BEYOND O&M

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Smart Energy Design Assistance Center (SEDAC), University of Illinois at Urbana Champaign
• Maintenance and Energy
• Utilities and Benchmarking
• Maintenance Programs
• Recommended Tips

Take away:

Regular Maintenance costs less over the long term!
• ~40-50% of building energy and energy costs are from heating, cooling, fans, and pumps and much higher when adding in lighting.

• Some utility budgets exceed maintenance salaries

• Building Operator is in control of equipment operation, maintenance, and replacement.
• Newer School (~200,000 sf) with BAS.

• Exhaust Fans weren’t scheduled.

• Estimated $7,000 in savings from scheduling off when school was unoccupied.

• Maintenance goes beyond fixing broken equipment. Maintenance is making sure the building systems are running in the best means possible.
• What are your utility costs or budget?
• The first step to excellent maintenance is knowing what you are using.
Usually finance department is in charge of these.

Don’t be shy to ask for them.

You can typically download from the internet if you know account/meter numbers.

Why look at these?
### Utility Bill Example

**ComEd**
An Exelon Company

**www.comed.com**
Customer Service / Power Outage
English 1-800-EDISON1 (1-800-334-3311)
Spanish 1-800-955-9237
Hearing/Speech Impaired 1-800-572-1586 (TTY)

For Electric Supply Choices Visit www.diuillinois.org

Your Usage Profile
13-Month Usage (Total kWh)

<table>
<thead>
<tr>
<th>Year</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
<td>1234</td>
</tr>
<tr>
<td>2020</td>
<td>1234</td>
</tr>
<tr>
<td>2019</td>
<td>1234</td>
</tr>
<tr>
<td>2018</td>
<td>1234</td>
</tr>
<tr>
<td>2017</td>
<td>1234</td>
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<tr>
<td>2016</td>
<td>1234</td>
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<tr>
<td>2015</td>
<td>1234</td>
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<tr>
<td>2014</td>
<td>1234</td>
</tr>
<tr>
<td>2013</td>
<td>1234</td>
</tr>
<tr>
<td>2012</td>
<td>1234</td>
</tr>
</tbody>
</table>

**Electric Usage**

<table>
<thead>
<tr>
<th>Month</th>
<th>kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jul-11</td>
<td>367</td>
</tr>
<tr>
<td>Aug-11</td>
<td>563</td>
</tr>
<tr>
<td>Sep-11</td>
<td>864</td>
</tr>
<tr>
<td>Oct-11</td>
<td>0</td>
</tr>
<tr>
<td>Nov-11</td>
<td>0</td>
</tr>
<tr>
<td>Dec-11</td>
<td>544</td>
</tr>
<tr>
<td>Jan-12</td>
<td>480</td>
</tr>
<tr>
<td>Feb-12</td>
<td>407</td>
</tr>
<tr>
<td>Mar-12</td>
<td>567</td>
</tr>
<tr>
<td>Apr-12</td>
<td>503</td>
</tr>
<tr>
<td>May-12</td>
<td>344</td>
</tr>
<tr>
<td>Jun-12</td>
<td>477</td>
</tr>
<tr>
<td>Jul-12</td>
<td>678</td>
</tr>
</tbody>
</table>

**Average Daily**

<table>
<thead>
<tr>
<th>Month Billed</th>
<th>kWh</th>
<th>Temp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last Year</td>
<td>21.0</td>
<td>71</td>
</tr>
<tr>
<td>Last Month</td>
<td>14.0</td>
<td>65</td>
</tr>
<tr>
<td>Current Month</td>
<td>21.2</td>
<td>74</td>
</tr>
</tbody>
</table>

**Bill Summary**

- Previous Balance: $61.21
- Total Payments - Thank You: $61.21
- Amount Due on July 24, 2012: $61.79

**Meter Information**

<table>
<thead>
<tr>
<th>Date</th>
<th>Meter Number</th>
<th>Load Type</th>
<th>Reading Type</th>
<th>Previous</th>
<th>Reading Present</th>
<th>Difference</th>
<th>Multiplier</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/9</td>
<td>0000000000</td>
<td>General Service</td>
<td>Total kWh</td>
<td>148.21 Actual</td>
<td>55.00 Actual</td>
<td>97.21</td>
<td>1.00</td>
<td>47.9</td>
</tr>
</tbody>
</table>

**Service from 5/31/2012 to 7/2/2012 - 32 Days**

**Electricity Supply Services**

- Electricity Supply Charge: 678 kWh X 0.06177 = 41.88
- Transmission Services Charge: 678 kWh X 0.00815 = 5.53
- Purchased Electricity Adjustment: 3.39

**Delivery Services - ComEd**

- Customer Charge: 6.86
- Standard Metering Charge: 2.76
- Distribution Facilities Charge: 678 kWh X 0.02467 = 16.32
- I. Electricity Distribution Charge: 678 kWh X 0.00121 = 0.82

**Taxes and Other**

- Smart Meter Program: 0.02
- Environmental Cost Recovery Adj: 678 kWh X 0.00027 = 0.18
- Energy Efficiency Programs: 678 kWh X 0.00161 = 1.09
- Franchise Cost: $26.19 X 2.04000% = 0.99
- State Tax: 2.54

**Total Current Charges**

$81.79

*Note: This bill is an example and may not reflect actual charges.*
Many methods for this

- Spreadsheet
- Third Party Software
- Energy Insights (ComEd)
- Portfolio Manager
UTILITY BILLS - TRACKING

**Total kWh**

**Therms**
One step further is to track weather

Use Cooling and Heating Degree Days

- Represent intensity of weather for the day/month/year
- Available at degreedays.net
  - Use closest weather station
- Add to spreadsheet
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Degree Days.net - Custom Degree Day Data

Degree Days.net calculates degree-day data for energy-saving professionals worldwide. The software is developed by BizEE Software based on temperature data from Weather Underground.

New! Degree Days.net Desktop: Assemble lots of data, fast. Export it all into a single spreadsheet. Try out our new desktop app today.

Degree Days.net

Enter a weather station ID if you have one, or search for any city, state, ZIP code, or airport code.

Weather station ID

Degree day type
- Heating
- Cooling

Temperature units
- Celsius
- Fahrenheit

Base temperature
- 65°F

Include base temperatures nearby

Breakdown
- Monthly
- Weekly
- Daily
- Average

Period covered
- Last 12 months

Generate Degree Days
**Monthly Gas Usage**

- HDD line is a relative indicator of gas use.
- Notice pretty good seasonal dependency.

**Monthly Electricity Usage**

- 2008 had summer school.
- Fairly high spring and fall baseload.
Then, things go crazy.
Comparing current usage to historic usage may help to notice malfunctioning equipment, equipment off schedule, etc.

- Better estimating of utility budgets.
- Verify energy savings projects.
- May want to investigate submetering or an energy dashboard.
Once you know your consumption you can begin to compare to other buildings.

Compare on a per foot basis.

- Usually seen as kBtu per square foot per year
- Can also compare electricity or natural gas use per square foot.

Know how much room there is to improve
ENERGY STAR’s Target Finder
Commercial Buildings Energy Consumption Survey (CBECS)
- Uses similar building types in the same areas
- Input zip code, facility characteristics, and annual energy consumption
- Receive a score of how you compare
- If your score is higher than 75 you could qualify as an ENERGY STAR building
New Schools, < 20 years old

- Electric kBtu/sf
- Gas kBtu/sf

Energy Use Intensity (kBtu/sf/yr)
Comparing current usage to historic usage may help to notice malfunctioning equipment, equipment off schedule.

Comparing to other buildings can help quantify your potential for energy savings / reduction.
Performance of the building is heavily influenced by maintenance.
VARIOUS MAINTENANCE APPROACHES


- **Reactive**
  (“run it until it breaks”) $18/hp

- **Preventative**
  (“follow the schedule”) $13/hp

- **Predictive**
  (“test when to replace”) $9/hp

- **Reliability Centered Maintenance** (hybrid) $6/hp
COST OF DEFERRED MAINTENANCE

Maintenance and Energy
Utilities and Benchmarking
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Recommended Tips

Graphic from Stonegate Property Inspections, LLC

Repair costs

Structural failures occur
Structure not usable
Start of major failures
Start of minor failures
Normal wear

Time in years

Total cost of major repair (C)
Total cost of minor repair (B)
Total cost of preventive maintenance (A)
ECONOMICS OF MAINTENANCE

It is estimated that O&M programs targeting energy efficiency can save 5% to 20% on energy bills without significant capital investment (PECI 1999).

Tune-ups typically translate to energy savings of 5% to 15% (E SOURCE).

Cost of tune-up (ENERGY STAR)
- $0.01-$0.10/sf newer bldg
- $0.10-$0.50/sf older bldg

US DoE Forrestal Bldg.
- Steam trap maintenance
- program saved $250,000/yr
CHILLER TUNE-UPS = 5% OF COOLING COSTS

To maintain efficiency in O&M

- Maintain economizers
  - Test at least twice a year
  - Damper operation
  - Adjust air temperature sensors
- Clean and replace air filters
- Inspect and clean evaporator and condenser coils
- Measure and correct and refrigerant charge
- Fix leaks in cabinet and supply ducts
- Reset condenser water temperature
- Stage multi-chiller operation to improve part-load performance
- Other:
  - Raise thermostat settings
  - Reduce run hours
  - Reset chilled water temp
  - Clean evaporator and condenser tubes
  - Minimize use of reheat
  - Don’t cool unused space
To maintain efficiency in O&M

- Develop and implement routine inspection and maintenance program
  - Check steam traps and lines (replace as necessary)
  - Condensate pumps
- Boiler tune program once per year
- Insulate piping and central storage tank
- Blowdown to remove accumulated dissolved solids
  - Excessive blowdown wastes water, energy, and chemicals
- Water treatment program to prevent scale and corrosion
- Clean and inspect boiler water and fire tubes
- Use expansion tank to temper boiler blowdown drainage
- Install meters on boiler system make-up lines and recirc water loop
- Consider summer shutdown

BOILER TUNE-UPS = 6% GAS SAVINGS
To maintain efficiency in O&M

- Test traps and replace as failed
  - Sight method (visually observe steam escaping)
  - Sound method (ultrasonic measuring equipment)
  - Temperature method (thermography) least reliable
  - Automatic diagnostics (self-diagnosing steam trap)

- Checklist for possible trap failure
  - Abnormally warm boiler room
  - Condensate received venting steam
  - Condensate pump water seal failing prematurely
  - Boiler operating pressure difficult to maintain
  - Vacuum in return lines difficult to maintain
  - Water hammer in steam lines
  - Higher than normal energy bill
  - Inlet and outlet lines to trap nearly the same temperature
Presentations will be available at:
presentations.sedac.org

Web site: www.sedac.org
Contact: info@sedac.org
1-800-214-7954