Recommissioning Existing Labs To Realize Energy Savings

Utilities and Energy Management
www_utilities.cornell.edu
Agenda

- Overview of Cornell University
- Energy Conservation Initiative (ECI)
- ECI recommissioning program
- Questions and answers
Cornell University

- 18,000 student body
- 12,000 faculty/staff
- 745 acre campus
- Endowed, Contract Colleges, & Campus Life
Cornell University

- 260 buildings; 13,600,000 sf
- $36 million total energy cost
- Average energy cost $2.65/sf
- Average energy input 179,000 btu/sf
- Average metered use 212,000 btu/sf *

* Includes cooling
**Cornell University (Endowed)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Existing</th>
<th>Planned</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab Buildings</td>
<td>20</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Sq. Footage</td>
<td>2,400,000</td>
<td>570,000</td>
<td>2,970,000</td>
</tr>
<tr>
<td>Fume Hoods</td>
<td>500</td>
<td>200</td>
<td>700</td>
</tr>
<tr>
<td>Energy Cost</td>
<td>11,000,000</td>
<td>3,000,000</td>
<td>14,000,000</td>
</tr>
<tr>
<td>Average $/sf</td>
<td>4.60</td>
<td>5.50</td>
<td>4.70</td>
</tr>
</tbody>
</table>

*Projects planned for completion by 2010 total $500 million*
Cornell University

- Existing utility infrastructure
  - 115kV electric substation
  - Central heating plant
    - 90% coal, 8 MW cogen
  - Central chilled water plants
    - Lake Source Cooling
## Existing Utility Infrastructure Loads

<table>
<thead>
<tr>
<th>Utility</th>
<th>Average</th>
<th>Peak</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric</td>
<td>27</td>
<td>35</td>
<td>MW</td>
</tr>
<tr>
<td>CHP</td>
<td>125</td>
<td>375</td>
<td>klbs/hr</td>
</tr>
<tr>
<td>CWP</td>
<td>4,300</td>
<td>18,000</td>
<td>tons</td>
</tr>
</tbody>
</table>
Projects planned will strain infrastructure
Chartered Kyoto Task Team
Expanded energy management program
Created ECI
Energy Conservation Initiative

- Goal = reduce energy use by 20%!
- Multi-phase seven year plan
- Recommissioning → studies → pilots → projects
- NYSERDA support for studies
- Maintenance & continuous commissioning
- Outreach & education
Energy Conservation Initiative

ECI
Endowed
2001 – 2008
(4.0 Million Sf.)

ECI
Contract Colleges
2002 – 2010
(3.5 Million Sf.)

Recommission
Study
Design
Pilot
Implementation
ECI Recommissioning

Recommissioning

1. Identify funding, team, tools, and schedule
2. Correct defective space and central system equipment
3. Recommission systems to original design intent +
4. Document findings, corrective action, and results
5. Monitor system performance to confirm savings
ECI Recommissioning

- Identify funding, team, tools, & schedule
  - Establish funding source
  - Commit senior technicians for duration
  - Purchase & calibrate dedicated tools
  - Prepare detailed work & progress schedule
ECI Recommissioning

- Correct defective space/central equipment
  - CAV/VAV boxes, dampers, valves
  - Sensors, transducers, transmitters
  - DDC, EMC systems
  - AHU’s, pumps
ECI Recommissioning

- Recommission to original design intent +
  - Locate CD’s, TAB reports, & submittals
  - Identify air flows & hood face velocities
  - Adjust set points & control sequences
  - Improve where possible
ECI Recommissioning

- Document findings, corrections, & results
  - Prepare recommissioning forms
  - Record findings & corrective action taken
  - Log equipment/system performance data
  - Archive in secure & accessible location
ECI Recommissioning

- Monitor performance to confirm savings
  - Benchmark initial performance data
  - Trend & evaluate monthly performance data
  - Regularly compare initial v. monthly data
  - Tune as necessary
  - Confirm savings
ECI Recommissioning Results

- 42 buildings recommissioned
- Total 4 million sf ~ $400,000
- Central mechanical room equipment
- Limited space controls
- 2 full-time senior technicians
- 24 month duration
## ECI Recommissioning Results

### Endowed buildings – 4 million sf *

<table>
<thead>
<tr>
<th>Year</th>
<th>Total btu ** (x $10^6$)</th>
<th>btu/sf</th>
<th>HDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-2001 (Avg)</td>
<td>837</td>
<td>209,000</td>
<td>6,875</td>
</tr>
<tr>
<td>2001-2002</td>
<td>846</td>
<td>211,000</td>
<td>6,163</td>
</tr>
<tr>
<td>2002-2003</td>
<td>848</td>
<td>212,000</td>
<td>7,526</td>
</tr>
</tbody>
</table>

* 2.4 million sf lab buildings

** In ’02/03 steam = 44%, electric = 32%, chilled water = 24%
<table>
<thead>
<tr>
<th>Year</th>
<th>Total btu Δ</th>
<th>btu/sf Δ</th>
<th>HDD Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/03 vs. 01/02</td>
<td>+ &lt; 1%</td>
<td>+ &lt; 1%</td>
<td>+ 22%</td>
</tr>
<tr>
<td>02/03 vs. 99/01</td>
<td>+ 1%</td>
<td>+ 1%</td>
<td>+ 10%</td>
</tr>
</tbody>
</table>
ECI Recommissioning Results

- Typical findings
  - Defective AHU equipment & boxes
  - Incomplete algorithms & schedules
  - Overridden & disabled features
  - Miscalibrated sensors & transmitters
  - Non-functioning EMCS tools
ECI Recommissioning Results

- Continuous commissioning
  - Initial performance data benchmarked
  - Trends & graphics evaluated quarterly
  - Systems tuned as required
  - Data, results, & lessons documented
ECI Recommissioning Example

Olin Hall – Chemical Engineering
ECI Recommissioning Example

- 130,000 sf; 35,000 sf = 40 fume hood labs
- Average energy use 217,000 btu/sf
- Pneumatic space control
- Excessive air change rates: 60,000 cfm
- Central air fans at full speed
ECI Recommissioning Example

- 12 ac/hr → 8 ac/hr (↓10,000 cfm)
- Fume hood VAV set at 100 fpm
- 3-box room air flow functioning
- Highly variable occupancy
- Identified high sensible heat load area
- 1 FTE for 1 month = $15,000 cost
- @ $5.00/cfm = $50,000/year savings
ECI Recommissioning Example

Vet Medical Center
ECI Recommissioning Example

- 320,000 sf; 45,000 sf = 43 fume hood labs
- Average energy use 346,000 btu/sf
- Digital space control
- Excessive air rates, noise, cold spaces
- Central air fans at full speed: 140,000 cfm
ECI Recommissioning Example

- 15 ac/hr → 8 ac/hr (↓ 50,000 cfm)
- Fume hood VAV set at 100 fpm
- Rebuilt AHU valves & humidifiers
- Installed occupancy sensors
- Software reviewed, corrected, standardized
- $200,000 cost
- @ $5.00/cfm = $250,000/year savings
Conclusion

- Recommissioning, is it worth it?
  Absolutely
- What did we learn?
  - Question standard practices
  - Work with building staff
  - Data, data, data
  - Plan ➔ do ➔ check ➔ act
Conclusion

Questions?

Don’t let your building’s energy DISAPPEAR UP THE CHIMNEY during the winter break!

Remember to CLOSE YOUR HOOD SASH before you leave for the break!

- Turn off lights and computers
- Unplug electronics like microwaves, TV’s, and VCR’s
- Help save energy and reduce global warming!

This message brought to you by: Bjorn Nudel and Cornell Utilities.