GYA Interdisciplinary Working Session: Facilities Working Group

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Eliza Hotchkiss, Analyst

April 19th – 22nd 2010
Introductions and Overview

• NREL
• GYA
• Working together
• Objective of the working sessions
• Outline of our two-day workshop
  – Background Information
  – Working with auditors
  – Manuals
  – Resources DVDs
  – Note cards
• Overview of today’s agenda
Visioning
Approaches to Energy Efficiency

Organizational
- MM&T
- O&M
- Awareness

Technical
- Energy Efficient Equipment
- Controls
Utility Bill Cleanup

Heather Davis
USDA Forest Service, Sustainable Operations
Utility Bill Cleanup

WHY?

• Build benchmark
• Monitor progress on reductions
• Save money!
• EO 1352 – Reducing Improper payments
• EO 13514 – Sustainable Buildings
• EO 13423 – Strengthening Fed Environmental, Energy and Transportation Management
Utility Bill Cleanup

HOW TO GET STARTED?

• Determine points of contact:
  • Facility Engineer
  • Budget

• Request utility account information from internal system… will need to contact utility provider too!

• Match meter numbers to facilities
Utility Bill Cleanup

QUESTIONS TO ASK?

1. **Rates**
   1. Are you on a government rate?
   2. Can that site be charged residential rates?

2. **Usage**
   1. Seasonal facilities
   2. Power at closed facilities

3. **Leaks**
   1. Unusually high usage

4. **Are you paying concessionaire utilities?**

5. **Do we own the property?**
Utility Bill Cleanup

EXAMPLES OF SAVINGS!

• Phone bill for an old district office that closed 40 years ago
• A compound that was converted from higher commercial rate to residential rate saving $10,000+ year
• Water leak of 1,000s of gallons

UTILITY BILL CLEANUP CASE STUDY
Questions?

Check out the resources in the provided CD for more information
Break

10 minute break
Energy Use in Buildings

Why do we build?

• To stay dry
• To keep warm
• To keep cool
• For protection
Energy Use in Buildings

- **HVAC 51%**
  - Space Heating
  - Air Conditioning
  - Ventilation

- **Lighting 21%**
  - Interior
  - Exterior

- **Plug Loads 9%**
  - Refrigeration Equipment
  - Computers and Office Equipment

- **Water 8%+**
  - Water consumption
  - Water heating
  - ILA: Industrial, landscaping and agricultural

Source: Energy Information Administration, 2003 Commercial Building Energy Consumption Survey, Table E1A (September 2008).
Degree Days Data

Note: CDD = cooling degree days; HDD = heating degree days
The peak demand for the day is 2,500 kW.

Total electricity use 36,000 (kW) for the day is equal to area under the curve.
Building Envelope

• 51% of energy consumed in buildings is for heating, ventilation and air conditioning

• Energy is wasted through:
  – Energy loss (or gain) through the building envelope
  – Inefficient HVAC equipment
    • Pumps and motors
    • Controls
    • Settings
    • System type and size
Building Envelope ECMs

Typical building envelope Energy Conservation Measures (ECMs) include:

- Increase levels of insulation in roof, walls and floors where necessary
- Install windows with a higher U-value
- Install external shading to protect windows from solar gains in hotter climates
HVAC ECMs

- Convert constant volume systems to variable air volume systems
- Replace inefficient motors with variable frequency drives (aka variable speed drives)
- Install optimization controls and use ASHRAE guidance settings
- When renovating consider more efficient HVAC systems
HVAC ECMs

- Convert Constant Volume systems to Variable Air Volume systems

Constant volume systems:
- Supplies a constant demand despite occupancy requirements

Variable air volume systems:
- Adjusts temperature and air flow by zone requirements
- Used in conjunction with VFD/VSDs greater energy savings are experienced
HVAC ECMs

- Replace inefficient motors with more efficient VSDs/VFDs

Improving motors can make significant savings

Equipment manufacturer should be contacted to make sure equipment can handle variable flow conditions

Applicable systems:
- Secondary chilled water loops
- Fan coil unit or AHU ventilator loops
- Boiler motors
HVAC ECMs

- Upgrade HVAC controls and sensors to match seasons, occupancy demands, standard guidelines from ASHRAE

HVAC Control system improvements typically produce considerable energy savings with minimal capital investments

- Match HVAC schedules to occupancy schedules
- Optimize control strategies for improved efficiency and comfort (e.g. weather optimization)
HVAC ECMs

- Upgrade HVAC controls and sensors to match seasons, occupancy demands, standard guidelines from ASHRAE

- Install programmable thermostats
- Reduce outdoor air and exhaust air flow rates per ASHRAE 62.1-2007
- Enable air-side enthalpy economizer operation
- Optimize supply and exhaust air ductwork static pressure
HVAC Walk-through

- Manual
- Nameplate ratings
  - Looking up information online
- Register of complaints – common complaints, etc.
- Dan Stevenson, MSU
Discussion & Questions

- Tours
- Feedback
- Discussion Items
Lighting

Lighting accounts for 25% of the total electricity used in the federal sector.

Electric lighting accounts for more than a third of all electricity consumed for commercial use in the United States.

Lighting is used internally and externally for:
- Security
- Access
- Safety
- Task lighting
- General lighting
- Specific/specialized lighting
Typical Lighting ECMs

• Optimize use of natural daylight
• Replace lamps and ballasts with modern, efficient lamps / ballasts
• Replace incandescent lamps with compact fluorescent lamps (CFLs)
• Implement task lighting
• Install state-of-the-art lighting controls
Typical Lighting ECMs

Optimize use of natural daylight

• Use natural, free daylighting as much as possible
  • Switch off lighting
  • Use daylighting sensors

• Use technologies that incorporate daylighting
  • Sunpipes/suntubes
  • Skylights
  • Hybrid solar lighting
Typical Lighting ECMs

Replace lamps and ballasts with modern, efficient technologies

- Fluorescent lights and electronic ballasts
  - Replace T-12 lamps and magnetic ballasts with low wattage T-8 lamps and electronic ballasts (or T-5s where available/applicable)
  - Replace standard T-8 lamps with low wattage T-8 lamps and low ballast factor ballasts
- Install perimeter dimming ballasts and controls (near windows)
- Optimize interior security lighting
## Typical Lighting ECMs

<table>
<thead>
<tr>
<th>Lamp Type</th>
<th>T-12</th>
<th>T-12 ES</th>
<th>T-8</th>
<th>T-5*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watts</td>
<td>40</td>
<td>34</td>
<td>32</td>
<td>54</td>
</tr>
<tr>
<td>Initial lumens</td>
<td>3,200</td>
<td>2,850</td>
<td>2,850</td>
<td>5,000</td>
</tr>
<tr>
<td>Efficacy (lm/W)</td>
<td>80</td>
<td>84</td>
<td>89</td>
<td>93</td>
</tr>
<tr>
<td>Lumen depreciation**</td>
<td>10%</td>
<td>10%</td>
<td>5%</td>
<td>5%</td>
</tr>
</tbody>
</table>

* High-output T-5 in metric length  
** Change from “initial lumens” to “design lumens”  

Source: Philips Lighting
Typical Lighting ECMs

Replace lamps and ballasts with modern, efficient technologies

- Light Emitting Diodes (LED)
  - Replace standard exit signs with LED exit signs
  - Install LED task lighting and retail lighting
  - Replace incandescent and energy inefficient fixtures with LED fixtures where applicable

Caliper Website

Typical Lighting ECMs

- **Implement task lighting**
  - Remove up-lighting where ineffectual
  - Reduce general lighting and focus lighting in specific task areas
- **Install state-of-the-art controls**
  - Occupancy sensors
  - Daylight sensors
  - Timers
  - Integrated control designs
- **Replace incandescent lamps with compact fluorescent lamps (CFLs)**
  - Screw in lamp retrofit
Typical Lighting ECMs

Improve High Intensity Discharge (HID) Lamps and Applications

There are three main types of HID lamps: mercury vapor, metal halide and sodium.

- Replace magnetic HID ballasts with electronic ballasts and reduce lamp wattage
- Replace HID lamps and fixtures with T-8 or T-5 lamps
- Reduce lighting levels in over lit areas by de-lamping or installing skylights/suntubes, etc
- Ensure current electronic ballasts are low factor ballasts with 32W T-8s
- Reduce operational load (e.g. turn off security lights during the day, switch off general lighting at night)
- Reduce security lighting levels at night
Lighting Walkthrough/Talkthrough

- Manual
- Foot candles
- Lamp types
- System Efficacy (lumens/watt) = Number of Lamps * Ballast Factor

For example, a two lamp ballast with 32 Watt T-8 lamps and a ballast factor = 1.10 has a connected electrical load = 32 Watts x 2 lamps x 1.10 B.F. = 70.4 Watts
Break

10 minute break
Plug Loads

Plug loads are devices that plug into a building’s electrical system. They include:

– Office equipment (fax machines, computers, printers, and copiers)
– Appliances
– Soda machines
– Drinking fountains
– Refrigerators
– TVs
– VCRs

Plug loads account for 9% of a building’s total electrical use
Plug Loads

Energy conservation measures to reduce plug loads

- Activate power management on computers and monitors
- Replace desktop computers with laptop computers and a docking station
- Replace CRT monitors with LCD monitors
- Install vending machine misers on refrigerated vending machines and de-lamp advertising lighting
- Install occupancy sensor controlled surge protectors in offices
- Replace appliances with Energy Star appliances
Plug Loads

Measuring plug loads can help understand where energy is being used:
- HOBOs and Kill-a-watt meters
Typical Plug Load ECMs

Technical Specifications

- Activate power management settings on all computers through built-in Windows tools
  - “Turn off monitor” set to 15 minutes
  - “System Standby” set to 30 minutes
  - “Hibernation” set to 45 minutes
- Limit screen-saver use

Cost Guidelines

- Power management settings are already built in to Windows at no additional cost
- Average labor time per computer should be 15 minutes
Typical Plug Load ECMs

- Laptop computers consume 50-80% less power than desktop computers

- Cost Guidelines
  - Average laptop and docking station cost is $1,000-$2,400/laptop
  - If implementation costs are too high, the site should incrementally replace existing computers with laptops and docking stations in the normal upgrade cycle

<table>
<thead>
<tr>
<th>Computer Type</th>
<th>Processor Type</th>
<th>Active / On (Watts)</th>
<th>Suspended (Watts)</th>
<th>Off (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Docked Laptop</td>
<td>Intel Core 2 Duo</td>
<td>62</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Desktop w/ LCD</td>
<td>Intel Core 2 Duo</td>
<td>76.2</td>
<td>6</td>
<td>3.5</td>
</tr>
<tr>
<td>Desktop w/ CRT</td>
<td>Intel Core 2 Duo</td>
<td>145.25</td>
<td>16</td>
<td>7</td>
</tr>
</tbody>
</table>
Typical Plug Load ECMs

- Replacing CRT monitors with LCD monitors reduces energy use by 50-75%

- Cost Guidelines
  - LCD monitors cost $150-$360 per monitor, depending on size
  - If implementation costs are too high, the site should incrementally replace existing monitors when they require replacement

<table>
<thead>
<tr>
<th>Monitor Type</th>
<th>Size</th>
<th>Active / On (Watts)</th>
<th>Suspended (Watts)</th>
<th>Off (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRT</td>
<td>15&quot;</td>
<td>61</td>
<td>19</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>17&quot;</td>
<td>90</td>
<td>9</td>
<td>4</td>
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<td></td>
<td>19&quot;</td>
<td>104</td>
<td>13</td>
<td>4</td>
</tr>
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<td></td>
<td>21&quot;</td>
<td>135</td>
<td>14</td>
<td>5</td>
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<tr>
<td>LCD</td>
<td>15&quot;</td>
<td>11.7</td>
<td>3.4</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>17&quot;</td>
<td>16.7</td>
<td>4.8</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>18&quot;</td>
<td>25</td>
<td>7.2</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td>21&quot;</td>
<td>35.8</td>
<td>10.4</td>
<td>1.8</td>
</tr>
</tbody>
</table>
Plug Talk-through
Questions?

- Questions from the day
- *Jot down potential ECMs on notecards*

- What’s next on the agenda?
  - Tour of a LEED certified building, Bozeman Public Library