

Advanced Manufacturing Office

U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy



ISO 50001

Technical Partnerships

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Pete Langlois & Paul Scheihing
Advanced Manufacturing Office (AMO)

ISO 50001 Overview

- What it is:

- A **global standard** around managing energy based on expertise from 56 countries
- A **management model** for continual improvement of energy performance
 - Manages energy efficiency, energy security, energy use and energy consumption
 - Similar to quality (ISO 9001) and environmental (ISO 14001) management system standards



A management system is:

- ✓ Say what you do
- ✓ Do what you say
- ✓ Prove it
- ✓ Improve it

- What it does:

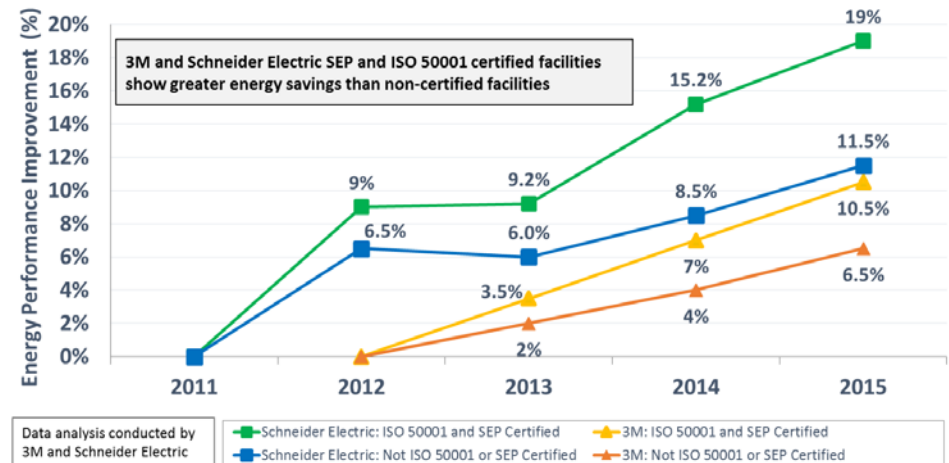
- Builds institutional knowledge throughout an organization
- Engages all staff (executive, facility, procurement, communications, etc.), not just facility management.
- Creates the market pull and business culture for industry to invest in advanced energy efficiency technologies
- Reduces business risk associated with unpredictable energy costs and supply
- Establishes an ingrained culture and practice around energy performance
- Enables more cost-effective and rapid investment in advanced energy efficient technologies

ISO 50001: Initial Performance Data

The most effective way for U.S. manufacturing facilities and buildings to achieve their fullest potential in energy efficiency is to adopt programs & policies that improve energy performance on a continuing basis

- AMO's Superior Energy Performance (SEP) program demonstrated that ISO 50001 can achieve:
 - Up to 30% improvement in energy performance over three years
 - 12% average reduction in energy costs within 15 months of implementation

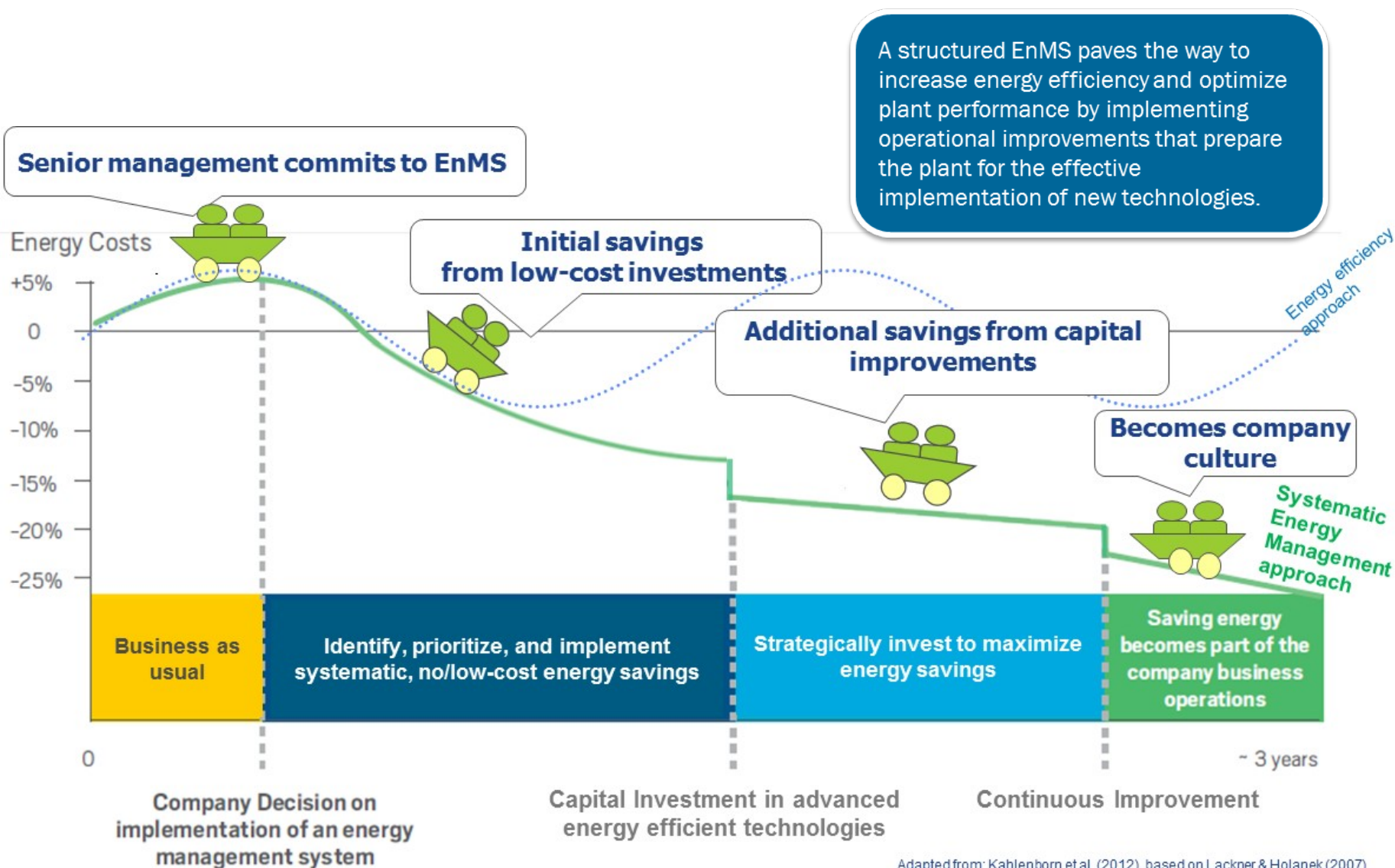
Broad implementation of ISO 50001 in the U.S. will significantly improve energy efficiency and reduce GHG in U.S. manufacturing facilities and buildings.



Savings at certified facilities greater on average compared to non-certified facilities:

- **3M: 62% greater over 3 years:** 18 ISO 50001 sites across 7 countries; 2 US SEP, 1 Korea SEP certified; 257 non-ISO 50001
- **Schneider Electric: 65% greater over 4 years:** 20 ISO 50001 in North America; 16 US SEP certified; 30 non-ISO 50001

Systematic Energy Management Results in Continuous Improvement



Adapted from: Kahlenborn et al. (2012), based on Lackner & Holanek (2007)

U.S. Energy Management Practices - Current to Future

| | Current State: Project by Project | Desired Future State: ISO 50001 |
|------------------------------|---|---|
| Current adoption levels | Increasingly commonplace: 46% of U.S. manufacturing facilities have set goals for improving energy efficiency | Minimal: <0.1% of U.S. manufacturing facilities have adopted ISO 50001 |
| Approach | Project-based | System-wide |
| Scope and energy systems | Equipment and physical systems. Utility energy systems: Boilers, etc. | Equipment, systems, personnel, processes. Include key processes and unit operations. |
| Management buy-in | Ad hoc or none | Executive decision-maker involvement Top management commitment |
| Resilience to staff turnover | Dependent on energy champion or individuals | Cross-organizational involvement. Integrated in core organizational and business practice. |
| Self-sustaining | No – based on individual projects, individual-dependent | Yes – Plan-Do-Check-Act management cycle, individual-independent |
| Outcomes | Reliant on continuous streams of capital to support EE upgrades and sustained improvement | Establishes operational control procedures and organizational structure designed for continual improvement |
| Focus areas | Ad hoc and reactionary, typically utility-support energy systems | Structured analysis and prioritization of significant energy uses (usually key processes) |
| Energy in design | Ad hoc or none | Established process for energy consideration in design for new facilities, systems, equipment and processes |

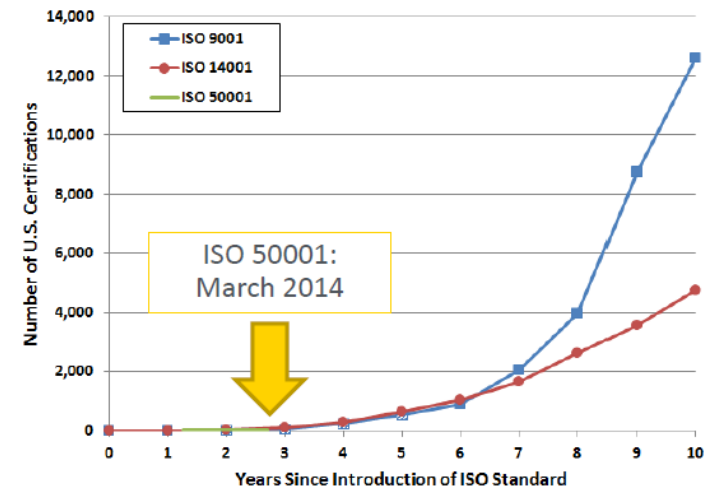
Barriers to Adoption of ISO 50001

Current adoption in US is very low:

- Other global countries offering tax incentives (not self-sustaining)
- ISO 14001 and ISO 9001 accelerated 6-8 years after introduction AND had market driver (auto, aerospace)
- Potential study results shows *over 9000 U.S. certified facilities by 2025, totaling \$30B in cost savings*

Market barriers to adoption:

- Economic and Financial barriers
 - Cost of verification and certification
 - Perceived workload burden of implementing EnMS: ~1 FTE
- Informational barriers
 - Perceived lack of business value
 - Lack of energy management training and expertise
 - Market confusion, lack of coordinated messaging
- Regulatory barriers
 - No strong levers or policies (e.g., tax breaks, laws, regulations) for energy management adoption in the U.S.
 - Lack of consistency in utility- and state-based EnMS programs



AMO's role

What AMO does:

- AMO is catalyzing the adoption of best practices in energy management systems (EnMS) to drive energy savings in the U.S. market.
- AMO is building the EnMS workforce that helps to certify energy professionals that have both energy engineering and ISO management system skills
- AMO is recognizing leaders in the market that are adopting ISO 50001 and validating the business case for ISO 50001

As a steward of U.S. manufacturing, AMO is in a unique position to bridge the gap from early adoption to market acceptance of ISO 50001 through market-based research and development.

DOE Role in Advancing Systematic Energy Management

“Project-by-project”
energy management
approach

Current situation

1% annual
improvement

Capital intensive
improvement: 1 to
5 year payback

Energy savings not
sustainable

DOE Role

Working with Industry to...

Reduce cost

- Tools and training streamline process
- Prioritization of energy opportunities
- Enterprise approach enables scale

Minimize Risk

- Better data analytics
- Corporate and management commitment
- Make the business case

Inform and Educate

- Training for various staff
- Develop “profession” around systematic EnMS and ISO 50001 implementation

Systematic
ISO 50001
energy management
approach

Goal at Scale

5% annual
improvement

10 to 20% low cost
improvement:
<1 year payback

Continual energy
performance
improvement

AMO's Dual Approach to EnMS/ISO 50001 Adoption

DOE builds the market to prepare companies to progress towards ISO 50001 conformance. DOE has developed an energy management continuum that begins with market-driven business culture and culminates in verified savings.



| | | |
|---------------------|---|--|
| DOE Role | Providing tools and the market onramp | Providing verified results and outcomes |
| Market Purpose | DOE's 50001 Ready self-attestation program prepares organizations for certification | DOE's SEP program fills the gap in the market for verified energy performance improvements from ISO 50001 implementation |
| M&V Protocol | 50001 Ready M&V Protocol | SEP M&V Protocol |
| Tools | 50001 Ready Navigator EnPI Lite | 50001 Ready Navigator Energy Performance Indicator (EnPI) Tool |
| Path to Achievement | <ol style="list-style-type: none"> 1. Complete 25 steps in 50001 Ready Navigator 2. Self-attest to completion 3. Report energy performance | <ol style="list-style-type: none"> 1. ISO 50001 certification 2. 3rd party SEP Performance Verification audit |

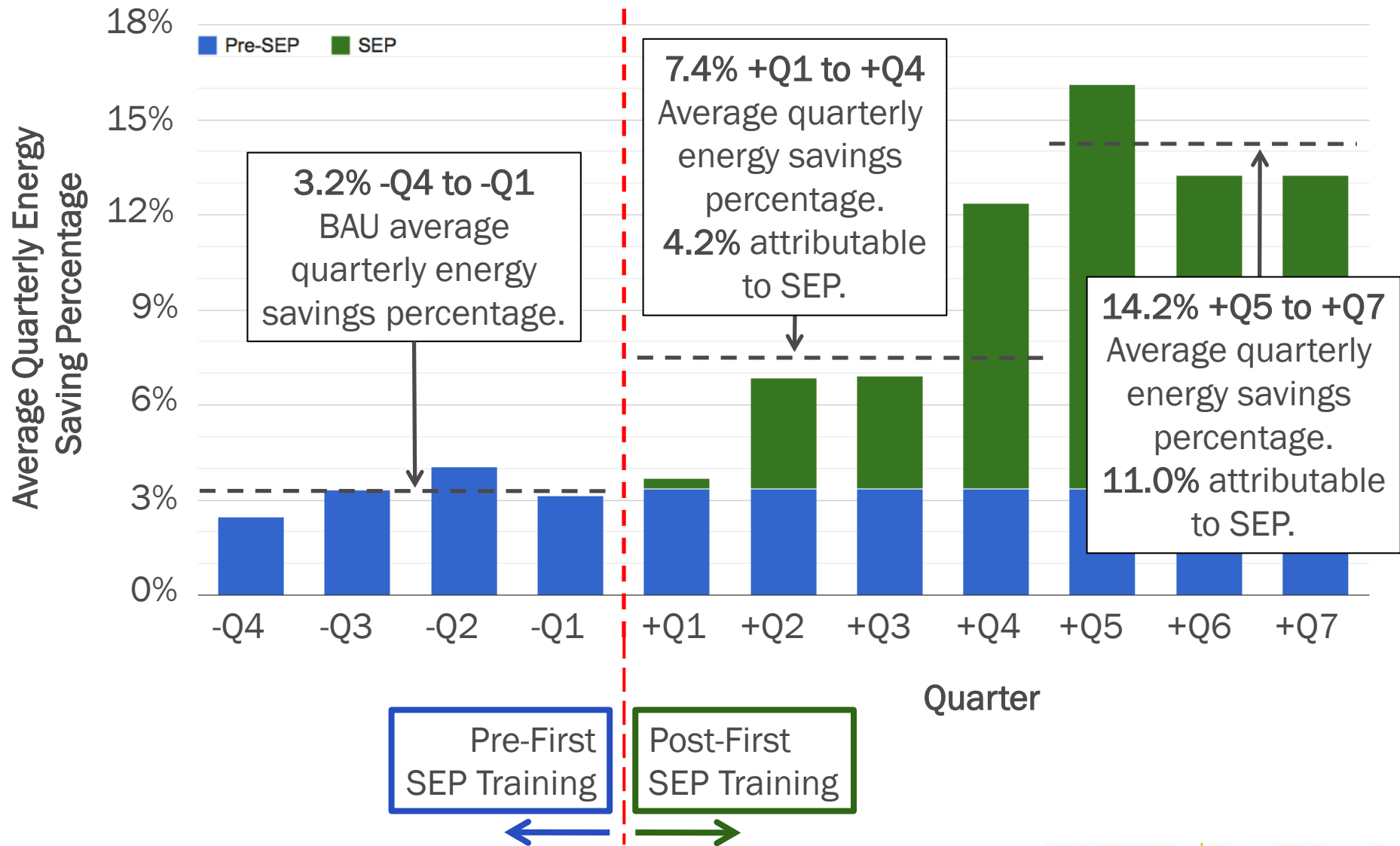
Verification of ISO 50001 through SEP Certification

- A voluntary continual energy performance improvement certification program recognizing excellence in organizational energy management practices.
- SEP certification based upon third-party verification of:
 - Energy management system (ISO 50001) and
 - Energy performance improvement (ANSI/MSE 50021)



- SEP provides verification of results to prove the business case and reduce risk
 - Robust measurement and verification processes through SEP
 - Credentialed auditing professionals (SEP Lead Auditor and SEP Performance Verifier)
 - Ensures consistent, comprehensive, and trusted results from EnMS audits
 - Provides credibility to internal decision-making around energy investments

Verified Facility-Wide Energy Savings Attributable to SEP



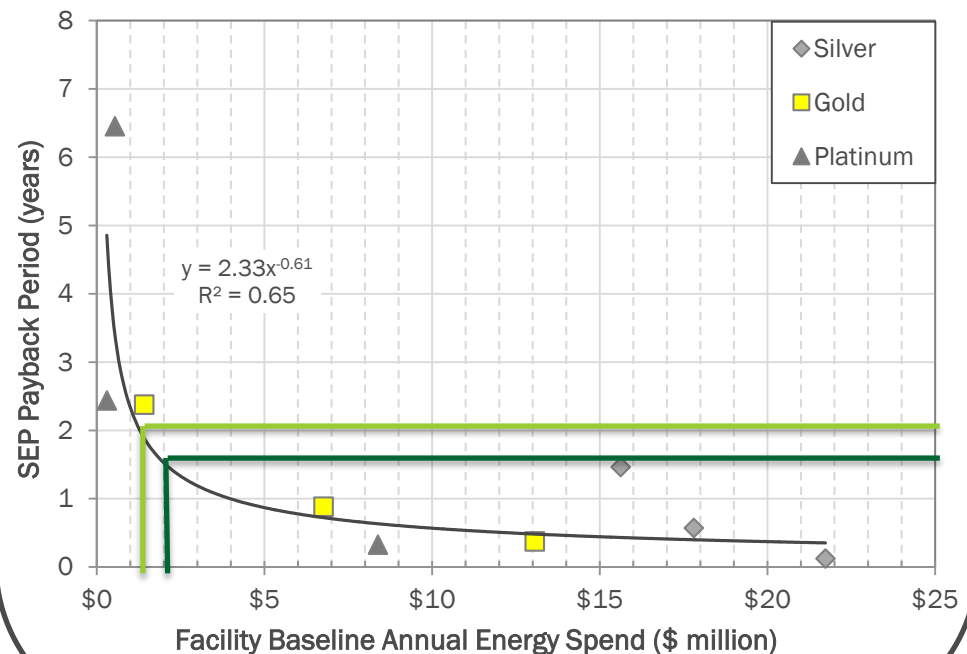
Savings: Cost-effective, deeper, credible

- Deeper, more rapid savings at less cost
- 2015 study of 10 SEP-certified facilities
 - 12% reduction in energy costs within 15 months of starting SEP implementation, on average
 - Saved over \$430,000/year on average from low/no cost operational improvements
- Credible, third-party verification
- Valuable data and analysis for higher confidence in energy efficiency investments

Payback:

Less than 2-year payback for facility with a baseline annual energy spend greater than \$1M

Less than 1.5-year payback for facility with a baseline annual energy spend greater than \$2M



Replicate results across company's facility and buildings nationally and internationally

SEP - Verified Results from ISO 50001 Conformance

- ★ Platinum certified
- ★ Gold certified
- ★ Silver certified

Improvement over 3 years unless stated otherwise

| | |
|---------------------------------|------------------|
| ★ Saanichton, BC Canada | 30.6% |
| ★ Smyrna, TN | 23.1% |
| ★ Clovis, CA | 16.7% |
| ★ Seneca, SC | 15.6% |
| ★ Costa Mesa, CA | 23.4% / 15 mo's |
| ★ West Kingston, RI | 20.0% |
| ★ Apodaca, Mexico (Monterrey 4) | 15.0% |
| ★ Peru, IN | 24.9% / 10 yrs |
| ★ Lincoln, NE | 22.0% / 10 years |
| ★ El Paso, TX | 14.8% |
| ★ Greensboro, NC | 13.7% / 16 mo's |
| ★ Columbia, MO | 13.3% / 1 yr |
| ★ Apodaca, Mexico (Monterrey 2) | 11.3% |
| ★ Hopkins, SC | 10.2% |
| ★ Tijuana, Mexico | 10.2% |
| ★ Cedar Rapids, IA | 8.8% |
| ★ Apodaca, Mexico (Monterrey 3) | 7.8% |
| ★ Foxboro, MA | 6.7% |
| ★ Lexington, KY | 5.9% |
| ★ Rojo Gomez, Mexico | 5.9% |

Schneider Electric

3M

HILTON
WORLDWIDE

| | |
|------------------------|-------|
| ★ Aberdeen, SD | 11.0% |
| ★ Hutchinson, MN | 10.7% |
| ★ Cynthia, KY | 6.9% |
| ★ Cordova, IL | 5.7% |
| ★ Decatur, AL | 5.2% |
| ★ Prairie du Chien, WI | 5.2% |
| ★ San Diego, CA | 22.7% |
| ★ La Quinta, CA | 17.6% |
| ★ Washington, DC | 15.9% |
| ★ Waikoloa, HI | 13.5% |
| ★ Honolulu, HI | 8.4% |
| ★ San Francisco, CA | 6.3% |

SEP - Verified Results from ISO 50001 Conformance (cont'd)

- ★ Platinum certified
- ★ Gold certified
- ★ Silver certified

Improvement over 3 years unless stated otherwise

| | | |
|---|-----------------------------|----------------|
|  | ★ Mack Trucks, Macungie, PA | 31.6% / 10 yrs |
| | ★ Dublin, VA | 28.4% / 10 yrs |
| | ★ Hagerstown, MD | 20.9% |
|  | ★ Canton, MS | 20.9% |
| | ★ Smyrna, TN | 17.7% |
| | ★ Decherd, TN | 8.0% |
|  | ★ Columbus, IN | 16.8% |
| | ★ Whitakers, NC | 15.5% / 7 yrs |
|  | ★ Detroit, MI | 32.5% / 10 yrs |
|  | ★ Ontario, NY | 25.7% / 5 yrs |
|  | ★ Bethlehem, PA | 17.0% |
|  | ★ Washington, DC | 16.5% |
|  | ★ Dunedin, FL | 12.2% / 2 yrs |
|  | ★ Wilson, NC | 15.1% / 10 yrs |
|  | ★ Gaithersburg, MD | 8.5% |
|  | ★ Cheswick, PA | 7.6% |
|  | ★ Carlisle, PA | 5.7% |

Last updated: April 11, 2017

SEP Status to Date

- 49 SEP-certified facilities
 - 5.2% - 30.6% energy performance improvement over 3 years
 - vs 1% business as usual in the US
 - 2017 Enterprise-wide adoption study demonstrated:
 - 5% annual energy performance improvement
 - > \$600,000 energy cost savings
 - \$19,000 implementation cost reduction
- Workforce
 - 111 Certified Practitioners in Energy Management Systems (CP EnMS)
 - 25 SEP Performance Verifiers

SEP Program: Continual improvement with Industry Feedback

2012 SEP Program

- Two pathways
- Silver level 5% over 3 years
- Initial SEP measurement & verification (M&V) protocol
- Initial SEP Scorecard
- Add on SEP from ISO 50001 requires repeating ISO 50001 audit



2017 SEP Program

- Single pathway
- Bronze level 1% over 3 years
- Enhanced SEP M&V protocol
- Enhanced SEP Scorecard
- Separation of ISO 50001 and SEP audits allowed



2018 SEP Program

- Greater sector parity
- SEP level 0% over 3 years
- Other enhancements?

SEP and other AMO R&D programs

| ISO 50001 and SEP Program | SMART manufacturing |
|---|---|
| Strong energy analytics | Advanced sensors to gather data at lower cost |
| Emphasis on operation control | Advanced process control |
| Focus on significant processes | Control of key processes and unit operations |
| Energy incorporated into manufacturing equipment and process design | Case for purchased of advanced measurement technology |
| Continuous improvement focus | Continuous monitoring |
| Training staff to operate equipment in optimal manner | Sophisticated staff with focus on optimal process control |

50001 Ready Recognition

Three Steps to Becoming 50001 Ready

STEP 1

Start Implementation of ISO 50001 principles

Use the 50001 Ready Navigator Online Tool

- ✓ The Navigator walks you through the process of implementing an energy management system and prepares you to be 50001 Ready.

STEP 2

Analysis of energy and emissions reductions

Adopt Valid Tool to Present Energy Performance

- ✓ DOE offers the EnPI Lite tool for 50001 Ready.
- ✓ EPA's Portfolio Manager can also be used
- ✓ Other tools can be approved by DOE

STEP 3

Request 50001 Ready recognition

Submit information to DOE for Review

- ✓ Self-attestation of completion of Navigator, executed by team leader and executive
- ✓ Submit energy performance data



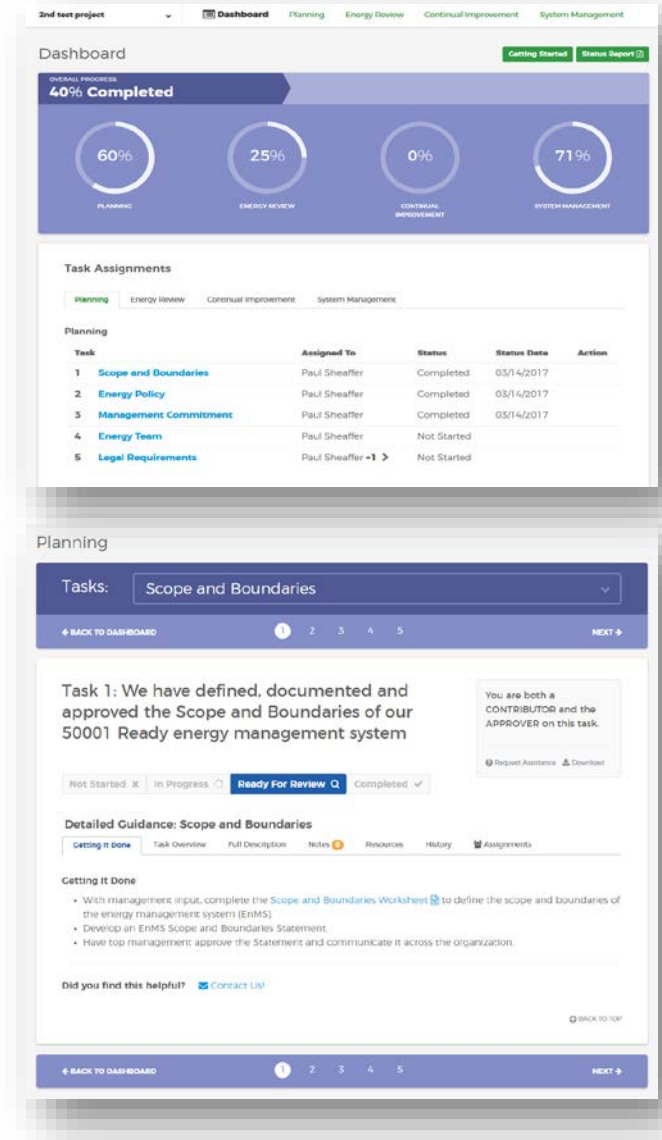
DOE or Utility
recognizes
50001 Ready
achievement

50001 Ready: Live in May 2017

- 74 users in 50001 Ready Navigator
- Preliminary expressions of interest include Wisconsin Focus on Energy, Efficiency Vermont, 3M, GM, and an IAC pilot program

50001 Ready Navigator

- Developed and maintained by DOE
- Resource to provide free training and information to the market
- Online tool with simple, step-by-step approach to ISO 50001 implementation
- Guidance broken into straight forward sections, including:
 - Getting It Done – what specifically needs to be accomplished
 - Task Overview – how does this task connect with ISO50001
 - Full Guidance – comprehensive guidance about the task
 - Transition Tips – from other ISO management systems or ENERGY STAR
- Track and update task progress
- Ability to assign tasks to team members to facilitate team collaboration
- Access over 100 related resources



EnPI Lite

EnPI Lite is a web based calculator developed and maintained by DOE that estimates **energy savings** relative to relevant variables, like production levels and weather, using linear regression.

EnPI Lite provides a user-friendly way for the market to practice regression-based energy modeling.

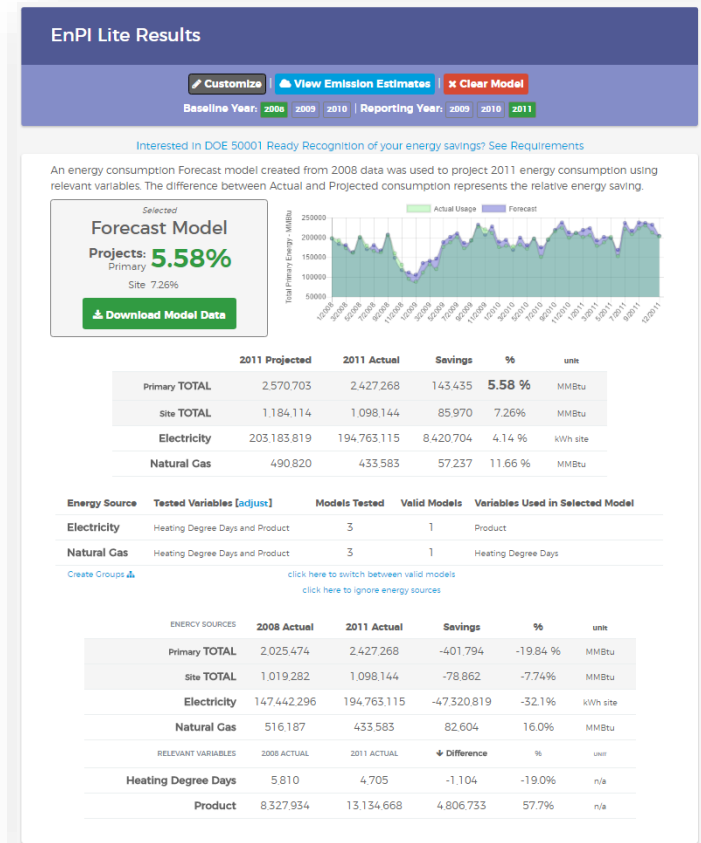
EnPI Lite Steps:

1. Input Energy Consumption and Relevant Variables

Input Options:

- Energy Footprint Tool
- ENERGY STAR Portfolio Manager

2. Regression Analysis (*automatic*)
3. Adjust Data / Models as needed
4. Download Results



50001 Ready, the Market, and Related Programs

- **50001 Ready:**
 - **Recognition:** Offers DOE recognition for self-attested, non-certified implementation of best practices from ISO 50001.
 - **Education:** Builds culture and practitioner value without requiring financial investment associated with certification or third-party verification
 - **Information:** Provides free technical resources (50001 Ready Navigator and EnPI Lite) that can be used by end users and adopted by utility programs.
- **Better Plants:** 50001 Ready is working with the Better Plants program to train TAMs to provide technical assistance to partner facilities. 50001 Ready is designed to help Better Plants partners more easily achieve their pledge goal.
 - Provide cohesive messaging around energy management
- **Industrial Assessment Centers:** 50001 Ready and IACs are piloting a joint program to provide small- and medium-sized manufacturing facilities with energy assessments aligned with 50001 Ready requirements.
 - Generate awareness and drive down costs at smaller facilities
- **Suppliers and enterprises:** 50001 Ready provides a no-cost option for corporations to incentivize their facilities and supplier facilities to implement foundational energy management practices
 - Combat perception of high level of effort for ISO 50001 implementation
- **Commercial and federal facilities:** Coordination with FEMP and BTO to provide technical support for non-manufacturing facilities catalyzes the adoption of EnMS to the broader U.S. market.
 - Bring ISO 50001 concepts beyond the industrial sector

Partnerships to Support Adoption

AMO is fostering public-private partnerships to advance the technical readiness of ISO 50001 with industry, and create a higher level of industry practice in energy management.

| Partner | Role |
|--|--|
| DOE | Provides tools, training resources, and recognition |
| US manufacturing and commercial building sectors | Uses resources Implements ISO 50001-based EnMS |
| Verification and certification bodies | Certifies facilities to ISO or SEP |
| Third parties, including: <ul style="list-style-type: none">• Utilities and regulators• Federal/States/Regional/Local government agencies• Standards and accreditation bodies (ISO, ANSI/ANAB)• NGOs and carbon reporting programs• Consultants and energy service companies• Large OEMs and supply chain leaders | <ul style="list-style-type: none">• Establish utility programs with technical assessment and financial incentives• Establish federal/state tax incentives• Implement state/local recognition and awards programs• Procure to product sustainability standard specifications and programs• Provide workforce training• Establish self-direct energy efficiency programs• Issue market-based recognition or rankings |

AMO Objectives and Targets

- MYPP Target 17.3: Catalyze a 3x increase in the number of ISO certified or conformant facilities by 2025
 - 2015 baseline: 4,000 facilities
 - Status of potential actions from FY17-FY21 MYPP:

| | |
|--|---|
| Develop processes and recognition for facilities to become “ready” to certify to ISO 50001 | Complete – 50001 Ready |
| Develop means to quantify energy savings industry-consistent measurement and verification protocols. | Complete – 50001 Ready M&V Protocol, SEP M&V Protocol |
| Develop an energy management tool to help users become ready to certify. | Complete – 50001 Ready Navigator |
| Engage 15+ states/utilities in adopting AMO programs and tools as options for industrial opt-out, self-direct, or to directly meet goals or regulatory requirements. | In progress – 50001 Ready ratepayer engagement |
| Support at least 1,000 Better Plants or IAC facilities to become ISO 50001 ready by 2025 | In progress – IAC / 50001 Ready pilot program |
| Recognize 1000 or more U.S. facilities for conforming to ISO 50001 | In progress – SEP, 50001 Ready |