Industrial Energy Efficiency

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How to Save Energy

1. Contract an energy audit
   – list of recommendations
   – act upon a subset of them (implementation)
   – one time savings (5-15%)

2. Implement an energy management program
   – hire or train energy aware technicians
   – support and implement energy based projects
   – consider energy in all decisions (purchasing, production, scheduling) at all levels
   – continuous improvement and savings (30%-70%)
UF Industrial Assessment Center

• DOE energy audits for small to medium sized manufacturing companies.

• Service North and Central Florida, South Georgia, and East Alabama.

• One or two day on-site audit followed by a detailed report and follow-up survey.

• Provide hands on energy management experience for engineering undergraduate and graduate students.
DOE IAC Program

- 30+ year program; 26 University based centers
- Saved **243 trillion Btu** in 2008
- As of 2008 2,855 IAC students graduated
- IAC Program benefits:
  - **Objective information** to help make plants cleaner more energy efficient
  - Engineering students receive hands-on industrial experience
  - Universities build valuable **local industry relationships** to maintain a practical focus in their engineering curriculum
The Audit Process

• **STEP 1:** Pre-Assessment Information Gathering
  – Size of Plant and plant layout
  – Industry type (SIC/ NAICS code) and process description
  – Production levels, units and dollars, operating hours
  – A one year history of utility bills
  – List of major energy consuming equipment

• **STEP 2:** Ensure that key plant personnel are involved
  – Plant manager, Energy manager, Environmental personnel, Maintenance personnel

• **STEP 3:** Pre-Assessment Analysis
  – Analyze the manufacturing process
  – Analyze utility bills for trends and errors; establish unit cost of energy
  – Review design and other technical documentations
  – Identify possible energy saving potential recommendations

• **STEP 4:** Assessment

• **STEP 5:** Post Assessment Activities
  – Conduct engineering and financial analysis
  – Complete IAC Report
  – Follow-up to Report
Assessment Recommendation (AR)

• Types of recommendations:
  – Energy Management
  – Lighting systems
  – Motors & pumps
  – HVAC
  – Heat/cooling recovery
  – Compressed air
  – Steam generation
  – Insulation
  – Building envelope

• Recommendations contain detailed technical and financial analysis of the potential savings.
## UF-IAC – Saving Energy


<table>
<thead>
<tr>
<th>Recommended Savings</th>
<th>Usage Reduction</th>
<th>% Reduction</th>
<th>Cost ($) Savings</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Energy</td>
<td>21,158</td>
<td>18.5%</td>
<td>$112,763</td>
<td>MMBtu</td>
</tr>
<tr>
<td>Electrical</td>
<td>1,798,108</td>
<td>26.7%</td>
<td>$92,185</td>
<td>kWh</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>1,256</td>
<td>5.1%</td>
<td>$2,425</td>
<td>MMBtu</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Implemented Savings</th>
<th>Usage Reduction</th>
<th>% Reduction</th>
<th>Cost ($) Savings</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Energy</td>
<td>4,784</td>
<td>4.2%</td>
<td>$26,167</td>
<td>MMBtu</td>
</tr>
<tr>
<td>Electrical</td>
<td>400,283</td>
<td>5.9%</td>
<td>$20,857</td>
<td>kWh</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>420</td>
<td>1.7%</td>
<td>$2,146</td>
<td>MMBtu</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Initial Plant</th>
<th>Usage</th>
<th>Cost ($)</th>
<th>Unit Cost</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Energy</td>
<td>114,549</td>
<td>$559,848</td>
<td>$6.80</td>
<td>MMBtu</td>
</tr>
<tr>
<td>Electrical</td>
<td>6,745,730</td>
<td>$376,186</td>
<td>$0.062</td>
<td>kWh</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>24,430</td>
<td>$104,044</td>
<td>$2.69</td>
<td>MMBtu</td>
</tr>
</tbody>
</table>

Total Assessments: 441
Recommendations/audit: 8.5
Implementations/audit: 3.6
Example Audit Recommendation

Replace Metal Halide (MH) lights with high bay fluorescent lighting.

- 400 Watt MH is cheap ($10 bulb)
- T8 Fluorescent (high bay $200, 6x$5=$30)

• MH has a restrike time (20 min)
• Fluorescent is 200 Watt and controllable
  - occupancy sensors ($80)
  - dimmable for daylight sensing

• Payback?
  
  \[(400W-200W)\times8760h=1.75kW\cdot h\]

source: 1000bulbs.com, grainger.com
Industrial Energy Efficiency; Timothy Middelkoop, Ph.D. C.E.M.
Quantifying Industrial Energy Savings

• Low hanging recommendations are often inexpensive, low risk, and most likely save money (5-15%).

• Large savings come from large investments and often have less marginal savings (30%?).

• Huge savings can come from process changes but most require intimate knowledge of the process (70%).
Managing Energy

- **Requires commitment (ISO 50001)**
  - commitment to change
  - capital
  - continuous improvement
- Requires an educated workforce
- Requires data
- Requires validation

ISO 50001 plan-do-check-act cycle

http://www.iso.org/iso/iso_50001_energy.pdf
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An Educated Workforce

• Integrated into curriculum
  – motivate in introductory courses
  – provide tools in technical classes
  – provide integration and experience with energy capstone course

• Industrial energy management classes
  – fundamentals of energy use
  – exposure to alternative technologies
  – measurement and validation
  – provide hands on experience (labs, audits, etc.)

http://grainger.com
Educated Savings (Data)

• Larger savings come from part load and process change

• Measurement and validation require data
  – standalone data loggers
  – handheld tools with data logging capability
  – equipment controls
  – process controls

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Putting it Together: Experience

• Hands on experience is invaluable
  – instrument training
  – combine measurement, data logging, savings prediction and validation

• Onsite audits are invaluable

• The work/home provides many learning opportunities

• Basic kits under $100
  (current/voltage/PF, temperature, air velocity calculator, stopwatch, service meters)

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Energy Labs

• Assessment Training by Rutgers CASE (Preliminary DOE IAC program)
• Hands-on
• Fundamentals
• Measurement
• Low cost
• Portable
Continuing Education and Certification

• Certified Energy Manager (C.E.M) certification by the AAE
  – provides continuous continuing education

• DOE EERE website webinar series
  – many high quality educational materials, case studies, and software
  – webcasts, webinars etc.
    http://eere.energy.gov/industry/resources/webcasts.html

• Vendors often provide webinars and webcasts
References and Resources

- AEE CEM: http://aeecenter.org
- ISO 50001: http://iso.org
- DOE EERE ITP: http://eere.energy.gov/industry
- DOE IAC Program: http://iac.rutgers.edu
- Fluke instruments: http://fluke.com
- HOBO data loggers: http://onsetcomp.com
Questions?

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