

# Global Energy Management System Implementation: Case Study

USA, Superior Energy Performance

## GENERAL DYNAMICS

Ordnance and Tactical Systems

*Defense contractor improves energy performance nearly 12%, achieving a six-month payback and earning Gold-level certification by Superior Energy Performance*



General Dynamics became the first U.S. defense contractor to achieve certification under both ISO 50001 and Superior Energy Performance (SEP), based on the company's energy management system at a plant it operates in Scranton, PA, USA.

Photo: [U.S. Army](#)

### Case Study Snapshot

**Industry:** Defense Contracting

**Energy Management System (EnMS) guidance/standard:** ISO 50001

**Key driver for EnMS:** Environmental stewardship, government requirements, and cost reduction

**Improvement focus:** Seven processes using significant amounts of energy

**Location:** Scranton, Pennsylvania, USA

**Product(s):** Large-caliber artillery and mortar projectiles

**Cost to implement:** \$255,000

**Annual energy cost savings:** \$956,000

**SEP Marginal Payback period:** About six months

**Energy sources:** Electricity and natural gas

**Energy reduction goal:** 25% reduction in energy intensity by 2020

## Business Benefits Achieved

General Dynamics Ordnance and Tactical Systems (GD-OTS) worked with the U.S. Department of Energy's Advanced Manufacturing Office to successfully implement an energy management system (EnMS) at a federal ammunition plant in Scranton, Pennsylvania. GD-OTS staff members set an energy baseline and assessed opportunities to save energy in the plant's significant energy-using systems. By implementing the recommended projects and the EnMS in compliance with ISO 50001 and Superior Energy Performance (SEP), GD-OTS staff improved energy performance at the plant by 11.9%.

Energy achievements at the Scranton plant were verified by a third party to establish GD-OTS as an SEP Gold Certified Partner. The plant's energy resources are now proactively managed via a rigorous business system to sustain those energy savings and continue strengthening plant energy performance in the future.

### About Superior Energy Performance (SEP)

SEP is a market-based plant certification program that provides industrial facilities with a clear path to achieve continual improvement in energy performance while also boosting competitiveness.

To be certified under SEP, an industrial plant must implement an energy management system (EnMS) in conformance with ISO 50001 and make verified improvements in energy performance. SEP is accredited by the American National Standards Institute.

Implementing the EnMS saves the plant 107 billion Btu (113,000 GJ) and lowers energy costs by (US) \$956,000 annually. The \$255,000 investment in implementing the EnMS (including internal staff time) produced a marginal payback of just six months. This SEP marginal payback is based solely on *operational* energy cost savings attributable to the energy management program.

## Company and Facility Profile

General Dynamics is one of the largest defense contractors in the United States. The company is organized into four business groups: Aerospace, Combat Systems, Information Systems and Technology, and Marine Systems. The Scranton facility featured in this case study is part of Ordnance and Tactical Systems within the Combat Systems group. The Scranton plant is a government owned, contractor operated facility and is a leading domestic source of large-caliber artillery and mortar projectiles, having produced more than 28 million projectiles since starting production in 1963. Manufacturing operations performed at the ammunition plant include forging, nosing, heat-treating, machining, coating with phosphate, and painting. The plant also conducts destructive and non-destructive testing.

The Scranton plant’s main sources of energy are natural gas and electricity. Its significant energy users (SEUs) that consume natural gas include forging furnaces, heat-treating furnaces, and boiler systems, while its electricity-consuming SEUs include cooling towers, lighting, forging presses, and air compressors.

## Business Case for Energy Management

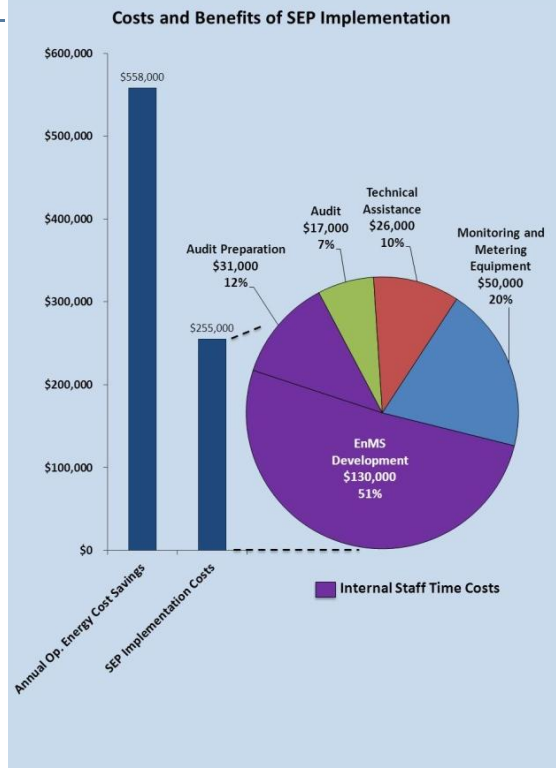
Staff members were motivated to participate in the ISO 50001/SEP pilot plant program by the clear benefits realized from previous management systems implemented at the facility (e.g., ISO 14001). The Scranton ammunition plant has always been a boldly innovative facility. GD-OTS management recognized and embraced this opportunity to lead and set the example for other plants.

Other factors in the contractor’s decision to implement an EnMS included overall cost reductions, government assistance, and mandated and voluntary energy efficiency and environmental goals. As a federally owned facility, plant operations are required to comply with a variety of federal laws and directives designed to promote energy efficiency. For example, Executive Order 13423, “Strengthening Federal Environmental, Energy, and Transportation Management,” directs the plant to decrease its energy consumption by 3% annually until 2015. In addition, GD-OTS had previously pledged to reduce its energy use by 25% or more in 10 years as a “Save Energy Now LEADER” (now called the Better Plants program) in partnership with the U.S. Department of Energy. Given its large energy consumption, the ammunition plant represented a great opportunity to improve energy performance and achieve high-impact results.

## Cost-Benefit Analysis

COSTS, SAVINGS, AND PAYBACK	
<b>Total Cost for Implementing SEP</b>	<b>\$255,000.</b>
<b>Internal Plant Staff Time (subtotal)</b>	<b>\$161,000.</b>
EnMS Development and SEP Data Collection	\$130,000.
SEP/ISO 50001 Audit Preparation	\$31,000.
<b>External Costs (subtotal)</b>	<b>\$93,000.</b>
External Technical Assistance	\$26,000.
EnMS Monitoring and Metering Equipment	\$50,000.
SEP/ISO 50001 Audit (3rd party auditor)	\$17,000.
<b>Total Annual Energy Savings (Attributable to SEP)</b>	<b>\$956,000.</b>
Annual Operational Improvement Energy Savings (Attributable to SEP)	\$558,000.
Annual Capital Project Energy Savings (Attributable to SEP)	\$398,000.
<b>SEP Marginal Payback<sup>1</sup></b>	<b>~6 months</b>

<sup>1</sup> SEP marginal payback is based on operational energy cost savings attributable to SEP program and not on capital projects.



## Cost-Benefit Analysis

A detailed analysis quantified the costs and benefits associated with implementing SEP/ISO 50001 at the Scranton plant. This analysis considered all program costs, including staff time (existing employees). To help isolate the impacts of energy efficiency measures, energy use during the baseline period (2009) was normalized to reflect production levels and operations in effect during the impact reporting period (see timeline). Energy and cost savings were calculated using utility data.

This analysis shows that the plant’s \$255,000 investment to implement SEP saves the plant \$956,000 annually overall—and \$558,000 of those savings come from no-cost/low-cost operational changes. The operational savings alone paid back the investment in just six months, and the plant is expected to retain these savings over time through ongoing use of the EnMS.

## Energy Management System Implementation

GD-OTS’s Scranton ammunition plant had experienced prior successes in implementing management systems, including ISO 14001 (for the environment), ISO 9001 (for quality), and OSHAS 18001 (for occupational health and safety). The recognized benefits of these previously implemented management systems made it easy to obtain management commitment for ISO 50001.

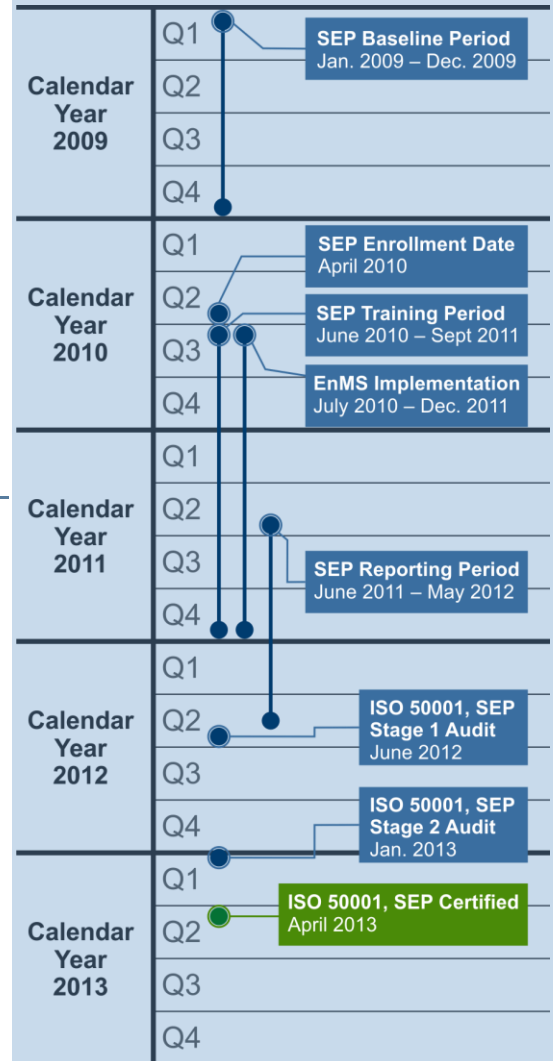
Scranton’s wider plant staff was engaged in the EnMS/SEP effort upon the energy team successfully demonstrating the program’s potential to reduce operational overhead—ultimately increasing competitiveness. Plant management continued to educate employees about EnMS training tools via the facility’s closed-circuit TV broadcasting system.

Prior to beginning the SEP program, the staff had recorded some historical information about energy usage by its heat-treating furnaces—but not to the extent required by ISO 50001 and SEP. Therefore, an essential step in implementing the EnMS was to determine a baseline representing energy consumption during “Business As Usual.” This effort to connect energy consumption to specific, individual processes proved a revelation for the Scranton operation: the plant’s largest energy user turned out to be its primary forging furnace.

The baseline effort revealed precise values for all the SEUs, enabling plant officials to identify high-impact actions using the EnMS (e.g., a gas-fired rotary hearth furnace used for forging was the primary consumer of natural gas, while its respective forge shop cooling tower consumed the largest amount of electricity).

Following the baseline effort, the plant took an aggressive approach, executing projects for seven SEUs (see specifics in “Company and Facility Profile” section above). Following an in-depth evaluation, the Energy Management Team created a performance improvement project and goal for each SEU. These objectives and targets were updated quarterly to ensure that the plant remained on task and drove the required reductions in energy intensity. Each objective and target was associated

### General Dynamics Scranton Facility SEP Timeline



SEP certification requires a facility to set an energy baseline, establish an energy team, identify and pursue energy-saving measures, and achieve verified energy savings between the baseline and reporting period. The cost-benefit analysis that determined the payback of six months (presented on the preceding page) considered only those savings achieved as a direct result of operational improvements.

with a specific action plan to be carried out by designated parties, who were also responsible for reporting back to the Energy Management Team on any issues or successes.

**Managing Energy Better**

Prior to the baseline effort, General Dynamic Ordnance and Tactical Systems’ Scranton facility had used a sub-metering system composed of various independent meters. In preparation for SEP’s rigorous verification process, the plant energy team added meters to all significant energy-using equipment, enabling a more detailed look into energy consumption on a process level.

Data resulting from this \$50,000 sub-metering upgrade proved valuable in helping GD-OTS plant engineers develop the EnMS. New insights gained from the improved metering led to new procedures and operations to reduce overall energy intensity at the process level—and these reductions translated directly into energy savings at the plant level.

The more extensive metering also assists plant officials in justifying future investments; before the sub-meters were installed, capital project impacts had been predicted using only rough engineering estimates. Metering also proves any realized savings, increasing management buy-in on future capital projects. Currently, the sub-meters and modeling tools (see “Measurement and Verification” section below) are used to forecast utility bills, especially when future production levels are known.

**Energy Savings Assessments**

In 2010, the Scranton plant participated in two energy savings assessments led by the Oak Ridge National Laboratory staff, with costs shared by the U.S. Department of Energy. These assessments identified the most cost-effective opportunities to save energy in the plant’s process heating, compressed air, and pump systems. The largest potential for savings was found in the plant’s process heating system.

On the basis of these assessments, GD-OTS identified and implemented various operational and capital projects in 2010 and 2011. One energy savings measure recommended by the assessments reduced fan cooling water flows for the facility’s forging furnaces. This single no/low-cost operational adjustment saves 3.3 billion Btu (3,500 GJ) or \$31,000 annually. The ammunition plant also invested in a capital project to install new recuperators for another furnace, saving an estimated 14 billion Btu (14,800 GJ) or \$132,000 per year. Building on these successes, GD continues to identify energy-saving opportunities through ongoing use of the EnMS.

**Sampling of projects implemented at the Scranton Ammunition plant**

Associated SEU	Project Description	Annual Energy Savings (site energy) Natural Gas: BBTu, GJ Electricity: kWh	Energy Cost Savings (\$)	Capital Investment (\$)
Air Compressors	Regulate air pressure with valve gate and proper piping	390,000 kWh	\$30,000	\$5,000
Forging Presses	Pump Compensators Erie I Press	404,000 kWh	\$31,000	\$28,000
System Optimization	Operational Controls	543,000 kWh	\$41,000	\$0
Cooling Towers	Temperature Control Forge Cooling Tower	300,000 kWh	\$23,000	\$0
Air Compressors	Air pressure reduced by over 50% in paint line	15,000 kWh	\$1,000	\$500
Cooling Towers	Increase operational set point and manage system horsepower	3.3 BBTu, 3,500 GJ	\$31,000	\$0
System Optimization	Operational Controls	22 BBTu, 23,000 GJ	\$208,000	\$0
Forge Furnace	Rehabilitate Erie I Furnace	19 BBTu, 20,000 GJ	\$175,000	\$1.0M
Heat Treat Furnace	Holcroft 1 Burners/Recoup	14 BBTu, 15,000 GJ	\$132,000	\$276,000
Boiler Systems	Installed new 500 HP boiler	7.4 BBTu, 7,900 GJ	\$70,000	\$350,000

**“ISO 50001 provides Scranton with an effective plan and framework to manage energy-intensive operations.”**

Jeff Brunozzi  
Vice President  
Large Caliber Ammunition Operations

**“Superior Energy Performance is the mechanism responsible for driving continuous improvement in energy performance.”**

Stephen Cannizzaro  
Sustainability Manager  
Environmental/Facilities Engineer

## Measurement and Verification

To measure and verify improvements achieved across the facility, SEP offers use of an energy performance indicator (EnPI) tool, which provides a plant-wide energy profile. Effective use of this tool requires a thorough knowledge of the factors that affect a plant's energy intensity and the ability to use statistical techniques to analyze and normalize data.

This tool is extremely helpful in discerning actual energy performance improvement at the facility level in compliance with the SEP measurement and verification protocol. Credible savings estimates also make it easier to build the case for future operational changes or capital investments.

## Internal and Third-Party Audit and Certification

GD hired DEKRA, a certification body accredited by the American National Standards Institute, to verify the plant's conformance with ISO 50001 and achievement of its SEP energy savings targets. GD-OTS first conducted an internal gap assessment to ensure readiness for this third-party verification. Other than that, no special preparation was needed for either Stage I, the ISO 50001/SEP "readiness review" audit, or Stage II, the onsite ISO 50001/SEP audit. GD-OTS was already acquainted with internal audits from its prior experience with other ISO standards and OHSAS 18001, so this review was a familiar exercise. The ISO 50001/SEP audit of the Scranton facility was completed in June 2012, and the 11.9% improvement in energy performance was ultimately verified at the Stage II audit in January 2013—qualifying GD-OTS as an SEP Gold Certified Partner (energy performance improved by between 10% and 15%).

## Barriers, Lessons Learned, and Results

### Barriers

GD-OTS encountered one complication unique to government owned, contractor operated facilities. The Scranton facility must abide by U.S. Army and International Traffic in Arms (ITAR) regulations. As a result, final SEP certification was delayed until April of 2013 to ensure that these requirements were met.

In deciding to address seven SEUs, GD-OTS made a concerted effort to significantly reduce energy consumption. However, this ambitious approach created some challenges, including demands on resources to fulfill plant-wide training and competency determinations.

### Lessons Learned

Before developing the EnMS and energy action plans, GD found it extremely helpful to scrutinize the plant at the process level. This baseline effort enabled the staff to key in on the most promising opportunities.



Personnel from General Dynamics and the Scranton Army Ammunition Plant receive 2012 Secretary of Defense Environmental Excellence Award.

## Superior Energy Performance Levels:

All facilities must meet a minimum energy performance improvement within three years after the baseline period.

Silver:	5%
Gold:	10%
Platinum:	15%

*“SEP helps to track and prove ‘without a doubt’ payback of projects. Project energy savings are based on actual data as opposed to opinions. Government funders are now more comfortable with reported results.”*

Joe Chup  
Senior Plant Engineer

The EnPI model proved valuable in enabling the staff to forecast potential savings due to changes in operations and/or the procurement of new equipment. This forecasting capability strengthened confidence in the proposed actions, facilitating the decision-making process—especially for capital investments.

Another notable outcome of EnMS implementation is a closer alignment between the Production Operations and Facility Engineering divisions at the plant. The energy team succeeded in demonstrating that many strategic utility reduction measures could help reduce energy intensity and overhead without infringing upon delivery schedules. Recognition of this compatibility generated greater cooperation between production schedulers and facility engineers, which has greatly enhanced the facility's ability to reduce energy intensity.

## Results

The Scranton plant reduced its energy intensity by 11.9% (from the baseline period to the reporting period) and attained SEP status as a Gold Certified Partner. The implemented energy efficiency measures that are attributable to SEP save 107 billion Btu (113,000 GJ) and \$956,000 in costs annually. The plant's participation in the SEP program demonstrates that large plants can obtain significant benefits by implementing an energy management system.

The Scranton facility has been widely recognized for its energy efficiency achievements, receiving the 2011 Army Material Command Green Innovation award, the 2011 Secretary of the Army Industrial Sustainability Award, and the 2012 Secretary of Defense Environmental Excellence Award for industrial sustainability.

Several additional Ordnance and Tactical Systems facilities are now participating in the SEP Enterprise-wide Accelerator project, which requires EnMS implementation in multiple or all facilities under a business unit, thereby expanding corporate energy savings.

The Scranton facility will continue to use the newly implemented EnMS and will seek SEP recertification in 2016 as part of a corporate-level strategic plan. GD-OTS is continually looking for opportunities to further reduce its energy intensity and potentially expand the EnMS to partner facilities.

***“SEP brought to light many energy intensity savings opportunities that were previously hard to justify. With the EnMS system in place and metering instruments installed, it is much easier to justify improvement projects, and management is more receptive to these proposals.”***

Stephen Cannizzaro  
Sustainability Manager  
Environmental/Facilities Engineer

## Keys to Success

- The Scranton Energy Management System was well received by Scranton's Labor Union and Senior Management.
- The facility is in an urban area, and certification is evidence of plant efforts to be a good neighbor. Certification of ISO 50001 and SEP is celebrated and announced to the community.
- ISO 50001 and SEP help drive analyses and actions that make metered data worthwhile. Without the SEP program, the facility would not have the data that allows for continual improvement.

The Global Superior Energy Performance (GSEP) initiative was launched in 2010 by the Clean Energy Ministerial (CEM) and International Partnership for Energy Efficiency Cooperation (IPEEC). Through GSEP's Energy Management Working Group (EMWG), government officials worldwide share best practices and leverage their collective knowledge and experience to create high-impact national programs that accelerate the use of energy management systems in industry and commercial buildings. For more information, please visit <http://www.cleanenergyministerial.org/energymanagement>

