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U.S. DEPARTMENT OF
ENERGY

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.

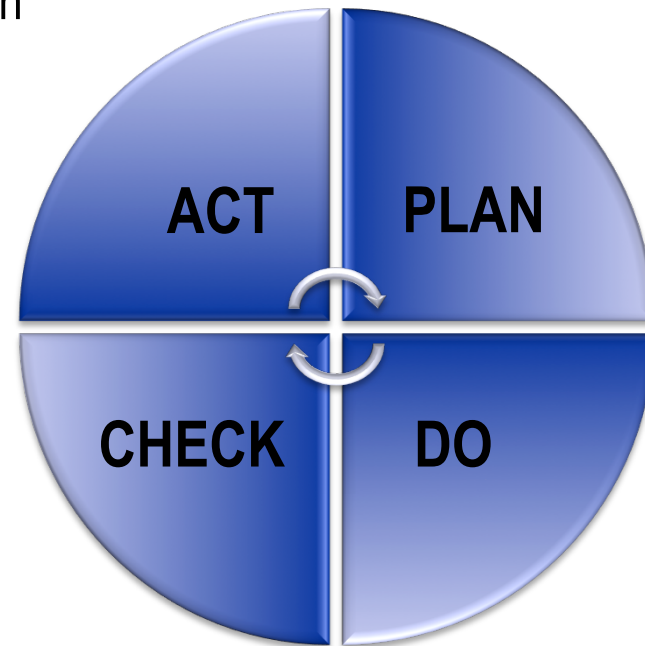


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Introduction to ISO 50001 – Foundation and Requirements

- ▶ 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

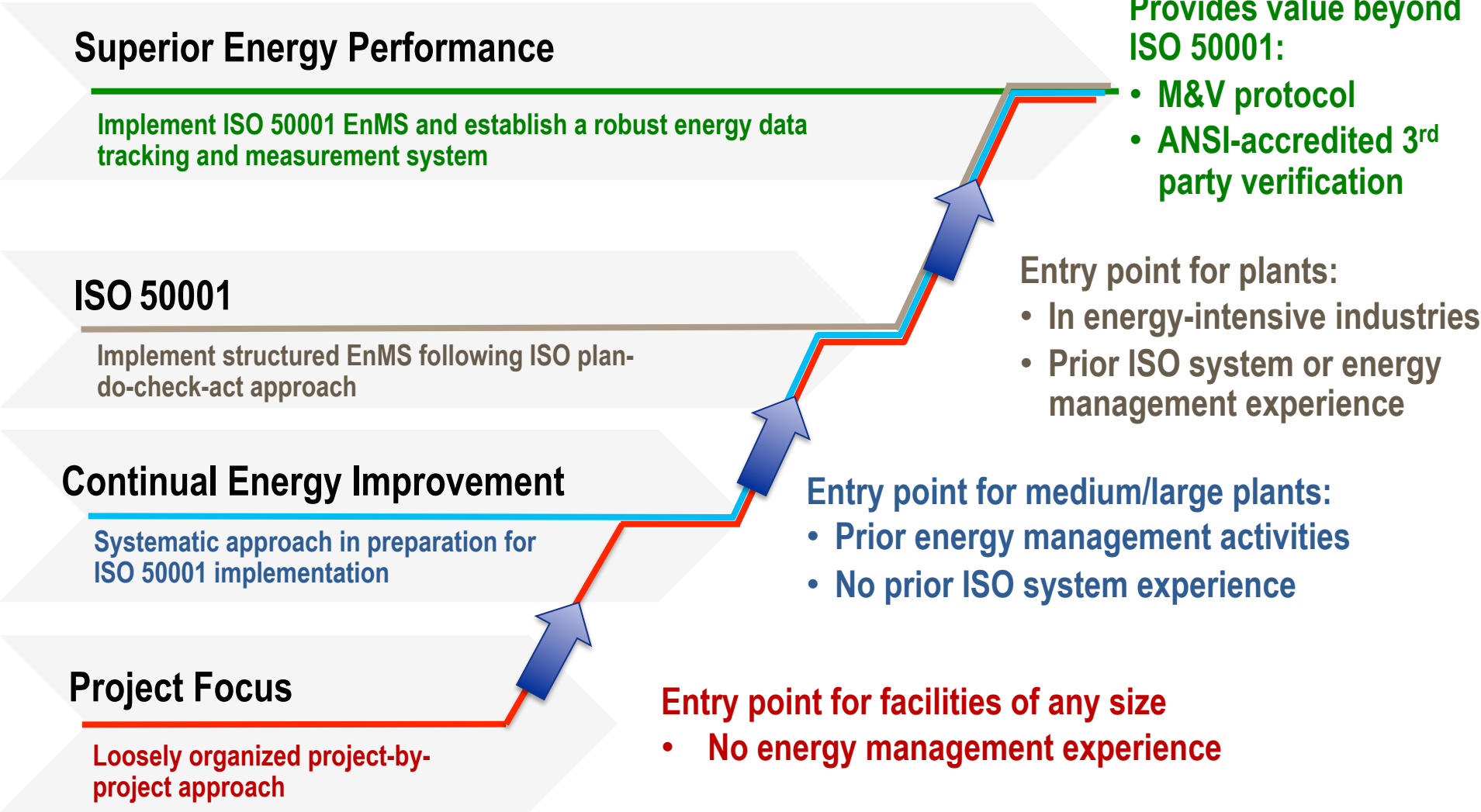
Performance Characteristics		Silver	Gold	Platinum
Energy Performance Pathway	Energy Performance Improvement	Meets 5% energy performance improvement threshold over the last 3 years.	Meets 10% energy performance improvement threshold over the last 3 years.	Meets 15% energy performance improvement threshold over the last 3 years.
Mature Energy Pathway Uses Best Practice Scorecard to earn points for energy management best practices and energy performance improvements.	Energy Performance Improvement	Meets 15% energy performance improvement threshold over the last 10 years.		
		management best practices	management best practices and 10 points for energy performance (<u>beyond</u> 15% over the last 10 years)	management best practices and 20 points for energy performance (<u>beyond</u> 15% over the last 10 years)

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.

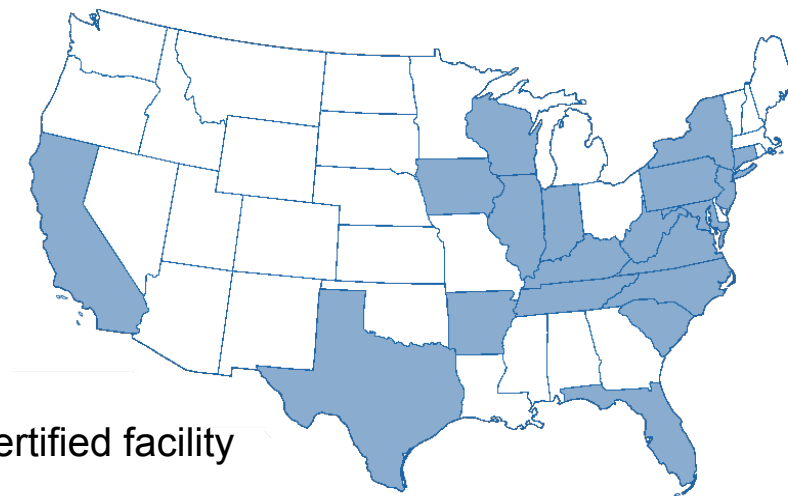


Strategic Energy Management Continuum



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

Superior Energy Performance Program Certifications

	Facility Name	Facility Wide Verified % Energy Performance Improvement
Platinum	Volvo Trucks, NA <i>Dublin, VA</i>	25.8
	Dow Chemical Company <i>Texas City, TX: Manufacturing facility</i>	17.1
	3M Canada Company <i>Brockville, Ontario, Canada</i>	15.2
Gold	Cook Composites and Polymers <i>Houston, TX</i>	14.9
	General Dynamics <i>Scranton, PA</i>	11.9
	Allsteel <i>Muscataine, IA</i>	10.2
	Cooper Tire <i>Texarkana, AR</i>	10.1
Silver	Olam Spices <i>Gilroy, CA</i>	9.8
	Owens Corning <i>Waxahachie, TX</i>	9.6
	Dow Chemical Company <i>Texas City, TX: Energy systems facility</i>	8.1
	Nissan, NA <i>Smyrna, TN</i>	7.2
	Freescale Semiconductor, Inc. <i>West Austin, TX</i>	6.5
	3M Company <i>Cordova, IL</i>	6.2
	Bridgestone Americas Tire <i>Wilson, NC</i>	16.8

- ▶ 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

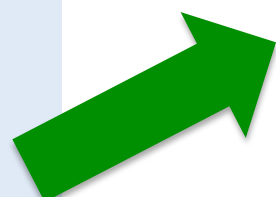
- ▶ SEP business value can be:
 - Quantified through analysis of cost and benefit data from SEP certified facilities.
 - Enhanced by understanding the value of SEP to facilities.
 - Communicated to facilities considering SEP.

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



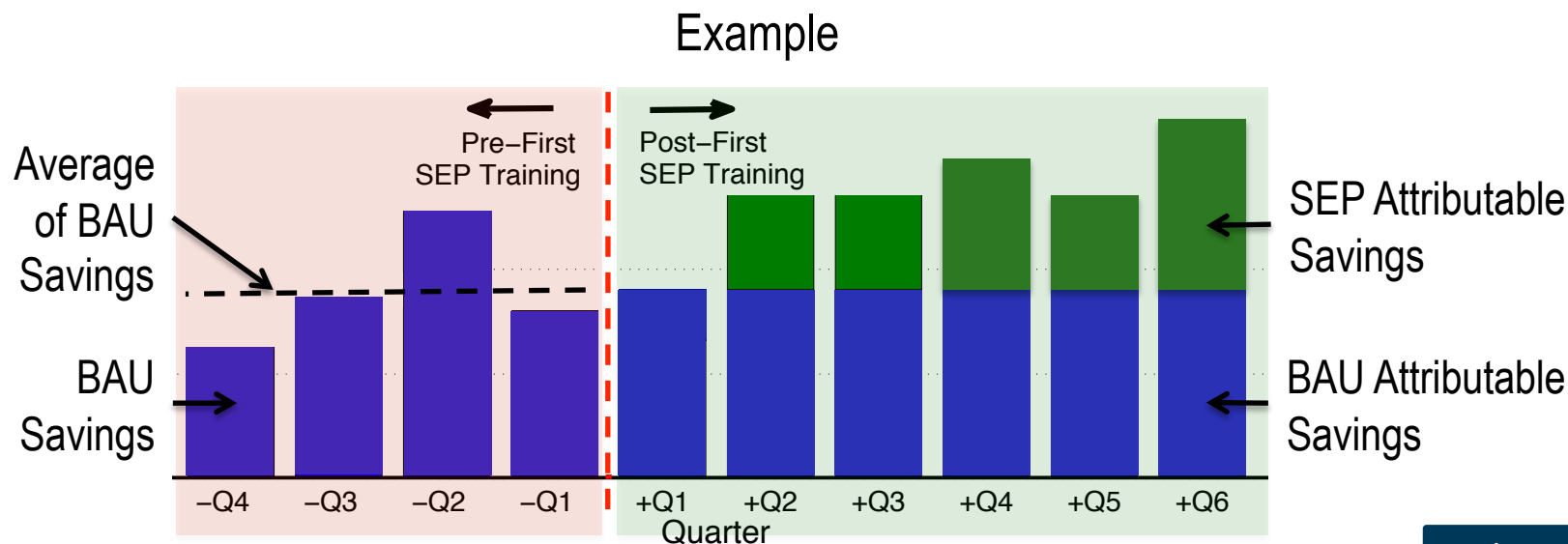
SEP Implementation Costs

(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.



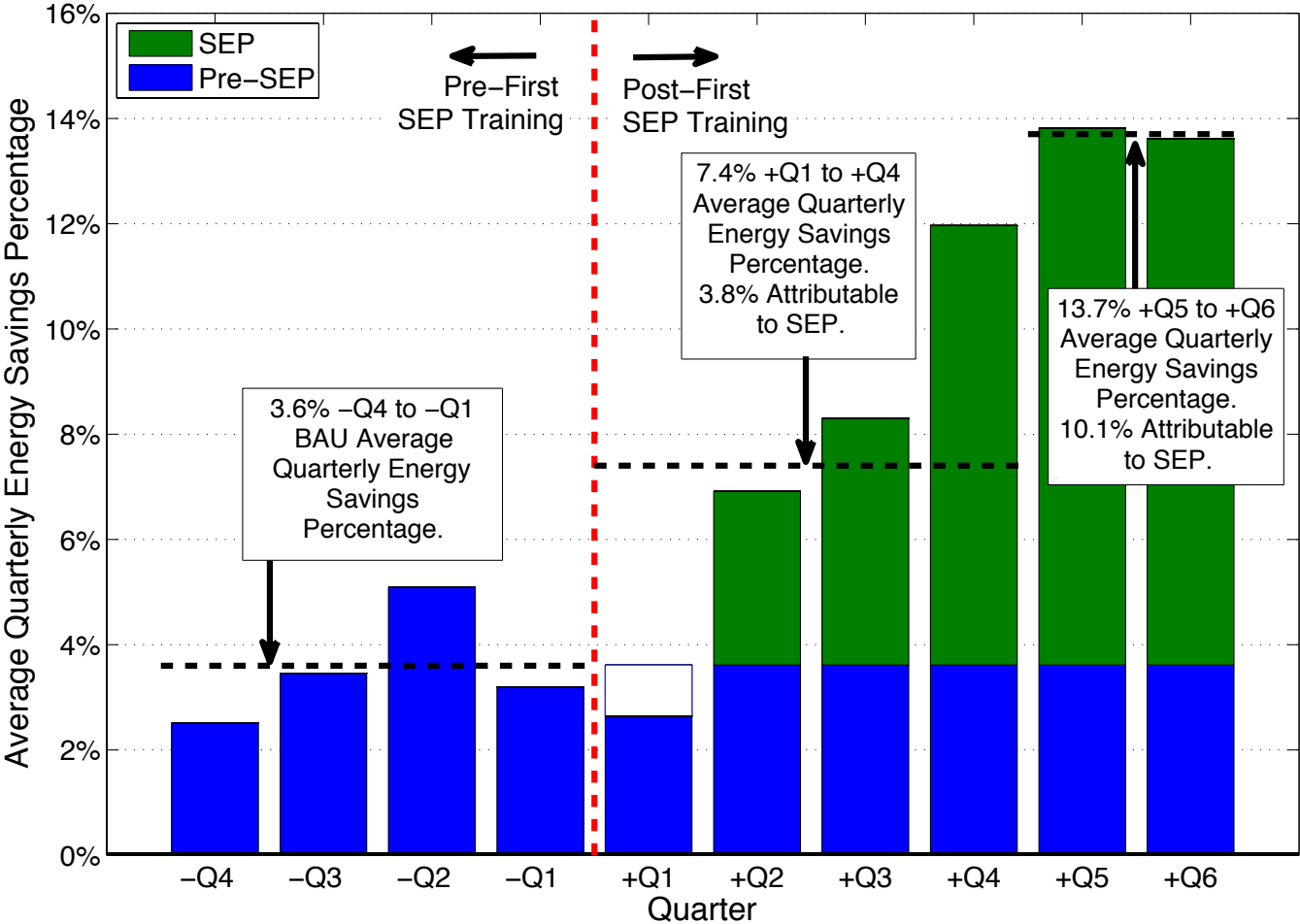
Determining SEP Business Value – Aggregating Nine SEP Facilities

- ▶ 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.

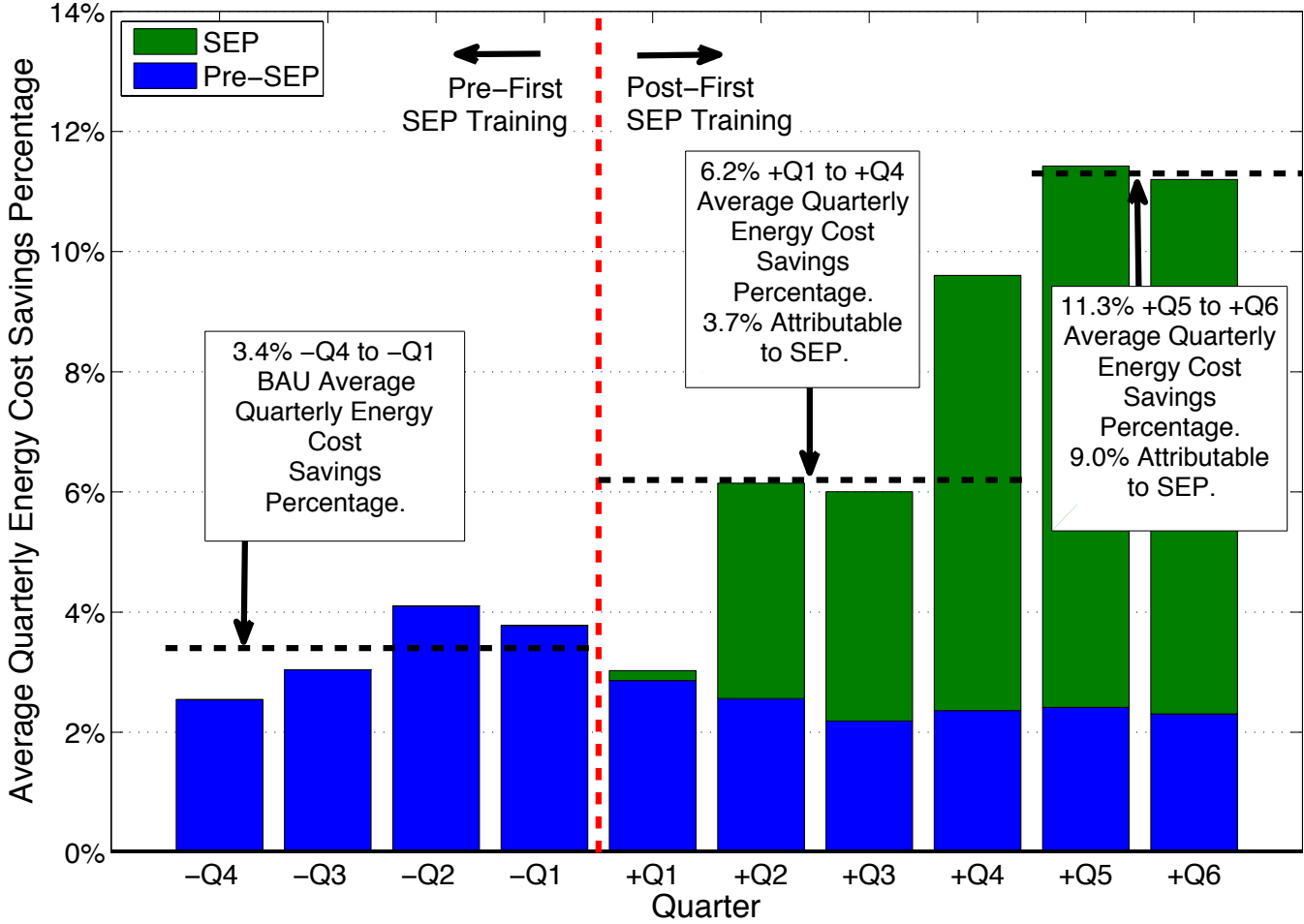
Results – Energy Savings Percentages



- ▶ Facilities required longer than one quarter to implement an EnMS.
- ▶ SEP attributable savings start in +Q2 when EnMS implementation starts to impact energy savings.



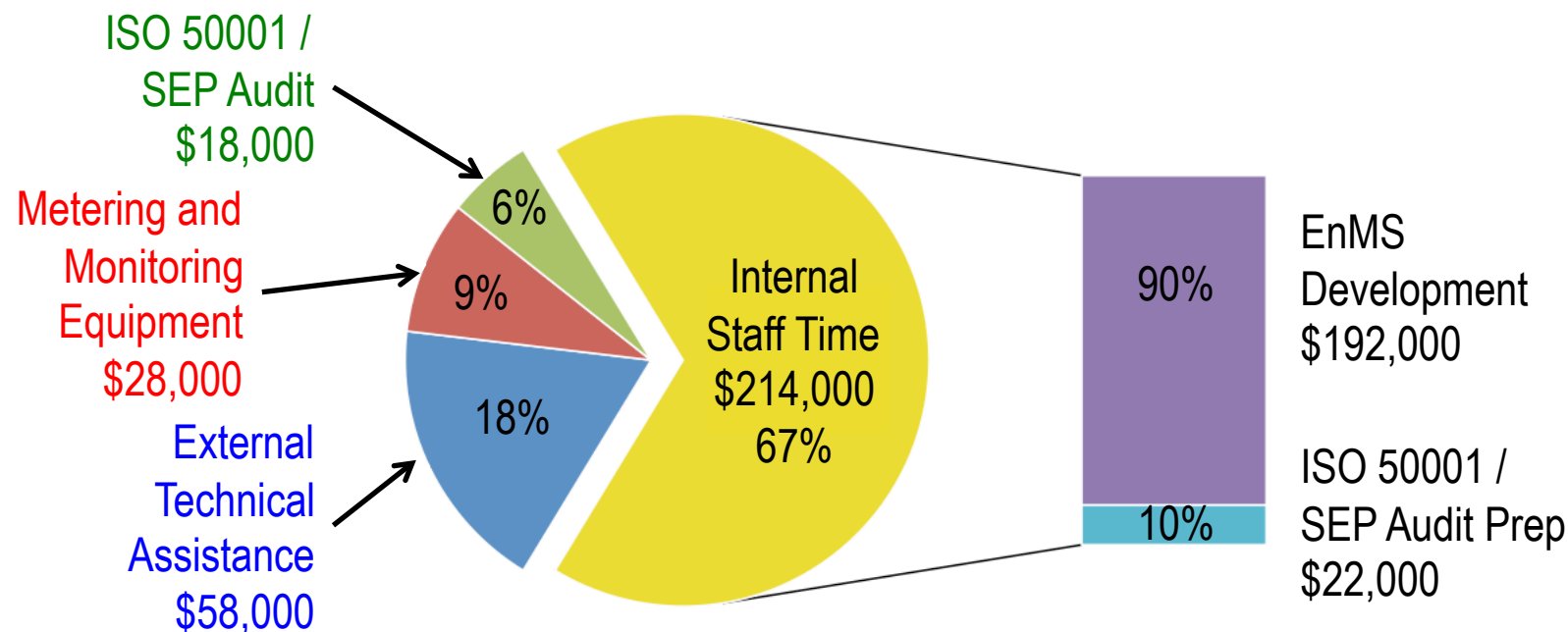
Results – Energy Cost Savings Percentages



- ▶ 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



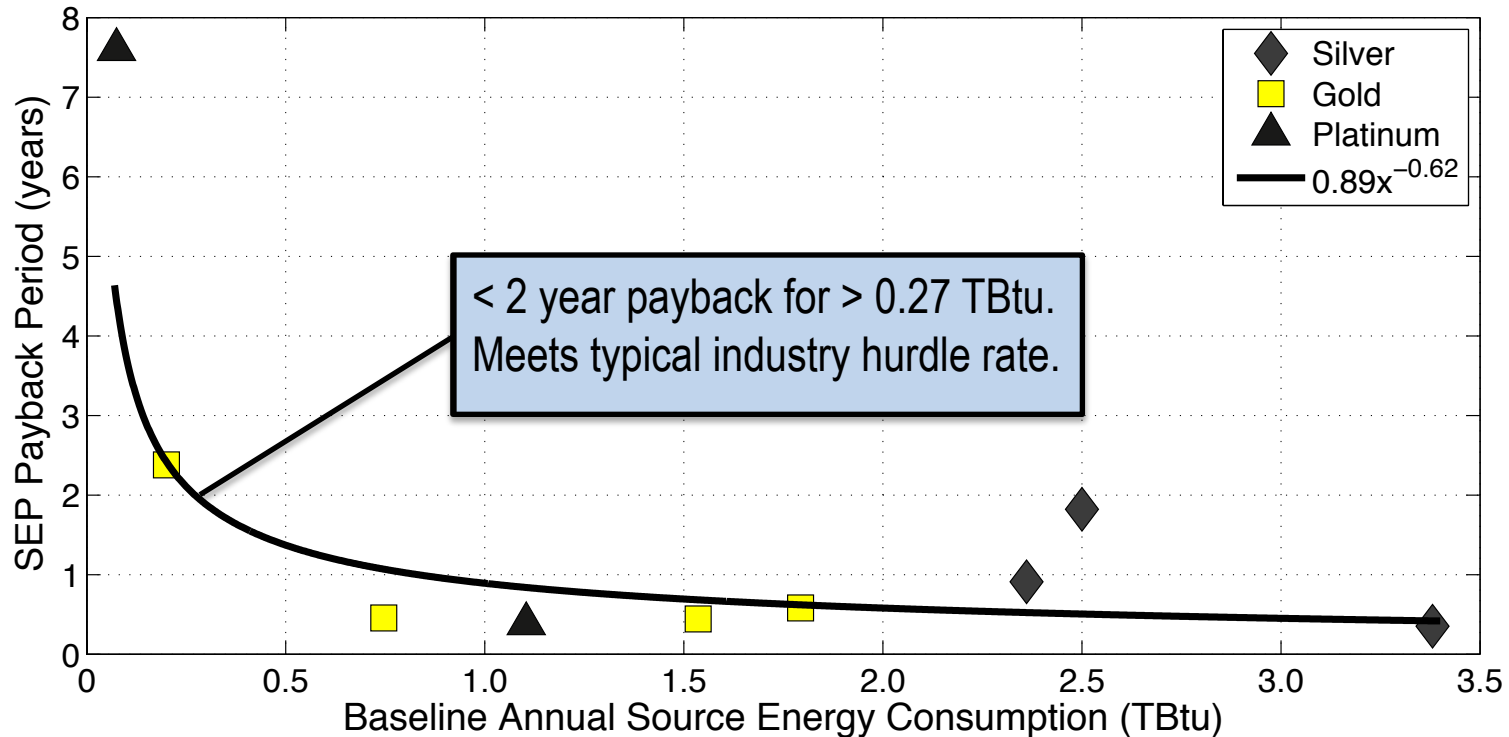
- ▶ Average total cost = \$319,000
 - Summation with above numbers not exact due to rounding errors
- ▶ Average of 1.5 person years to develop, implement, and maintain EnMS.
- ▶ Energy team typically comprised of existing staff.
- ▶ One facility reported installing far more metering equipment than needed.
 - \$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

$$\frac{\text{Costs}}{\text{Benefits}} = \frac{\text{EnMS and SEP Implementation Costs}}{\text{Operational Energy Savings (attributable to SEP in SEP reporting period)}}$$

- ▶ 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.

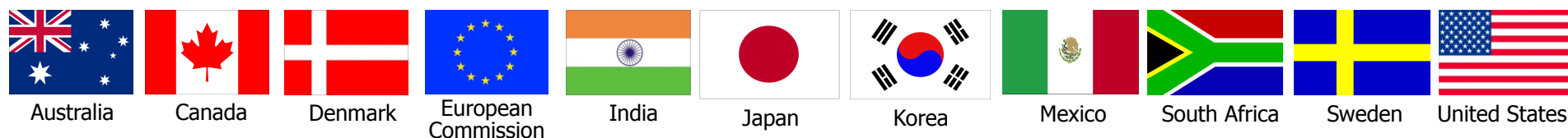
- ▶ *While the ISO 50001 EnMS provided a strong business process to manage energy, the addition of SEP energy performance improvement targets and third party certification provided significantly enhanced value, making the program worthwhile.*

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

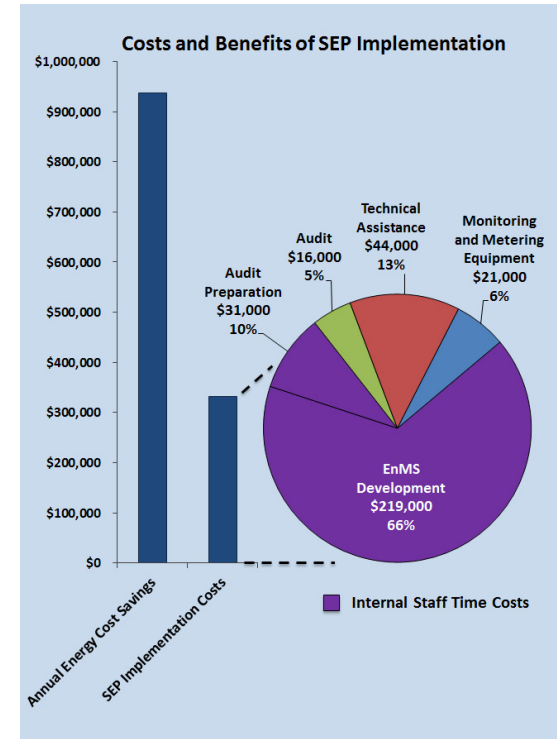
- ▶ Detailed case studies being developed under GSEP.

- Nissan (developed)

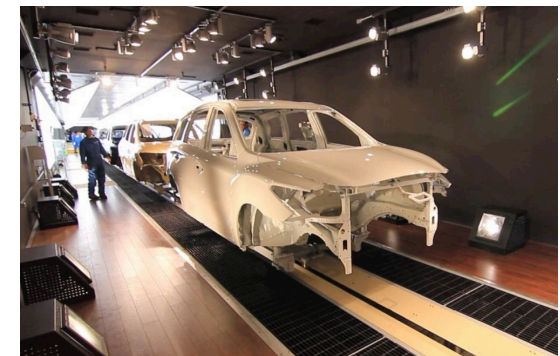
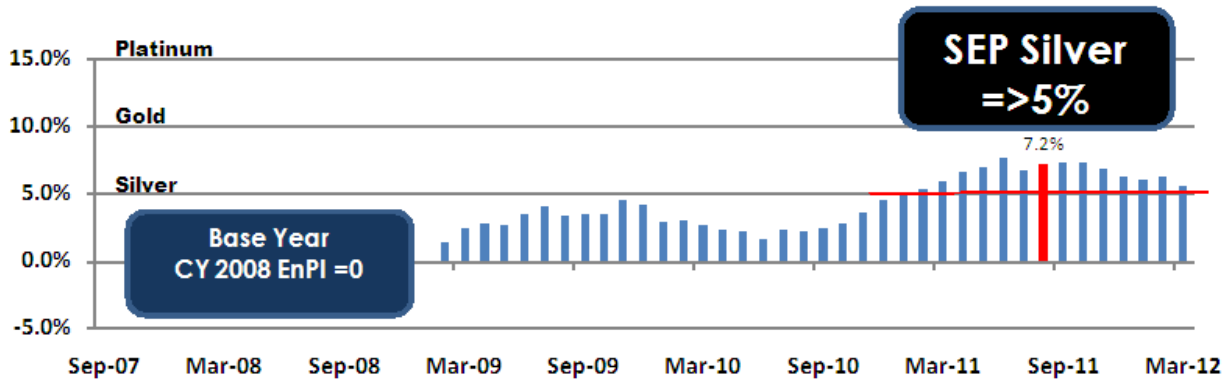
Nissan improved energy performance at its vehicle assembly plant in Smyrna, TN by 7.2% with a four-month payback period implementing SEP.

- Volvo Trucks and General Dynamics (under development)

- ▶ Provide additional details to presented study.



Monthly SEP Percent Energy Performance Improvement



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