Industrial Energy Assessments

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Security Classification:
- Report: Unclassified
- Abstract: Unclassified
- This Page: Unclassified

Limitation of Abstract: Unclassified

Number of Pages: 30

Name of Responsible Person: Unclassified
University of Illinois

- Three campuses
- Total on-campus enrollment: 67,600
- Operating budget: $2.7 billion
- Separately funded research: $616 million
University of Illinois at Chicago (UIC)

- Total on-campus enrollment: 25,690
- Full-time employees
  - Faculty: 2,380
  - Administrative and professional: 2,971
  - Support staff: 5,364
- Operating budget: $1.25 billion
- Separately funded research: $234 million
Energy Resources Center (ERC)

- Created in response to the 1973 oil embargo
- ERC is a public service, research, and special projects organization
- Dedicated to improving energy efficiency and the environment across all markets
- ERC is a "fast response" team of professionals capable of quickly extending technical expertise, advice, and professional assistance
- Staffed by faculty, professional engineers, architects, economists and computer specialists
Energy Resources Center Research Groups

- Building Sciences Research
- Combined Heat and Power/Distributed Generation
- **Engineering Solutions Group**
  - *USDOE Industrial Assessment Center*
- Policy and Assessment Group
Engineering Solutions Group
Overview

- Provide unbiased energy management solutions to Midwestern businesses and not-for-profits, state and local government
  - Energy conservation, energy supply chain management
  - Waste minimization and productivity solutions
  - Industrial, commercial, and institutional clients
  - Currently expanding to a national presence
Need for Energy Management

- Three Major Issues
  - Economic Competitiveness
    - Reduce commercial/institutional/governmental energy use
    - Reduce production costs and industrial energy use
  - Energy Security
    - Reduce oil and other energy imports (natural gas)
    - Reduce vulnerability to “shortages” of oil
  - Environmental Quality
    - Issues of global warming, acid rain, ozone depletion, etc.
Statistics

  - Industrial 35%
  - Commercial/Residential 34%
  - Transportation 27%
## EIA-MECS DATA 1998

<table>
<thead>
<tr>
<th></th>
<th>Electricity</th>
<th>Natural Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect Process Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boiler Fuel</td>
<td>5,568</td>
<td>2,471</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Process Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process Heat</td>
<td>103,299</td>
<td>3,104</td>
</tr>
<tr>
<td>Process Cooling</td>
<td>54,473</td>
<td>21</td>
</tr>
<tr>
<td>Machine Drive</td>
<td>457,344</td>
<td>96</td>
</tr>
<tr>
<td>Electrochemical</td>
<td>87,200</td>
<td>n/a</td>
</tr>
<tr>
<td>Other Processes</td>
<td>3,380</td>
<td>51</td>
</tr>
<tr>
<td>TOTAL</td>
<td>705,696</td>
<td>3,272</td>
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</tbody>
</table>
## EIA-MECS DATA 1998

<table>
<thead>
<tr>
<th>Non-process Direct Use</th>
<th>Electricity</th>
<th>Natural Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility HVAC</td>
<td>79,355</td>
<td>392</td>
</tr>
<tr>
<td>Facility Lighting</td>
<td>61,966</td>
<td>n/a</td>
</tr>
<tr>
<td>Other Facility Support</td>
<td>14,338</td>
<td>39</td>
</tr>
<tr>
<td>On-site Transportation</td>
<td>1,380</td>
<td>5</td>
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<tr>
<td>Electrical Generation</td>
<td>n/a</td>
<td>204</td>
</tr>
<tr>
<td>Other</td>
<td>696</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>157,735</strong></td>
<td><strong>640</strong></td>
</tr>
</tbody>
</table>
Assessment Overview

- **Energy Audit Goals**
  - Identify the types and costs of energy used
  - Identify opportunities that reduce energy use (energy costs)
  - Conduct economic analyses on opportunities to determine cost effectiveness (ROI, ROR)
  - Recommend implementation strategy
  - Recommend implementation financing
  - Measurement and verification (Cx)
Energy Savings Opportunities

- No-cost and maintenance issues
  - 2 to ? percent expected savings
- Low-cost/short payback actions
  - 5 to 15 percent expected savings
- High-cost/longer payback actions
  - 15 to ? percent savings
Top 5 Requirements for Success

- Management commitment to EM
- Staff cooperation (willing to learn)
- Management willing to invest in energy projects
- Time and budget available to conduct energy assessments
- Implementation strategies
Industrial Assessment Methodology

- Acquire 12 months of energy bills and basic information about the plant
  - Electricity
  - Natural gas
  - Operating schedule
  - Equipment list
  - Energy concerns and actions taken to date

- Analyze bills and information
  - Seasonal usage patterns
  - Operational usage patterns
  - Calculate avoided energy costs
  - Puts upper limit on what can be saved
Industrial Assessment Methodology

- Plant assessment
  - Initial sit down
  - Walk through
    - Get familiar with production flow and systems
    - Identify energy users and their locations
    - Consolidate ideas
  - Breakout
    - Collect data
    - Take static measurements
    - Install monitoring equipment
Industrial Assessment Methodology

- Initial questions to plant management
  - Current/future operations
  - Impending changes
  - Thoughts and ideas
  - Their “wish list”
- Continue data collection
- Debrief plant management
Industrial Assessment Methodology

- Basic energy using systems
  - Compressed air and the associated distribution system
- Motors
- Lighting
- HVAC/building pressurization
- Boiler/steam system
Industrial Assessment Methodology

- Other energy using systems
  - Refrigeration
  - Melting furnaces
  - Process ovens
  - Cracking towers
  - Welding
The UIC-IAC

- Since FY00
  - Currently working on fourth year
- 82 assessments to date
- 16 general industry groups assessed
- Over 700 recommendations made
- Goal is to save client at least 10% of total energy budget within their capital investment guidelines
UIC-IAC Results
FY2001 - FY2002

- Conducted 48 assessments
- Identified 383 savings opportunities
- On average, each assessment
  - $275,000 in savings opportunities
  - Implementation cost of $295,000
  - Simple payback of 13 months
- 159 of the 351 recommendations implemented (~45%)
UIC-IAC Results
FY2001 - FY2002

- Recommendations per assessment day (energy only)
  - Average savings: $60,000
  - Implementation cost: $100,000
  - Simple payback: 1.7 years

- Recommendations per assessment day (energy, waste and productivity)
  - Average savings: $254,000
  - Implementation cost: $260,000
  - Simple payback: 1 year
Industrial Programs - Non IAC

- Improve E2, P2 and productivity in within Chicago’s industrial base
  - Increase efficiency
  - Retain business within city
- Provided funding for assessments and implementation projects
- Program started in January 2001
- Targeted Metal Casting industry first
  - One of the most energy intensive industries
- 17 assessments completed
Industrial Programs-Non IAC

- Predicted savings in the Metal Casting industry
  - $3.5M in cost savings identified
  - 45% in energy efficiency opportunities
  - 43% in productivity improvement opportunities
  - 12% in waste reduction opportunities
- Implementations continuing
- Assessment work continuing in the Chemicals industry and the Food and Kindred products industry
  - Implementation projects started for Chemicals industry
Industrial Programs-Non IAC

- State of Illinois Industrial Programs
  - Improve E2, P2 and productivity in within State’s industrial base
    - Increase efficiency
    - Retain business within State

- Industries studied since 1996
  - Plastics, Metal Fasteners, Chemicals, Foods, Metal Casting, Paperboard
Industrial Programs-Non IAC

- Continuation of State Programs
  - New administration
  - Targeting 10 economic development areas
  - Multi year program starting in FY05
  - “Thousands of audits”
  - “Greater than 50 percent implementation rate”
Energy Conservation Success Story

- Primary metals manufacturer
- Major energy user is a natural gas furnace with no pre-heated air
- Recommended a two-pass heat exchanger for furnace exhaust
  - Returned 1,600°F air to furnace
  - Predicted energy use reduction of 35%
  - Predicted annual savings of $197,000
  - Predicted investment payback of less than two years
- This hardware is in the budget for purchase
Energy Conservation Success Story

- Chemical facility with 102 steam traps failed in the open position
- Boiler operating at ~83-85% efficiency (new equipment)
- Steam system operating at 175 psig
- Annual natural gas, water and chemical treatment savings of $154,000
  - 40,000 MMBtu in natural gas
  - Replacing steam traps with new units cost $26,000
  - Simple payback just over two months
- This project has been installed
Energy Conservation Success Story

- Facility using two 150 hp screw compressors
  - Operating in tandem with no air storage
  - Compressors not communicating with each other, both attempting to service same loads
  - Recommend adding air storage and sequencing controls
- Compressors operating as “base” and “trim” units with trim in load/unload mode
- Annual energy and demand savings of $14,000
- Simple payback in 2.3 years (budgeted)
Conclusions

- Energy waste is ubiquitous in all markets
  - Unnecessary and costly
  - Prudent energy conservation opportunities are available and real
    - Virtually all plants can take advantage of at least NC/LC opportunities
    - Many MC/HC opportunities fall within MARR of industrial plants
    - Doing nothing is not an option as energy costs in a deregulated market cannot be ignored