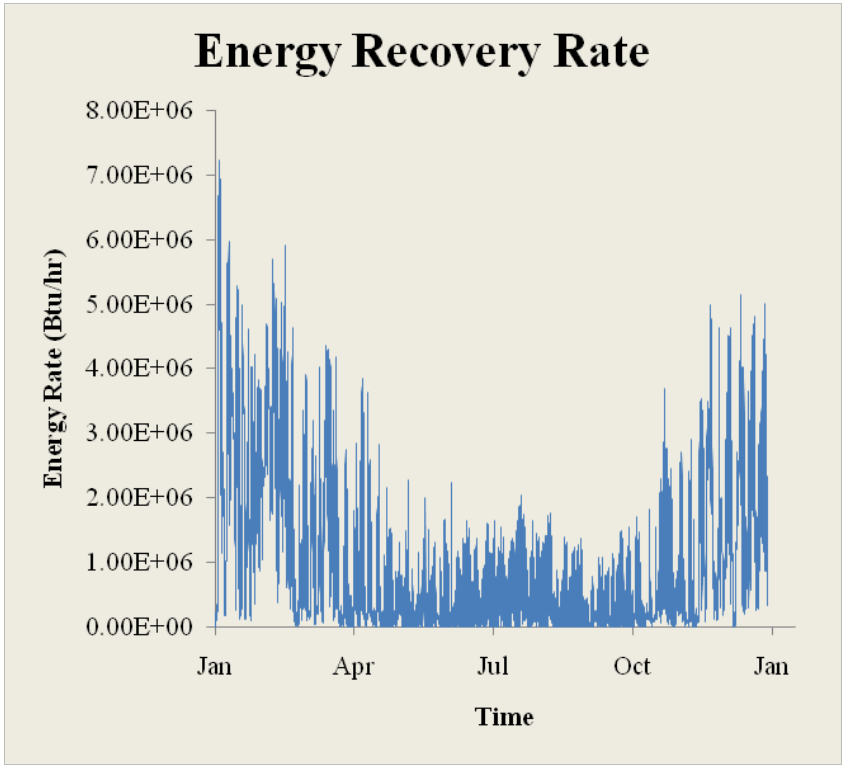
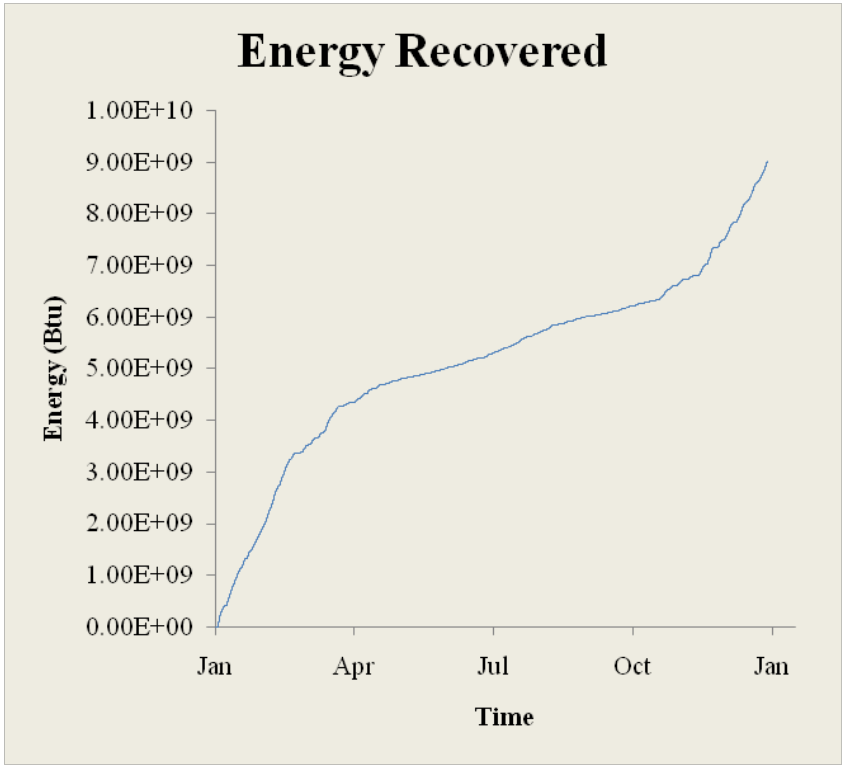
HRS Annual Baseline Results





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Recommendations

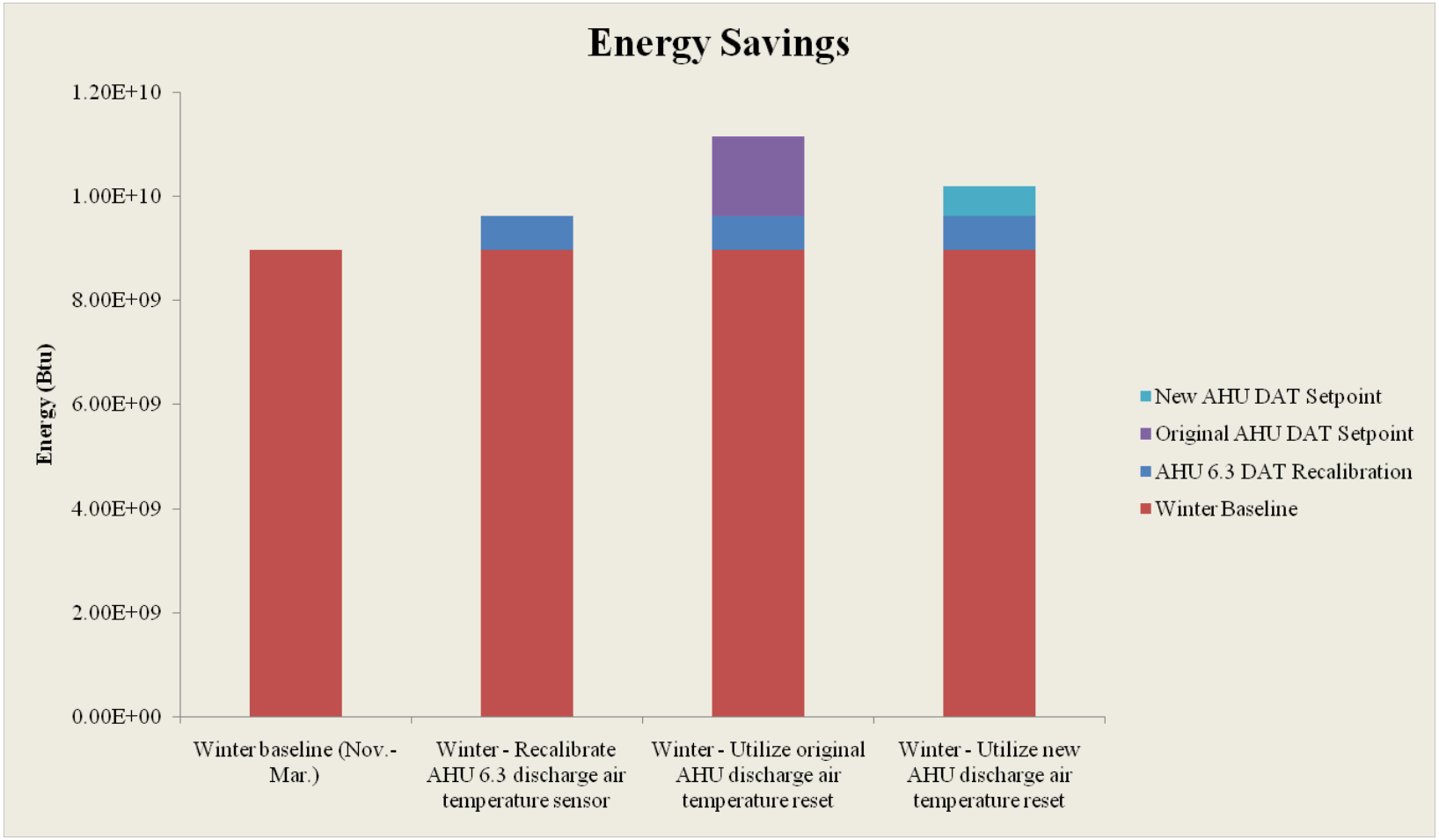
- Recalibrate AHU 6.3 Discharge Air Temperature (DAT) sensor
  - Sensor reading ~ 10 ºF out of calibration
- Utilize original AHU DAT reset
  - 55 ºF vs.

Outside Air Temperature (F)	Discharge Air Setpoint (F)
16	65
55	55

- Utilize new AHU DAT reset
  - 55 ºF vs.

Outside Air Temperature (F)	Discharge Air Setpoint (F)
16	60
55	55

Savings Comparison



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Savings Comparison

Case/Recommendation Description	CUP Energy Savings (Btu/yr)	Cost Savings ($/yr)
Year round baseline	9.73E+9	$60,160
Winter baseline (Nov.-Mar.)	8.97E+9	$50,140
Recalibrate AHU 6.3 discharge air temperature sensor (Δ = Incremental savings over winter baseline)	9.63E+9 (Δ = 6.6E+8)	$53,830 (Δ = $3,690)
Utilize original AHU discharge air temperature reset (Δ = Incremental savings over winter baseline)	11.15E+9 (Δ = 2.18E+9)	$62,320 (Δ = $12,180)
Utilize new AHU discharge air temperature reset (Δ = Incremental savings over winter baseline)	10.19E+9 (Δ = 1.22E+9)	$56,960 (Δ = $6,820)

Lessons Learned

- Detailed modeling is beneficial
  - Savings are significant and quantifiable
- 3rd party review of ESCO design/install
  - System is operating as intended
- Instrumentation for future HRS designs
- Sensor calibration of HRS
  - BAS alarms
  - Operator training

HVAC Energy Conservation Recommendations to Model

- Increase supply discharge air temperature
  - Balance lab module heat loads
  - Optimize air flow rate vs. temperature
- Reduce reheat water temperature and/or flow
  - Eliminate off-hours reheat
- Increase chilled water temperature and/or decrease flow

HVAC Energy Conservation Recommendations to Model

- Reduce laboratory air flows
  - Reduced flows when unoccupied
    - Justification of enhancing flow control instrumentation
  - Real-time air quality
- Lab module thermostat setback

Other Applications

- Building modeling
  - Whole building
  - Individual rooms / areas
- HVAC modifications
  - Pumps, piping
  - Fans, ductwork
  - Coils, heat exchangers, cooling towers
  - Controls

Other Applications

- Process equipment
  - Heat exchangers
- Compressed air
- Steam systems
- Control system optimization

Contact Information

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