Superior Energy Performance®
U.S. DEPARTMENT OF ENERGY

Case Study
May 2015

HARBEC—a Specialty Plastics Manufacturer—Improves Energy Performance 16.5% with SEP

HARBEC, Inc. worked with the U.S. Department of Energy (DOE) Advanced Manufacturing Office to successfully implement an energy management system (EnMS) that meets all requirements of ISO 50001[1] and Superior Energy Performance® (SEP™). HARBEC's implementation of the EnMS at its small plastics manufacturing facility in Ontario, New York, enabled a 16.5% improvement in energy performance, saving over $50,000 a year. HARBEC will recoup its investment in SEP within 2.4 years, demonstrating that even smaller manufacturing plants can cost-effectively realize significant benefits from implementing an EnMS.

Business Benefits Achieved

Implementing the EnMS saves the company's sole plant six billion Btu (6,300 GJ) each year and lowers energy costs by (US) $52,000. The $127,000 that the plant spent to implement the EnMS and obtain SEP certification will be paid back through savings in approximately 2.4 years. This SEP marginal payback is based solely on operational energy cost savings attributable to the energy management program.

Energy savings achieved at the plant were verified by an accredited third party, earning the facility certification as an SEP Partner at the Platinum level. 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.

[1] International Organization for Standardization Standard 50001, energy management

Working toward carbon neutrality, HARBEC, Inc.'s small-scale specialty plastics manufacturing facility in upstate New York implemented an energy management system that earned both ISO 50001 and Platinum Superior Energy Performance certification. Photo: HARBEC, Inc.

Project Summary	
Industry	Plastics
Facility location	Ontario, New York, USA
SEP certification level	Platinum
Energy management system	ISO 50001
Energy performance improvement	16.5% over 3 years
Annual energy cost savings	$52,000
Cost to implement	$127,000
Payback period	2.4 years

"The nature of SEP and ISO 50001 is that they fuel themselves. As more people see that these approaches work and save significant amounts of money, they will choose to participate."

— Bob Bechtold
President
HARBEC, Inc.

Business Case for Energy Management

Becoming a Carbon-Neutral Company

Among the factors that motivated HARBEC to implement an EnMS and participate in the SEP program was the company goal to become carbon-neutral. HARBEC nurtures its green image, which delivers growing value in domestic and international markets. As supply chains and the global economy become increasingly eco-conscious and regulated, the company is strategically positioning itself as a carbon-neutral supplier. This status is already beneficial in Europe and Asia, where large markets for carbon-free plastics are flourishing.

HARBEC employs a variety of carbon mitigation tactics to offset its footprint. These tactics include using renewable and clean energy, offsetting carbon emissions by purchasing carbon credits, and participating in the SEP program. SEP provides guidance, tools, and protocols to drive deeper, more sustained savings through energy management. Future HARBEC activities may include capturing methane and planting trees.

Managing Clean Energy Resources

To boost facility energy efficiency, the plant resolved to install more efficient equipment and implement an ISO 50001-compliant EnMS. The EnMS has proven extremely useful in managing the plant's clean energy resources, including the two onsite wind turbines and combined heat and power (CHP) system—which generates heat and electric power from the combustion of natural gas. Exhaust heat from the CHP system is used to heat and even cool the facility after running through an absorption chiller, ultimately reducing plant costs.

"Increased participation in ISO 50001 and SEP will drive the market to develop more new products and equipment that will further increase energy efficiency and performance. Companies will participate as long as it turns into dollars."

— Bob Bechtold
President
HARBEC, Inc.

HARBEC's president, Bob Bechtold (left), management representative, Amy Bechtold (middle), and energy manager, Jeff Eisenhauer (right), make up the energy team at HARBEC. The team is shown next to the plant's CHP unit.
Photo: HARBEC, Inc.

Benefits of SEP and Keys to HARBEC's Success

SEP provides numerous advantages for all participating companies. For HARBEC, these included the following:

- HARBEC has company-wide commitment to energy management and environmental stewardship. Incorporation of the management system has enhanced the level of energy awareness throughout the company.
- President Bob Bechtold's desire to run a carbon-neutral company was key in HARBEC's committing to the EnMS and earning SEP certification.
- SEP provided HARBEC with the tools to monitor and verify energy reductions.
- Third-party verification under SEP provides evidence of proven energy savings.
- ISO 50001 has been integrated into the Enerit software system.

Company and Facility Profile

HARBEC is a relatively small plastics manufacturer focusing on specialty and complex prototypes, tooling, machined components, and injection-molded plastic and metal parts. HARBEC serves customers in the aerospace, medical, and transportation industries and earns annual revenue of roughly $15 million. A modular business structure enables the company to rapidly accommodate changes in these dynamic markets.

Eco-Economics

HARBEC takes great pride in being an energy and environmentally conscious company. A corporate core value, described by the term eco-economics, is the belief that profitability and environmental stewardship can and should be mutually reinforcing. HARBEC's go/no-go criteria for environmental and energy projects are different from those for other proposed projects, which are required to pay for themselves within a specified period. For energy projects, HARBEC compares the expected energy cost savings to the cost of the project over its lifetime. An energy project is approved if it generates a net positive cash flow, as determined by comparing the cost of the financed project to anticipated reductions to the energy bill. Recent increases in lending options and greater credibility in energy-saving projects nationwide have enabled HARBEC to enter into financing arrangements with no risk and no money down.

In addition, HARBEC management considers energy expenses as fixed costs. This practice allows a portion of funds allocated to pay future utility bills to be redirected to projects that reduce the size of those bills. This environmentally friendly business approach and philosophy creates greater flexibility and openness to implementing energy efficiency or renewable energy projects, reducing the risk that a profitable idea will be overlooked simply because it does not pay for itself within a specified time period. This approach has enabled HARBEC to generate over three fourths of the electricity needed to power the plant using its CHP system and two wind turbines (with capacities of 250 kW and 850 kW). The CHP system consists of five heat exchangers and 25 microturbines, which have a maximum capacity of 750 kW.

EnMS Development and Implementation

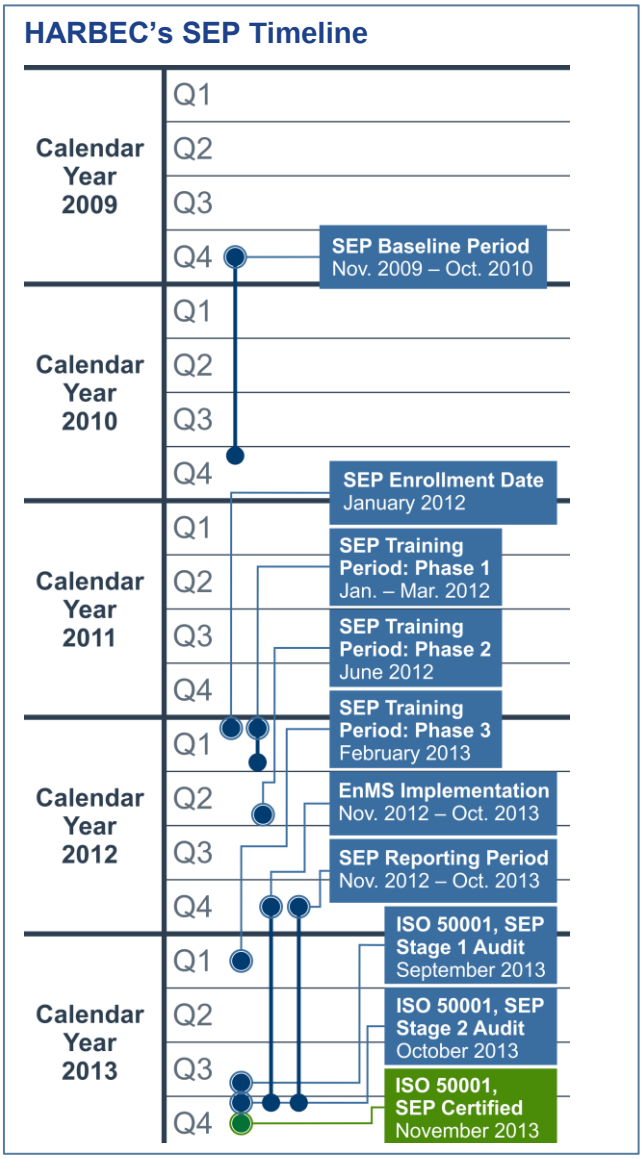
Developing the EnMS

Implementing an EnMS in conformance with ISO 50001 was an unfamiliar task for the HARBEC energy team. Bob Bechtold, HARBEC president and a powerful advocate for energy management, contracted with the New York State Energy Research and Development Authority (NYSERDA) for a coach to help implement the system. The first step for the HARBEC energy team and their coach was to select a baseline period representing "business as usual" production and energy consumption. The team selected November 2009–October 2010, as it was the earliest 12-month period with available verified data.

To focus energy improvement efforts on the areas of highest potential impact, the energy team then performed a mass energy balance analysis across the facility to identify the most significant energy uses (SEUs). Realizing that the CHP plant provided for about 47% of HARBEC's annual onsite energy supply, the team decided to focus on that system.

EnMS Rollout

Plant staff began EnMS implementation in November 2012, and the project was completed in October 2013 (see timeline on following page).



Designing the Action Plan

Newly installed data collection devices (i.e., instrumentation) showed that the CHP plant presented a significant opportunity for energy savings. Further analysis of plant equipment energy usage drove the development of four separate action plans. The first plan aimed to reduce unnecessary run time on the CHP plant when there was no demand for thermal energy (see table at right). Prior to this operational changeover to running the CHP plant in "thermal following mode," the plant had generated a fixed power load regardless of demand, and unused thermal energy had been dumped or wasted. Completion of this action plan saved 5,717 MMBtu and $43,000 annually at prevailing energy prices—with no capital investment.

Project implemented at the HARBEC Ontario Plastics plant

Project Description	Annual Energy Savings (MMBtu)	Annual Energy Cost Savings ($)	Capital Investment ($)
Operated CHP plant in "thermal following mode"	5,717	$43,000	$0

The three additional action plans defined specific strategies to increase energy efficiency in other plant systems in the future:

1) Reduce parasitic demands on cooling tower fan and hot water circulation pumps by incorporating variable frequency drives.
2) Use excess chiller capacity to cool process water for the injection mold machines during all but summer months.
3) Add automatic sequencing so that only the required number of microturbines operate at any one point in time.

Overall, the EnMS enabled a systematic identification and execution of cost-effective opportunities to save energy and reduce emissions.

Achieving ISO 50001 and SEP Certification

Training HARBEC Staff

While the HARBEC EnMS was being developed, the New York State Pollution Prevention Institute (P2I) at the Rochester Institute of Technology delivered a training session to the entire staff at the HARBEC facility. This training described the ISO 50001 standard and, using input from HARBEC, showed ways to improve the energy efficiency of each SEU. P2I offered the training without charge, as the institute plans to leverage the knowledge gained for future training. The session helped increase employee engagement and participation in facility efforts to improve

energy efficiency. Conformance to the ISO 50001 standard has helped HARBEC modify its corporate energy culture to actively encourage energy efficiency suggestions from plant staff. These suggestions are particularly valuable because these workers operate the systems daily and are the most familiar with plant processes.

Preventative Maintenance

In addition to saving energy, the EnMS and new sub-metering helped to identify equipment that was nearing failure through lack of maintenance. The new system encourages preventive maintenance to reduce equipment downtime. The enhanced oversight of energy use also reduces unnecessary equipment starts and stops, extending the service life of electromechanical devices across the facility. Decreasing the wear and tear on machines also increases the facility's overall profitability.

Elevating Energy Efficiency Awareness

The company elevates awareness of energy efficiency efforts internally by hanging posters and offering awards for suggestions. In addition, monthly energy data for each department is posted on the facility's internal metrics display. For the benefit of the general public, HARBEC uses Energy Management Live software to post its real-time, system-specific energy consumption data. These data are accessible on the HARBEC website.

"SEP participation helped reveal new energy savings opportunities and helped us to develop a formal and continuous energy management training program—ultimately strengthening all energy awareness activities."

— Amy Bechtold
Compliance Manager and Energy Management Representative
HARBEC, Inc.

Sub-Metering

Historically, HARBEC metered only the highest-level systems: incoming utility power and renewable power. In 2012, meters were installed on all electrical generation and major energy-consuming equipment (at the department level) throughout the facility, using a $50,000 grant from the Wayne County Economic Development Agency. This grant is not considered in the cost-benefit analysis and payback calculation because the decision to install meters was made prior to SEP participation. HARBEC exported, and continues to export steam from their CHP units to a neighboring facility, which runs their entire heating and cooling system. HARBEC spent an additional $4,000 to meter this exported steam. This cost is included in the cost-benefit and payback calculation.

Meters now track the plant's use of compressed air, natural gas, hot and chilled water, and city water throughout the facility. This level of sub-metering enabled plant staff to create a baseline for each utility and develop energy reduction goals and action plans for each specific unit (as mentioned above, under Designing the Action Plan). The expanded metering has also streamlined the monitoring of plant operations so that the plant engineer and other staff no longer need to spend time assembling data and calculating the energy and overall performance of plant equipment. They can now view equipment-specific, real-time energy consumption data and alerts on HARBEC's automated monitoring system, freeing personnel to perform other job responsibilities, such as seeking out new opportunities to improve production efficiency. Overall, the EnMS encourages additional energy savings, and SEP implementation has helped HARBEC in its move to carbon neutrality.

EnPI Tool Improves Analysis

To measure and verify plant-wide improvements, DOE offers an energy performance indicator

(EnPI) tool. By providing a plant-wide energy profile, this tool is extremely helpful in isolating actual energy performance improvement in compliance with the SEP measurement and verification protocol. 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. HARBEC's use of the EnPI tool enables monthly examination of overall energy use to determine whether the facility is operating as expected.

Internal and Third-Party Audit and Certification

HARBEC hired DEKRA, an SEP verification body accredited by the American National Standards Institute (ANSI) and the ANSI-ASQ National Accreditation Board (ANAB), to verify the plant's conformance with ISO 50001 and its achievement of SEP energy savings targets. The HARBEC energy team was well prepared for both audits (Stage I, the ISO 50001/SEP "readiness review" audit, and Stage II, the onsite ISO 50001/SEP audit) because of its prior experience with other management systems and use of the Enerit systematic energy management software (see Software Simplifies Use of EnMS section below). HARBEC already held management system certifications in ISO 9001 (for product quality) and ISO 14001 (for the environment).The ISO 50001/SEP readiness review audit of the plant was completed in September 2013, and the 16.5% improvement in source energy performance was ultimately verified at the Stage II audit one month later—qualifying HARBEC as an SEP Platinum Certified Partner (attaining an energy performance improvement of 15% or more).

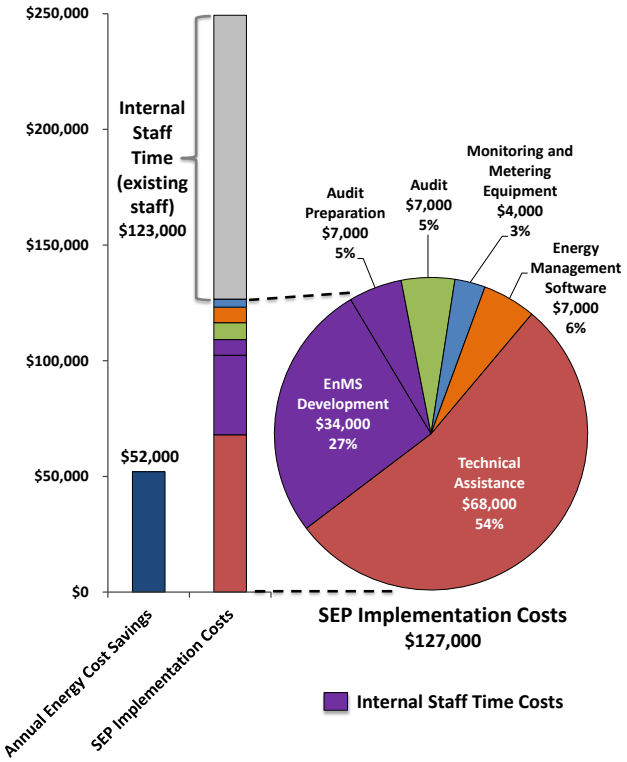
Evaluating the Costs and Benefits of Implementing SEP

A detailed follow-up analysis quantified the costs and benefits associated with implementing SEP/ISO 50001 at the HARBEC plant. As shown in the pie chart (at right), this analysis considers all program implementation costs including:

- Internal staff time spent on developing the EnMS
- Internal staff time spent preparing for the SEP/ISO 50001 audits
- Technical assistance
- Monitoring and metering equipment
- The third-party audit

In estimating the cost of internal staff time, this analysis considered only the time of staff not previously engaged in energy management activities. The time expended by plant staff already engaged in energy management is considered a sunk cost and therefore not included in the payback calculation (see table on following page). Thus, although the total cost for the facility's internal staff to develop the EnMS was $157,000, much of the EnMS was developed by staff members already engaged in energy management, and the analysis considers only the $34,000 to cover the time of other internal staff.

Costs and Benefits of SEP Implementation



COST-BENEFIT ANALYSIS: Costs, Savings, & Payback	
Total Cost for Implementing SEP	**$127,000**
Internal Staff Time	$164,000
EnMS Development and SEP Data Collection	*$157,000*
SEP/ISO 50001 Audit Preparation	*$7,000*
Existing Internal Staff Time[1]	-$123,000
External Technical Assistance	$68,000
EnMS Monitoring and Metering Equipment	$4,000
SEP/ISO 50001 Audit (third-party auditor)	$7,000
Energy Management Software[2]	$7,000
Total Annual Energy Savings (Attributable to SEP)	**$52,000**
Annual Operational Improvement Energy Savings (Attributable to SEP)	$52,000
Annual Capital Project Energy Savings (Attributable to SEP)	$0
SEP Marginal Payback[3]	**2.4 years**

[1] The time expended by plant staff already engaged in energy management is considered a sunk cost and therefore not included in the payback calculation.

[2] Software purchase was a company decision and is not required for SEP certification.

[3] SEP marginal payback is based on operational energy cost savings attributable to the SEP program.

To help isolate the impacts of energy efficiency measures, energy use during the reporting period (November 2012–October 2013) was normalized to reflect the production levels and operations in effect during the baseline period (November 2009–October 2010). Energy and cost savings were calculated using these normalized data and actual utility data.

Overall, the analysis shows that the plant's $127,000 investment in SEP saves the plant $52,000 annually (at prevailing energy prices), paying back the EnMS investment in 2.4 years. All of those savings come from no-cost/low-cost operational changes, and ongoing use of the EnMS is expected to sustain these savings over time.

Barriers

Committing to an Aggressive Schedule

The HARBEC energy team committed to an aggressive and challenging SEP certification schedule. Despite this schedule, the energy team was able to successfully pass both Stage I and Stage II of the ISO 50001/SEP audit and become certified within a three-month period.

Accounting for Onsite Electricity Generation

An additional challenge faced by the HARBEC team was in accounting for the plant's onsite generation of renewable and CHP electricity. SEP uses source energy accounting, so the electricity produced onsite from wind turbines and CHP had to be handled differently from utility-purchased electricity, which includes offsite generation and distribution losses. Some time and effort was needed to understand how this onsite-generated electricity would affect the energy performance calculations in the DOE EnPI tool.

Lessons Learned

Software Simplifies Use of EnMS

Implementation of the ISO 50001 standard requires intensive use of data and documentation describing the core elements of the EnMS. This documentation covers such topics as organizational energy policy, energy objectives, energy action plans, and other required records. To more efficiently and transparently implement the EnMS, the energy team used the ISO 50001 Manager Pro, a cloud-based software system produced by Enerit.

By incorporating ISO 50001 into a database, HARBEC could use this software to streamline document management, eliminating the need for voluminous paper references. The software simplified the certification process, enabling plant officials to efficiently track revisions; obtain approvals; provide review; and view detailed, software-generated audit reports to help quantify energy improvement efforts both prior to and following certification. Because the software also integrates ISO 14001 and ISO 9001 standards into the same database, plant staff enjoy easy access to all ISO management systems. The software system continues to be an integral part of HARBEC's ISO 50001-compliant EnMS.

EnMS Encourages Persisting Savings

HARBEC learned that while the company had made great strides in energy performance, savings seldom persist without regular follow-up to ensure operational efficiency. Some of the greatest energy savings can be attained at little or no cost, such as those that accrued from changing CHP operations (to thermal following mode). The EnMS gave the HARBEC plant a way to rigorously measure its carbon footprint and a roadmap for achieving carbon neutrality.

Moving Forward

HARBEC's reputation as an energy-conscious company is recognized by various federal programs. HARBEC is a partner in the Green Power and Energy Star programs of the U.S. Environmental Protection Agency, a Better Plants Challenge Partner,[2] and now a Platinum SEP-Certified Partner with DOE. The SEP certification validates HARBEC's systematic approach to reducing energy consumption and associated emissions.

The HARBEC plant will continue to use its newly implemented EnMS and will seek SEP recertification in 2016 in accordance with the HARBEC corporate strategic plan. The company is continually looking for opportunities to further improve its energy performance and leverage its newly implemented EnMS to support its corporate goal of carbon neutrality.

[2] SEP and Better Plants are distinct yet complementary partnership programs administered by the U.S. Department of Energy. SEP certifies individual plants for meeting the ISO 50001 standard and making verified improvements in their energy performance, while Better Plants asks entire companies to commit to reducing their manufacturing energy intensity 25% or more within the next 10 years. These companies set ambitious goals, establish energy management plans, and report progress annually to DOE. Better Plants partners can implement SEP, whether at a single plant or across the entire enterprise, to help meet corporate energy goals. Learn more.