Benchmarking Industrial Plant Energy Efficiency

How EPA’s ENERGY STAR® Program Helps Industry Improve Energy Efficiency

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ENERGY STAR Industrial Partnership
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Learn more at energystar.gov
ENERGY STAR

- Voluntary government partnership
  - *Goal: reduce carbon dioxide emissions*
  - Introduced by EPA in 1992 to enable companies to improve in energy efficiency

- The national symbol of energy efficiency and environmental protection
  - Awareness exceeds 70% of U.S. households
  - A brand owned and managed solely by the government

- Focused on improving energy efficiency of:
  - Products
  - Homes
  - **Plants & buildings**

- For industrial businesses, EPA helps manufacturers improve strategic energy management.
ENERGY STAR & Industry

• EPA’s goals:
  
  – “Shift the curve” of energy performance for manufacturing industries
  – Identify the transformative practices to achieve top energy performance
  – Help companies succeed in achieving top performance
Barriers to energy efficiency prevent progress

- Lack of objective measurement methods
- Scarce information on how to improve
- Lack of corporate commitment
ENERGY STAR provides business a clear pathway to succeed

1. Evaluate risks, prepare energy strategy with senior management

2. Build company-wide energy program, using ENERGY STAR guidelines for energy management

3. Look to suppliers and customers
Step 1 - energy strategy

Energy Strategy for the Road Ahead

- helps companies prepare a strong energy strategy
- developed with 20 leading companies and their senior managers

Report at: www.energystar.gov/energystrategy
Step 2 - guidance for managing energy

ENERGY STAR Guidelines for Energy Management

- help to put in place a strong energy management program
- help to benchmark energy use & practices
- consulted by thousands of organizations
- based on the successful practices of ENERGY STAR’s partners

www.energystar.gov/guidelines
Step 3 - help in managing energy across the value chain

Energy Value Chain

Upstream / Inputs
- Efficiency enforcement
- Reduced embedded energy

Internal Operations
- Energy efficiency
- Energy as ‘lens’ for growth & opportunity
- New approaches to energy diversification and risk management
- New technologies

Downstream / Outputs
- Product recycling and repurposing
- Product and service redesign

Supplier Engagement Strategies
Internal Implementation Strategies
Customer Engagement Strategies

Product and service lifecycle energy requirements
ENERGY STAR designed to address the barriers

**Barrier**
- Lack of a bearing on efficiency

**Solution**
- Benchmarking is an objective measurement method
Let’s get on the same page

• Benchmarking
  – The process of comparing to something similar or the best

• *Energy* benchmarking
  – The process of comparing the energy performance of facilities, processes or equipment to something similar or the best
Types of benchmarking

• **Internal**
  – compares performance against internal baseline or benchmark

• **External**
  – compares performance against a metric “outside” of the organization
  – identifies “Best in Class” performance

• **Quantitative**
  – data-driven; compares actual numbers

• **Qualitative**
  – based on best practices; compares actions
Benchmarking’s place in energy management

• Fundamental practice

• Energy reductions and project measurement are nice but only benchmarking proves improvements have had an effect

• Can be based on comparison of management practices or energy data
  
  – **practice** benchmarking gives an idea of where to improve by identifying best energy management practices

  – **energy data** benchmarking informs how well an entity might perform and improve and the position of that entity in terms of energy performance

## Variety of benchmarking in energy management

<table>
<thead>
<tr>
<th>Energy Management Objective</th>
<th>Scale</th>
<th>Focus</th>
<th>Time Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess equipment efficiency</td>
<td>Equipment or process</td>
<td>Internal – comparison against other owned equipment or process</td>
<td>• Peak demand period</td>
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<td></td>
<td></td>
<td>External – comparison to industry standard or cooperative study with other organizations</td>
<td>• Three month sample</td>
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<td>• Continuous from baseline</td>
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<tr>
<td>Assess facility performance</td>
<td>Whole facility or sub-metered portion</td>
<td>Internal – comparison of single facility over time. Comparison of similar facilities within single organization External – comparison of facility against national performance rating</td>
<td>• Continuous from baseline</td>
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<td>• Annual</td>
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<tr>
<td>Assess department or divisional energy use</td>
<td>Facilities or sub-metered portions of facilities</td>
<td>Internal – comparison against internal sub-divisions</td>
<td>• Continuous from baseline</td>
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<td>• Annual</td>
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<tr>
<td>Assess organizational performance</td>
<td>All facilities</td>
<td>Internal – comparison over time or towards goal. Comparison of portfolio average against a national performance rating</td>
<td>• Continuous from baseline</td>
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ENERGY STAR benchmarks

- External
- Define “best in class” for an industry or building type
- Industry sector-specific at 6 digit NAICS code (or more refined)
- Energy data at the whole facility level
- Source energy intensity
- Normalized for key variables
ENERGY STAR Industrial Focuses

Delivering energy management to specific industries through ENERGY STAR
ENERGY STAR’s industrial sector-specific focuses

Collaborative process to develop:
✓ Energy Performance Indicator (EPI) to benchmark/rate plant energy performance
✓ Energy Guide

Facilitates:
✓ Sharing of best practices
✓ Networking
✓ Development of stronger company energy programs

Results in:
✓ Sophisticated plant benchmarking tool
✓ Recognition for energy-efficient plants with the ENERGY STAR
✓ Increased momentum for continued improvement
✓ Improved efficiency within an industry sector
✓ Prevention of carbon emissions
Benchmarking plant energy use: Facility energy performance ratings

Answers: “If all plants in the industry use energy as this one, what percent of plants in the country would be better, and what percent would be worse?”
Standardized measurement: the plant EPI

- Plant energy performance indicators (EPI)
  - Enable a higher level of energy management
    - Compare how efficiently a plant uses energy relative to those of its industry
    - Enable goal setting
    - Empower management to require greater energy performance from plants
    - Score plants on a **percentile basis (0-100)**, normalized to a plant’s unique configuration
      - ENERGY STAR defines score of 75 or above to be energy-efficient; 50 is average

- www.energystar.gov/epis
- www.energystar.gov/industrybenchmarkingtools
What EPA’s national level plant energy benchmarking accomplishes

- **Empowers industry to shift the curve of energy performance**
  - For most companies, the ENERGY STAR EPI is the first time they are able to see how their plants’ energy performance compares to that of their industry

- Enables companies in the benchmarked industry to set competitive goals for plant improvement

- Enables EPA to gauge improvement of an industry’s energy performance over time
Enabling companies to make informed energy investment decisions

Best investment opportunities are in lower quartiles - greatest potential for improvement

RCx & O&M improvements yield savings and label candidates

High scorers provide lessons learned and label candidates

Invest

Invest & Tune

Tune

Reward & Learn

Energy Performance Rating

Invest

Invest & Tune

Tune

Reward & Learn

100
More help to improve: Energy Guides

Practices and technologies available now to improve energy efficiency in an industry

- Identify existing & promising emerging technologies
  - provide brief overview of technology or practice
  - review its limitations
  - quantify potential energy and cost savings
  - estimate payback periods
  - provide case study from application
  - highlight industry success stories
## Example: Cement Industry Energy Guide

Over 40 efficiency measures for cement plants

<table>
<thead>
<tr>
<th><strong>No Capital Cost</strong></th>
<th><strong>Short Payback</strong></th>
<th><strong>Capital Projects</strong></th>
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<tbody>
<tr>
<td>Preventative maintenance</td>
<td>Energy &amp; Process Controls:</td>
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<tr>
<td>Seal Replacement (kiln)</td>
<td>- Kiln</td>
<td>Efficient Grinding Mills</td>
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<tr>
<td>Shell heat loss reduction</td>
<td>- Raw material</td>
<td>Roller Mill</td>
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<tr>
<td>Optimization of compressed air systems</td>
<td>- Finish Grinding</td>
<td>Grate Cooler</td>
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<tr>
<td>Low-Carbon Fuels</td>
<td>High-efficiency Classifier</td>
<td>Low-Pressure Drop Preheaters</td>
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<tr>
<td>Intergrinding Limestone</td>
<td>Improve Combustion System</td>
<td>Multi-Stage Preheaters</td>
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<tr>
<td>Reduced fineness cement</td>
<td>Indirect Firing</td>
<td>Precalciner</td>
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<tr>
<td>Increased Alkali Content</td>
<td>Optimize Grate Cooler</td>
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<td>High efficiency Motors</td>
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<td>Adjustable Speed Drive</td>
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<td>Blended Cement</td>
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<td>Slags in Clinkermaking</td>
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</tbody>
</table>
Case study

- Example: U.S. cement plant

- Initial cement plant ENERGY STAR EPI score: 61

- Upgraded in 2002, EPI verified energy reductions of 40%
  - Energy efficiency improved by 2.5 mmBtu/short ton of clinker

- Commercially available technologies employed (described in Energy Guide):
  - Improved grinding mills
  - Roller mills
  - Improved preheaters
  - Indirect firing

- New ENERGY STAR EPI score: 98
  - National energy efficiency scoring system demonstrated this plant is now one of the most efficient cement plants in the U.S.
Results – EPA experience with US auto assembly plants

• Based on ENERGY STAR benchmarking of auto assembly plants, EPA has seen fuel usage in the industry improve by 12 percent over a five year period.
• The level of inefficiency has also dropped by 1.0 mmBtu/vehicle.
• The range of performance has also narrowed.
  – This means that while the best auto assembly plants have improved, the others have more than "kept up" with this improvement.
ENERGY STAR benchmarking resources

- **Plants** use ENERGY STAR’s **Energy Performance Indicators (EPIs)**
- **Commercial Buildings** use ENERGY STAR’s **Portfolio Manager**

### Industrial EPIs
- Motor Vehicle Assembly
- Wet Corn Milling
- Cement Manufacturing
- Petroleum Refining (private system recognized)
- Pharmaceuticals
- Food Processing (variety)
- Glass Manufacturing (variety)
- Petrochemicals (draft)
- Pulp and Paper (drafts)
- Steel (draft)

### Portfolio Manager
- Office Buildings
- Hospitals
- K-12 Schools
- Hotels
- Supermarkets
- Retail Stores
- Warehouses
- Bank Branches
- Residence Halls
- Waste Water Treatment
- Court houses
- Medical Office Buildings
ENERGY STAR Benchmarking: Auto Assembly 2000-2005

2000 Distribution of U.S. Auto Assembly Plant Efficiency

2005 Distribution of U.S. Auto Assembly Plant Efficiency

Million Btu Source Energy per Vehicle
Lessons

• It is possible to benchmark plants and help industry improve.

• Benchmarking takes data (lots of it) and time.

• Benchmarked entity should be homogeneous.
Energy Management Systems

• Growing interest in the role of management systems to promote and ensure energy efficiency.
  – EPA’s ENERGY STAR program has been promoting a systems approach since 2003.

• Energy Management Systems (EnMS) can help organizations achieve greater savings.

• EnMS can help organizations build capacity and focus on continuous improvement

• EnMS provide a means (not an end) towards increasing efficiency

• EnMS do not measure or guarantee energy savings or CO₂ reductions on their own.
Management Systems Approaches

Management systems promote continuous improvement through:

- Organizational practices
- Organizational policies
- Team development
- Planning & evaluation
- Tracking & Measurements
- Communication & employee engagement

ENERGY STAR Guidelines for Energy Management

- Make Commitment
- Assess Performance & Set Goals
- Create Action Plan
- Implement Action Plan
- Evaluate Progress
- Recognize Achievements
- Re-Assess
Current efforts to create standards for energy management:

- ISO 50001 - Draft Energy Management Systems underdevelopment
- EN 16001 - European Energy Management Standards
- NSAI IS 393 – Irish Energy Management Standard
- ASTM standards being developed for:
  - Compressed systems, motors, steam systems, etc.
Considerations

• Elements of an EnMS can be applied without achieving certification
  – E.g: ENERGY STAR Guidelines & Partners

• EnMS Standards (ISO, EN, etc) are designed to be flexible
  – Scope, boundaries, etc. are defined by the user
  – A single processes / production lines can be certified within a plant to meet the standard
  – Determination of applicability of standard is done by paid Auditor

• Certification is not based on efficiency or savings
  – ISO 50001, etc. do not establish performance standards
  – Achieving a target or maintaining a level of performance is required for certification or re-certification

• Certification is expensive
  – Internal personnel costs
  – Auditor and registry expenses
  – Few companies have pursued certification to date
A systems approach to energy management is good to promote:
- Organizational & facility-wide EnMS are the most effective
- Shifts thinking from “projects” to “programs” to achieve greatest benefit

There are multiple pathways for promoting & implementing an EnMS.

The effectiveness of an EnMS is tied to its scope, goals, and the benchmarks are used.

Energy performance (efficiency, reductions etc.) ultimately reflects the effectiveness of an EnMS and corporate energy program.
Contact

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All resources found at:
www.energystar.gov/industry