Certifying Industrial Energy Efficiency Performance: Aligning Management, Measurement, and Practice to Create Market Value

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ACEEE Summer Study on Energy Efficiency in Industry

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Energy Efficiency and Climate Change

Increased nuclear (10%)
Increased renewables (12%)
Power sector efficiency & fuel (13%)
Electricity end-use efficiency (29%)
Fossil fuel end-use efficiency (36%)

Energy efficiency is the major path to limiting growth in global energy consumption and carbon emissions

Improved end-use efficiency accounts for two-thirds of avoided emissions in 2030

Focus on industrial energy efficiency is growing around the globe

- UN Industrial Development Organization is promoting systems energy efficiency and energy management standards for both developed and developing nations.

- International Organization for Standardization (ISO) is initiating a broad portfolio of initiatives to promote energy efficiency.

- China initiated plan to reduce energy use 20% per unit of GDP over 2005 levels by 2010.

- Through the Asia Pacific Partnership, the U.S., Australia, Korea, Japan, China, and India are promoting greater industrial energy efficiency.

- Energy efficiency is now a major focus of G-8 meetings.
US Industrial Energy Use

32 quads or ~33% of total U.S. energy consumption

- >200,000 sites
- 14.3 million jobs
- $5,900 billion in shipments
- $980 billion in exports

**U.S. industry represents:**

- 37% of U.S. natural gas demand
- 29% of U.S. electricity demand
- 30% of U.S. greenhouse gas emissions
- More energy use than any other single G8 nation
- Large opportunities for
  - Energy reduction
  - Emissions reductions
  - Fuel flexibility
Why US industry is not energy efficient

- The principal business of industry is production for the purpose of providing shareholder value.
- To improve shareholder value, managers seek ways to reduce the cost of everything required to support production (materials, labor, processing, packaging, and shipping),
  BUT...
Why US industry is not energy efficient

- Although the cost of energy is closely managed, energy use is not.
- For many facility managers, a false dichotomy exists between energy efficiency and production reliability, a core value.
- Separate budgets for equipment purchases and operations result in energy-inefficient procurement practices.
- Unless a facility actively manages energy use through a written energy management plan, substantial opportunities for improving energy efficiency are typically missed.
Primary barriers are institutional and behavioral, rather than technical. Industrial facilities without an effective energy management plan typically lack:

- Awareness of energy efficiency opportunities (also apply to consultants, and suppliers)
- A clear understanding on how to implement these improvement
- A system of collecting and analyzing data on energy use
- A consistent organizational structure to effectively manage energy use

- Knowledge resides with individual who has been trained - it is not institutionalized
- Trained individuals leave or transfer and take this knowledge with them
- Processes change over time and inefficiencies can re-occur
Some U.S. companies are already leaders in energy efficiency

- **3M’s** Global Energy Management Program has cut energy use 30% per net sales since 2000; now seek to reduce total energy use by >40% from 2000 levels by 2008.
- **Dow Chemical** achieved 22% improvement ($4B savings) between 1994 and 2005, now seeking another 25% from 2005 to 2015.
- **Toyota’s** North American (NA) Energy Management Organization has reduced energy use per unit by 23% since 2002; company-wide energy-saving efforts have saved $9.2 million in NA since 1999.
- **Dupont** applied "Six Sigma" energy management to complete >75 projects saving $250,000 annually per project and reducing GHG emissions by 68% since 1990—exceeding their 2010 target of 65%. Corporate-wide energy use has remained flat since 1990, despite a 35% increase in production.
- **Rohm and Haas**, a long-standing leader in energy management, won the 2006 American Chemistry Council Energy Award for projects that cut energy use by 450 billion Btu, saved >$3 million, and avoided 40,000 tons of related CO2 emissions.
- **United Technologies Corp** reduced global GHG emissions by 46% per dollar of revenue from 2001 to 2006, now seeking an additional 12% reduction from 2006 to 2010.

1 Btu/lb of product
**Why System Energy Efficiency Matters**

The term *industrial systems* refers to those systems that contribute to industrial production processes, including: motor systems (pumping, compressed air, and fan), steam systems, and process heating systems.

<table>
<thead>
<tr>
<th>% Manufacturing Energy Use by Type of System(^1)</th>
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<tbody>
<tr>
<td>Electrochemical - 2%</td>
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<tr>
<td>Process Cooling -1%</td>
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<tr>
<td>Motor Systems 12%</td>
</tr>
<tr>
<td>Other 4%</td>
</tr>
<tr>
<td>Facilities 8%</td>
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<tr>
<td>Steam 35%</td>
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<tr>
<td>Process Heating 38%</td>
</tr>
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**Energy Efficiency Improvement Opportunities**

- 20% or more typical for motor systems
- 10% or more for steam & process heating systems
- Most plants do not manage these systems for energy efficiency\(^2\)

\(^1\) Does not include offsite losses

\(^2\) 2002 MECS – plants indicated energy management activities for 6.3% steam, 16.6% compressed air, 7.5% process heating systems
Evolution of DOE’s Industrial Energy Efficiency Programs

- **Phase I - 1990s Development**
  - Developing market transformation techniques to encourage energy efficiency in industry (systems approach, develop training and tools, engage Allied Partners, newsletter, publications)

- **Phase 2 - 2000-2005 Deployment**
  - Focus on “getting the message out” - website, expand portfolio and deployment of publications, training, tools
  - Capacity building - developing a cadre of system experts (Qualified Specialists)
  - Test out plant assessment concepts - plant wide, targeted

- **Phase 3 - 2006-2010 Integration & Sustainability**
  - Energy Saving Assessments - “teach industry to fish”
  - Superior Energy Performance for Industry - direct engagement of industry in developing a market-based, sustainable industrial energy efficiency
Key BestPractices Program Elements

- Well-developed program of system optimization training for motor, compressed air, fan, pump, steam, and process heating
- System assessment software designed to help consultants and plant personnel to quickly identify opportunities
- Qualified Specialists
  - Equipment suppliers, consultants, and highly skilled end users who are experienced in system optimization in their area of specialty
  - Take the DOE Qualified Specialist training program - 2-3 days focused on application of the system assessment software tool
  - Successfully complete a rigorous qualifying exam that tests their ability to apply the software in conducting system assessments
- Experience in conducting 1-2 day system assessments (Industrial Assessment Centers, other)
Save Energy Now Products and Services

**Tools**
- Process Heating
- Steam Systems
- Plant Energy Profiler
- Motors & Pumps
- Fans

**Information**
- Website
- Information Center
- Tip Sheets
- Case studies
- Webcasts

**Training**
- Basic
- Advanced
- Qualified Specialist

**Assessments**
- Energy Savings Assessments
- Industrial Assessment Centers
Save Energy Now initiative

The U.S. Department of Energy (DOE):

- Created initiative in 2006 based on more than a decade of experience in industrial system energy efficiency
- Trains DOE energy experts to work with plant energy teams to identify opportunities for improving steam, process heating, pump, or compressed air systems through Energy Savings Assessments (ESAs)
- Together with energy experts, trains plant personnel to apply DOE software analysis tools to identify additional opportunities
- Recognizes plants with high energy savings resulting from implementation

http://www.eere.energy.gov/industry/saveenergynow/
Save Energy Now Results 2006-2007

- 303 assessments completed
- Implemented energy savings: 13.1 TBtu/$69.6 million
- Planned energy savings: 27.4 TBtu/$334 million
- Identified total energy savings: 55.5 TBtu
- Identified energy cost savings: > $548 million
- Total potential carbon dioxide (CO₂) emissions reduction: 3.6 million metric tons

**Estimated Payback Periods for Recommended Actions Identified in 2006**

- **< 9 months**
  - Improve insulation
  - Implement steam trap program
  - Clean heat transfer surfaces

- **9 mo. – 2 years**
  - Heat feed water with boiler blowdown
  - Lower excess oxygen
  - Flue gas heat recovery

- **2 – 4 years**
  - Modify steam turbine operation
  - Use oxygen for combustion
  - Change process steam use

- **> 4 years**
  - Install CHP system
Energy efficiency is peripheral to most corporate business strategies
R&D expenditures are minimal for process and energy technologies
Some US plants are “best-in-class” with state-of-the art technology and excellence in energy management
Combined heat & power applications are commonplace, but not as prolific as in EU and Japan
Incentives are lacking to invest in energy efficiency technologies
No common standard exists for managing energy
Workplace energy management skills are insufficient
Energy supply is constrained- limited energy fuel choices & volatile energy prices
Uncertain future environmental regulations
What would help all U.S. industry capture these energy savings?

- Provide industrial plants with easier access to information and tools for managing energy
- Provide incentives and recognition for effective industrial energy management
  - Integrate energy management into existing management systems (treat energy like every other resource)
- Develop *market value* for effective energy management and the resulting energy savings
- Offer the R&D and technological support required to help industry achieve a 2.5% annual energy savings
Superior Energy Performance Partnership

A partnership between industry and government to accelerate US industry’s energy efficiency by:

- Delivering tools, training, technologies & standards to all types of manufacturing plants
- Facilitating recognition and incentives for effective industrial energy management and energy efficient technology adoption

**Partners**

- U.S. Industry
- U.S. Department of Energy Industrial Technologies Program
- U.S. Environmental Protection Agency ENERGY STAR Program
- U.S Department of Commerce Manufacturing Extension Partnership
- American National Standards Institute
Partnership Goal

Proposed: US industry improves energy intensity by 25% over a 10 year period: from 2007 to 2016

Reducing U.S. Industry’s Energy Intensity by 25 percent

• Saves 8.4 quadrillion Btu per year

• Equal to energy consumption of state of California in one year; every house, commercial building, automobile and manufacturing plant
How will this framework affect plant energy performance?
Vision: By 2017

US industry improves energy intensity by 25% from 2007

US Industrial Sector
- A world leader in energy efficiency
- Known for best-in-class plants for energy-efficient technology
- A leading exporter of energy efficiency technologies and solutions
- Staffed by and working with engineers with extensive energy management expertise
- Driven by the performance of manufacturing plants
  - using ANSI-certified energy management systems
  - implementing system assessment protocols

Leading US Corporations
- Over 100 major corporations
  - Have integrated energy management into their business strategy
  - Improved their energy intensity by more than 25% from 2007 to 2017
  - Assist their plants and supply chain in becoming ANSI certified for energy efficiency

US Manufacturing Plants
- 25% of the 200,000 U.S. plants with 10 or more employees (50,000 plants) have adopted basic energy management principles
- 5,000 plants are certified by an ANSI accredited organization for energy management and committed to continuous improvement in energy efficiency
Corporate Level

Key Elements
- Energy baseline
- CEO commits to 10 yr goal to reduce energy intensity 25%
- Energy management plan
- Technology evaluation/best practices adoption
- Report progress annually

Resources
- Quick Start website
- Tools, training, and technologies
- Energy management tools
- Energy assessments

Rewards/Recognition
- Enhanced technical assistance
- Preference in RD&D solicitations
- National energy efficiency recognition

25% US industrial energy intensity improvement by 2017

Partner Plant

Key Elements
- Energy baseline
- Take steps to save energy, including creating an energy management plan
- Report energy savings annually

Resources
- Quick Start website
- System tools & training
- Energy management tools
- Energy assessments

Recognition
- Energy saving recognition
- Case study
- Publicity

Certified Plant

Key Elements
- Energy management standards
- System assessment protocols
- Independently certified energy savings

Resources
- Quick Start website
- System tools & training
- Energy management tools & support
- Energy assessments

Rewards/Recognition
- Utility incentives
- Market recognition
- Preferred supplier status
- National energy efficiency recognition
- Tradable credits/tags

Proposed Framework
Superior Energy Performance
Interim Steering Committee

- Determine the scope of work to support the initiative through April 2008
- Develop an implementation plan, including
  - Establish voluntary working groups as required
  - Work with DOE, EPA, and NIST to secure required resources
  - Develop a transition plan to a more permanent organizational structure that supports SEP goals

Interim Steering Committee Members

<table>
<thead>
<tr>
<th>Representative</th>
<th>Organization</th>
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<tbody>
<tr>
<td>Bill Allemon</td>
<td>Ford</td>
</tr>
<tr>
<td>Joe Almaguer</td>
<td>Dow Chemical</td>
</tr>
<tr>
<td>Bill Bailey</td>
<td>DuPont</td>
</tr>
<tr>
<td>Sean Diamond</td>
<td>Texas Petrochemical</td>
</tr>
<tr>
<td>Tom Dunn</td>
<td>Weyerhaeuser</td>
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<tr>
<td>Betsy Dutrow</td>
<td>EPA</td>
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<tr>
<td>Fred Fendt</td>
<td>Rohm and Haas</td>
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<tr>
<td>Martha Gibbons</td>
<td>IPSCO Steel</td>
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<tr>
<td>Jim Hoffman</td>
<td>Huntsman Chemical</td>
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<tr>
<td>Greg Jason</td>
<td>Cargill</td>
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<tr>
<td>Brad Reed</td>
<td>Toyota</td>
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<tr>
<td>Paul Scheihing</td>
<td>DOE ITP</td>
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<tr>
<td>Steve Schultz</td>
<td>3M</td>
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<tr>
<td>Dan Pitkin</td>
<td>NIST</td>
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<tr>
<td>Don Verdiani</td>
<td>Sunoco</td>
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<tr>
<td>Glen Wieger</td>
<td>Eastman Chemical</td>
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<tr>
<td>Jeff Yigdall</td>
<td>PPG</td>
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<tr>
<td>Michele Mazza</td>
<td>Owens Corning</td>
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What is a Corporate Partner?

Energy Policy Act (EPAct) of 2005, Section 106:
Voluntary Commitments to Reduce Industrial Energy Intensity

- Authorizes the Secretary of Energy to enter into voluntary agreements with industrial firms that consume significant amounts of energy to reduce the energy intensity of their production activities
- Participating companies agree to a 25% energy intensity reduction goal over 10 years (2007-2016) or an average of 2.5% per year from date the corporation joins the program
- Requires DOE to recognize and publicize the achievements of participants
- Partner may receive:
  - Early credit for energy intensity improvements and carbon reductions
  - For high-performers, preference in RD&D solicitations
  - Enhanced technical assistance from DOE to achieve energy intensity goals and to assist corporation’s plants and supply chain to become ANSI certified.
What is a Partner Plant?

- Any size industrial facility
- Plants with little or no experience in energy management
- Plants seeking to accelerate existing energy efficiency efforts
- Participate in self assessment of energy management practices
- Take steps to save energy

Benefits
- Develop baseline on energy use
- Begin actively managing energy use
- Identify energy cost savings opportunities
- Recognition for efforts

Tools & Resources
- Quick Start website
- Energy management guidelines
- Plant Energy Profiler
- System optimization training
- Assessments
- Software tools
- Access to qualified specialists
- Opportunity calculator
What is a Certified Plant?

- Meets ANSI Energy Management Standard (revision of existing ANSI standard)\textsuperscript{1}
- Applies Standardized Assessment Protocols for industrial systems (initially pumping, compressed air, steam, process heating) to assess plant facilities
- May use Certified Practitioners, recognized by third party (details TBD), to assist in:
  - Complying with energy management standards
  - Implementing system assessment protocols
- Uses an ANSI-accredited process to independently verify energy savings and compliance with the ANSI Energy Management Standards

\textsuperscript{1} ANSI MSE 2000:2005. \textit{Note}: the International Organization for Standardization (ISO) is undertaking work on an international energy management standard in 2008.
Energy Management Standard

Typical features include:

- a *strategic plan* that requires measurement, management, and documentation for continuous improvement for energy efficiency;
- a *cross-divisional management team* led by an energy coordinator who reports directly to management and is responsible for overseeing the implementation of the strategic plan;
- *policies and procedures* to address all aspects of energy purchase, use, and disposal;
- *projects* to demonstrate continuous improvement in energy efficiency;
- creation of an *Energy Manual*, a living document that evolves over time as additional energy saving projects and policies are undertaken and documented;
- identification of *key performance indicators*, unique to the company, that are tracked to measure progress; and
- *periodic reporting* of progress to management based on these measurements.
The System Assessment Protocols will provide a standardized framework for conducting assessments of industrial systems that will help define the market for both users and providers of these services.

By establishing minimum requirements and guidance for scope, measurement, and reporting, these system assessment protocols will provide greater transparency and higher value to industrial facilities. These attributes will:

1. increase access to project financing for energy efficiency improvements identified through application of these protocols, and
2. offer industrial facilities seeking certification for energy efficiency a well-defined path for initiating a process of continuous improvement
System Assessment Protocols

Proposed Goals
1. To create and test an initial portfolio of four (4) system assessment protocols that become the industry standard for that system type.
2. To prepare engineers as Certified Practitioners in the application of each system protocol.

Proposed Approach
1. Establish a portfolio of system assessment protocols, initially for compressed air, pumping, steam, and fired heaters
2. Create guidance and training on the use of the system assessment protocols
3. Define a skill set needed for individuals to effectively apply each system assessment protocol in industrial facilities
4. Create a professional training and certification program specific to each system type, to be administered by a third-party
### SEN Assessments vs. System Assessment Protocols

<table>
<thead>
<tr>
<th>Features</th>
<th>Save Energy Now Assessments</th>
<th>System Assessment Protocols</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>3 Days</td>
<td>Length determined by requirements of site</td>
</tr>
<tr>
<td>Assessment Scope</td>
<td>One system (of many similar systems in the plant) using a prescribed process</td>
<td>Any system within the technical expertise of the Certified Practitioner; must address minimum requirements; must include gap analysis of system management practices; Practitioner and Plant determine scope based on site needs</td>
</tr>
<tr>
<td>DOE Tools</td>
<td>Required</td>
<td>Not required; at the discretion of Practitioner</td>
</tr>
<tr>
<td>Train plant personnel</td>
<td>Required</td>
<td>Not required</td>
</tr>
<tr>
<td>Documentation</td>
<td>Basic report with estimates</td>
<td>Detailed documentation that meets assessment quality requirements</td>
</tr>
<tr>
<td>Performed by</td>
<td>ESA Experts (Qualified Specialists with additional preparation)</td>
<td>Anyone can use the protocols, but Certified Practitioners will be created who maintain a third-party recognized professional credential that requires regular refresher courses</td>
</tr>
</tbody>
</table>
How Does a Plant Become Certified?

Current Proposal:
The plant achieves validated initial energy intensity performance improvement via
1. Compliance with ANSI Energy Management Standard AND
2. implementation of >30% of total Btu energy savings opportunities that meet the company’s IRR and as identified by system assessment protocols, OR
3. demonstrates energy intensity improvement of >5% over past two years OR
4. meets or exceeds the best practice threshold from the application of each system protocol.

Note: some fee structure will be associated w/certification
Superior Energy Performance Work Plan

- Develop Quick Start website to help plants initiate energy management programs
- Help to coordinate U.S. participation in ISO energy management standard development
- Assist in design and delivery of “Save Energy Now” Partner Plant program
- Assist in design of ANSI-accredited plant certification program
- Assist in design and execution of voluntary “Save Energy Now” corporate energy efficiency program (EPACT Section 106)
Boosting Energy Management Performance

INCENTIVES:
- Recognition (ENERGY STAR, other)
- Access to low-interest capital
- Market value
- ITP resource commitment
- Tax credits
- Potential carbon credits
- OTHER?

2007 2008 2009 2010 2016

- Save Energy Now Partner Plant
- Save Energy Now Corporate Partner Agreement
- Pilot Certification
- Certified Plant (ANSI accredited)
- ENERGY STAR Plant
Key Milestones

May 2007  Interim Steering Committee formed
          Working Groups identified

July 2007  Work on program definition completed
          Initial Working Groups populated

Sept 2007  Save Energy Now Partner Plant Program announced
          Quick Start website available

Mid-2008  Energy Management Standard & System Assessment Protocols tested

Early 2009  Certified Plant Program ready for pilots

Early 2010  Certified Plant Program announced
Increasing US Industrial Energy Efficiency

- Moving the US industrial sector to an energy intensity improvement rate of 2.5% per year
- Certifying plant energy management programs; creating transparency for continual energy efficiency improvement
- Unite US corporate leaders in energy efficiency; commit to 25% energy intensity improvement over 10 years (through EPACT Section 106)
- Empowering the supply chain to demand energy efficiency
- Enhancing the business case for energy efficiency
- Paving the way for U.S. global leadership in energy efficiency technologies and practices
For more information

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