Assessing the Costs and Benefits of the Superior Energy Performance Program

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ACEEE Summer Study on Industrial Energy Efficiency

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Agenda

- Background
  - ISO 50001 – Energy Management System Standard
  - Superior Energy Performance (SEP) program
- Issue
  - Understanding of the SEP business value
- Methodology
  - Collection and analysis of SEP certified facility savings and cost data
- Results
  - Energy and energy cost savings
  - Payback
  - Qualitative findings
- Future Work
- Global Superior Energy Performance (GSEP)
- Conclusions
- Case Studies
Introduction to ISO 50001 – Energy Management System Standard

- Framework for industrial and commercial organizations to manage energy.
  - Requirements for energy management systems (EnMS).
  - Applies to any organization with energy uses.
  - Uses collection and analysis of available energy data to support energy management decision making improving:
    - Ability to benchmark, measure, and report.
    - Transparency and communication to management.
    - Operations and capital cost decisions.

- Global reach and impact:
  - 49 countries involved in standard development.
  - Many countries have nationally adopted ISO 50001, including the United States.
  - 3,000+ known certifications in 2 years since publication.
Introduction to ISO 50001 – Foundation and Requirements

- Foundation - Plan Do Check Act cycle
- Management of energy across entire organization
- Requirements include:
  - Top management commitment
  - Energy management team
  - Energy policy
  - Energy planning process
    - Energy review
    - Identification of significant energy uses
    - Establish energy baseline
    - Selection of one or more Energy Performance Indicators (EnPI) to quantify energy performance and measure improvements
  - Operating controls and procedures for energy uses
  - Documentation of energy performance improvement
  - Management review
Superior Energy Performance (SEP) – Implementing ISO 50001 in U.S. Industry

- A voluntary, market based, ANSI/ANAB-accredited certification program
- Roadmap for achieving continual improvement in energy efficiency while boosting competitiveness to industrial and commercial facilities.
- Goals
  - Drive continual improvement in energy performance.
  - Validate energy management practices and performance improvements.
  - Encourage uptake of EnMS throughout industry.
  - Support and build a market and workforce for EnMS.
- Structure
  - ISO 50001 foundation + quantified energy performance improvement targets.
  - Certification after third party verification of:
    - ISO 50001 conformant EnMS and
    - achievement of energy performance improvement target.
Superior Energy Performance – Performance Criteria for Certified Partners

<table>
<thead>
<tr>
<th>Performance Characteristics</th>
<th>Silver</th>
<th>Gold</th>
<th>Platinum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy Performance Pathway</strong></td>
<td>Energy Performance Improvement</td>
<td>Meets 5% energy performance improvement threshold over the last 3 years.</td>
<td>Meets 10% energy performance improvement threshold over the last 3 years.</td>
</tr>
<tr>
<td></td>
<td><strong>Mature Energy Pathway</strong></td>
<td><strong>Meets 15% energy performance improvement threshold over the last 10 years.</strong></td>
<td></td>
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</tbody>
</table>

This study focuses on facilities certified via Energy Performance Pathway

Mature Energy Pathway uses combination of points for achievement of energy performance improvements and energy management best practices.

- Meets a score of at least 35 points
- Minimum of 30 points required for energy management best practices
- Meets a score of at least 61 points
- Minimum of 40 points required for energy management best practices and 10 points for energy performance (beyond 15% over the last 10 years)
- Meets a score of at least 81 points
- Minimum of 40 points required for energy management best practices and 20 points for energy performance (beyond 15% over the last 10 years)

http://www.superiorenergyperformance.net/qualify.html
Implement structured EnMS following ISO plan-do-check-act approach

Entry point for plants:
• In energy-intensive industries
• Prior ISO system or energy management experience

Provides value beyond ISO 50001:
• M&V protocol
• ANSI-accredited 3rd party verification

Implement ISO 50001 EnMS and establish a robust energy data tracking and measurement system

Superior Energy Performance

Entry point for medium/large plants:
• Prior energy management activities
• No prior ISO system experience

ISO 50001

Continual Energy Improvement

Systematic approach in preparation for ISO 50001 implementation

Entry point for facilities of any size
• No energy management experience

Project Focus

Loosely organized project-by-project approach

Superior Energy Performance

Continual Energy Improvement

Project Focus

Strategic Energy Management Continuum
Superior Energy Performance – Demonstrations

States, regions, and utilities are partnering with U.S. DOE to support Superior Energy Performance demonstrations in companies across the country.

Corporate Industrial Participants:
Green highlight indicates company with one or more certified facility

- 3M
- Allsteel
- Ascend Performance Materials
- Bentley Prince Street
- Bridgestone Tire
- Coca-Cola
- CCP Composites
- Cooper Tire
- Cummins
- Curtiss-Wright Flow Control Company
- Didion Milling, Inc
- Dixie Chemical
- Dow Chemical
- Eaton
- Freescale Semiconductors
- General Dynamics
- Gerdau
- Harbec Inc.
- Haynes International
- Ingersoll Rand
- Land O’ Lakes
- Lockheed Martin
- Mack Trucks
- MedImmune
- Neenah Foundry Company
- Nissan
- North American Höganäs
- OLAM Spices
- Owens Corning
- Republic Conduit
- Schneider Electric
- Spirax Sarco
- UTC/Sikorsky
- United States Mint
- Volvo
- World Kitchen

www.eere.energy.gov/manufacturing/tech_deployment/sep_demonstrations.html
### Superior Energy Performance Program Certifications

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Facility Wide Verified % Energy Performance Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volvo Trucks, NA</td>
<td>Dublin, VA</td>
</tr>
<tr>
<td>Dow Chemical Company</td>
<td>Texas City, TX: Manufacturing facility</td>
</tr>
<tr>
<td>3M Canada Company</td>
<td>Brockville, Ontario, Canada</td>
</tr>
<tr>
<td>Cook Composites and Polymers</td>
<td>Houston, TX</td>
</tr>
<tr>
<td>General Dynamics</td>
<td>Scranton, PA</td>
</tr>
<tr>
<td>Allsteel</td>
<td>Muscatine, IA</td>
</tr>
<tr>
<td>Cooper Tire</td>
<td>Texarkana, AR</td>
</tr>
<tr>
<td>Olam Spices</td>
<td>Gilroy, CA</td>
</tr>
<tr>
<td>Owens Corning</td>
<td>Waxahachie, TX</td>
</tr>
<tr>
<td>Dow Chemical Company</td>
<td>Texas City, TX: Energy systems facility</td>
</tr>
<tr>
<td>Nissan, NA</td>
<td>Smyrna, TN</td>
</tr>
<tr>
<td>Freescale Semiconductor, Inc.</td>
<td>West Austin, TX</td>
</tr>
<tr>
<td>3M Company</td>
<td>Cordova, IL</td>
</tr>
<tr>
<td>Bridgestone Americas Tire</td>
<td>Wilson, NC</td>
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</table>

- 14 facilities SEP certified.
- Another 25 facilities pursuing certification.
  - Up to 6 more facilities anticipated by end of 2013.
- SEP certified facilities improved their energy performance
  - Between 6.2% and 25.8%
  - Facility average 11.7% via Energy Performance Pathway
Issue – Understanding the SEP Business Value

- Facilities investment in SEP
  - Staff time
  - Metering/Monitoring equipment
  - Expert technical assistance
  - Certification audit

- Facilities receive benefits from SEP
  - Energy cost savings
  - Third party verified energy savings
  - Internationally recognized standard

SEP business value can be:
- Quantified through analysis of cost and benefit data from SEP certified facilities.
- Enhanced by understanding the value of SEP to facilities.
- Communicated to facilities considering SEP.
Determining SEP Business Value – Data Collection Methodology

**Data Collection Methodology**

Nine Industrial Facilities

- **Questionnaire**
  - Facility identification
  - Energy consumption and costs
  - Operational and capital energy performance improvement actions
  - SEP implementation costs
  - Value of ISO 50001 and SEP to the facility

- **Phone Interview**
  - Review questionnaire answers
  - Qualitative insights

**Energy Consumption**

- Monthly energy consumption and savings
- Monthly energy prices (from facility or EIA)
- Regression models and relevant variables

**Energy Costs**

Energy costs = energy consumption * energy prices

**SEP Implementation Costs**

(including costs covered by U.S. DOE or utility demonstration sponsors)

- Internal staff time
- External technical assistance
- Metering and monitoring equipment
- Third-party ISO 50001 audit and SEP performance verification
Determining SEP Business Value – Attributing Savings to BAU and SEP

- First SEP training date set as SEP start date for each facility.
- Monthly savings aggregated into quarterly savings around first SEP training date for each facility.
  - Savings pre-first SEP training date = BAU.
  - Savings post-first SEP training date = BAU + SEP attributable.
- Average of quarterly savings pre-first SEP training = BAU portion of post-first SEP training quarterly savings.

Example

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Average Quarterly Energy Cost Savings Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-SEP</td>
<td>SEP Pre-First SEP Training 7.4% +Q1 to +Q4 3.8% Attributable to SEP.</td>
</tr>
<tr>
<td>Post-SEP</td>
<td>SEP Post-First SEP Training 13.7% +Q5 to +Q6 10.1% Attributable to SEP.</td>
</tr>
<tr>
<td>BAU</td>
<td>BAU Average Quarterly Energy Cost Savings Percentage.</td>
</tr>
<tr>
<td>BAU</td>
<td>BAU Savings 3.4% −Q4 to −Q1</td>
</tr>
<tr>
<td>SEP</td>
<td>SEP Attributable Savings</td>
</tr>
<tr>
<td>BAU</td>
<td>BAU Attributable Savings</td>
</tr>
</tbody>
</table>
Determining SEP Business Value – Aggregating Nine SEP Facilities

- Facilities’ baseline energy consumptions and costs vary.
  - 0.07 to 3.4 TBtu source energy (average = 1.5 TBtu)
  - $0.5 million to $21.9 million (average = $10.6 million)

- Facility energy and energy cost savings normalized by baseline energy consumption and energy cost.
  - e.g. \[
  \frac{\text{Facility quarterly energy savings}}{\text{Facility average quarterly baseline energy consumption}}
  \]
  - Result: facility energy and energy cost savings percentage values.

- Averages of nine facility normalized values provide aggregated savings values.

- Data availability
  - Four quarters prior to first SEP training
  - Six quarters after first SEP training
Results – Energy Performance Improvement Actions

- Facilities reported that ISO 50001 helped them identify operational (low or no-cost) improvements opportunities that previously had gone unnoticed.
  - 74% of energy and energy cost savings come from operation actions.

- Impact of SEP on operational / capital energy savings split:
  - Pre-first SEP training: 64 / 36 (operational / capital)
  - Post-first SEP training: 74 / 26 (operational / capital)

- All 9 facilities implemented operational energy performance improvement actions.
- 3 facilities only implemented operational energy performance improvement actions to achieve savings.
- Only 1 facility achieved greater than 50% of savings from capital improvement actions.
Results – Energy Savings Percentages

- Facilities required longer than one quarter to implement an EnMS.
- SEP attributable savings start in +Q2 when EnMS implementation starts to impact energy savings.
Results – Energy Cost Savings Percentages

- Programmatic focus on energy performance yields significant energy cost savings.
- BAU energy cost savings percentages vary post-first SEP training due to energy price fluctuations.
Results – Costs of Implementing and Certifying ISO 50001 and SEP

- Average total cost = $319,000
  - Summation with above numbers not exact due to rounding errors
- Average of 1.5 person years to develop, implement, and maintain EnMS.
- Energy team typically comprised of existing staff.
- One facility reported installing far more metering equipment than needed.
  - $15,000 metering and monitoring equipment average cost w/o this facility.
- ISO 50001 / SEP audit costs dependent upon facility size.
  - ranged from $16,000 to $20,000
Results – Payback

Capital energy performance improvement action costs and savings not included.

- SEP certification payback related to baseline energy consumption.
- < 2 year payback for facility with > 0.27 TBtu baseline annual source energy consumption.
Results – Qualitative Findings

- **Common qualitative benefits**
  - Identify overlooked operational energy performance improvement actions.
  - Effectively communicate the value of continual improvement across the facility.

- **Value of third party verification**
  - Top management has confidence in energy performance improvement results.
  - Credibility to energy savings claims.
  - Made the local community aware of sustainability efforts.
  - Encouraged facilities to stretch and meet a goal.

- While the ISO 50001 EnMS provided a strong business process to manage energy, the addition of SEP energy performance improvement targets and third party certification provided significantly enhanced value, making the program worthwhile.
Future Work

- Refine and use developed methodology in future studies.
  - Standardize and streamline data collection process.
- Obtain additional data as facilities achieve SEP certification.
  - Focus on small and medium sized facilities.

Global Superior Energy Performance (GSEP)

- U.S. DOE initiated the GSEP initiative.
  - 11 participating countries.
- GSEP enables the sharing of best practices of national programs and policies that encourage the adoption of EnMS and ISO 50001.
  - A forum for sharing experiences, not a global extension of U.S. SEP program.
- This analysis to be included in the GSEP international Energy Performance Database.
Conclusions

- Developed a methodology to quantify the costs and benefits of SEP participation.
- ISO 50001 enabled facilities to identify and implement more operational energy performance improvement actions.
  - 74% of energy and energy cost savings come from operational actions.
- Energy and energy cost savings increased significantly after SEP implementation over BAU savings. In first half of second year post-first SEP training, average:
  - Energy savings: 13.7% with SEP vs. 3.6% BAU.
  - Energy cost savings: 11.3% with SEP vs. 3.4% BAU.
- Average cost to implement and certify to ISO 50001 and SEP = $319,000.
  - Internal staff time = largest cost (67%)
- Payback < 2 years for facilities that consume > 0.27 TBtu per year.
Case Studies

- Detailed case studies being developed under GSEP.
  - Nissan (developed)
    - Nissan improved energy performance at its vehicle assembly plant in Smyrna, TN by 7.2% with a four-month payback period implementing SEP.
  - Volvo Trucks and General Dynamics (under development)
- Provide additional details to presented study.

Monthly SEP Percent Energy Performance Improvement

Costs and Benefits of SEP Implementation

- Internal Staff Time Costs

In MS Development $219,000
- Monitoring and Metering Equipment $21,000
- Technical Assistance $44,000
- Audit Preparation $31,000
- Audit $16,000

Annual Energy Cost Savings
- SEP Implementation Costs

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