

Global Energy Management System Implementation: Case Study

United States

HARBEC, Inc.

Specialty plastics manufacturer improves energy performance 16.5% to earn Platinum certification in Superior Energy Performance.



Business Benefits Achieved

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 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. 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 a 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. A non-financial benefit of the audit is the third party verification of Harbec's carbon neutral status.

Case Study Snapshot

Industry	Plastics
Location	Ontario, New York, USA
Energy Management System	ISO 50001
Product/Service	Precision manufactured parts
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.

Company Profile

HARBEC, Inc. is a precision manufacturer specializing in custom injection molding, CNC machining, complex prototypes, and additive manufacturing. HARBEC has customers throughout the world in the medical device,

aerospace, defense, transportation, consumer product, sporting goods, electronics, instrumentation, and other industry sectors. A modular business structure enables the company to rapidly accommodate changes in these dynamic markets. As a precision manufacturer of tightly toleranced parts and components, HARBEC uses a great deal of energy to operate three shifts within its 50,000 sq. ft. facility.

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. 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 for whatever period of time is required.

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 six heat exchangers and 18 microturbines, which have a maximum capacity of 820 kW.

Business Case for Energy Management

Becoming a Carbon-Neutral Company

HARBEC's President, Bob Bechtold equates high performance in business with doing the right thing, being responsible, and creating a value for the future. 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.

Bob committed HARBEC to achieve carbon neutrality, a significant goal for any business. But Bob did not want to achieve carbon neutrality simply by purchasing renewable energy or carbon credits from the open market. Rather, he wanted HARBEC to take full stock of its energy use, become accountable for its energy, and make deliberate short and long-term goals to reduce energy use, incorporate energy efficiency, produce onsite renewable energy, integrate a combined heat and power (CHP) system operating on thermal priority, and establish multi-year commitment for continuous energy innovation and improvement. HARBEC has achieved its goal for carbon-neutrality, and in January 2015 the company was awarded an "Environmental Excellence Award" for its "innovation in achieving carbon-neutrality" by the New York State Department of Environmental Conservation.

HARBEC's carbon-neutrality is comprised of several integrated objectives:

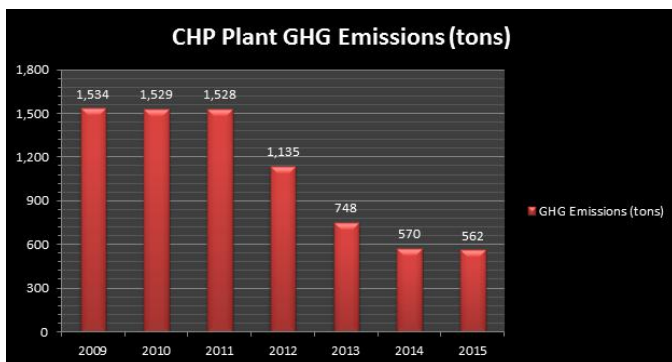
- Measuring and monitoring energy use throughout its facility.
- Achieving optimization in the use of energy resources.
- Establishing energy reduction targets and proactively pursuing them through eco-economic energy efficiency and management measures and solutions throughout HARBEC's manufacturing processes and facility.
- Deploying, integrating, and optimizing renewable (wind) thermal and electric (combined heat and power) systems.
- Purchasing a nominal amount of renewable energy credits from the open market to account for any differentials.
- Continuous improvement.

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 implementing on-site solar generation.

“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 pursuit of the ISO 50001/SEP EnMS enabled its ability to achieve carbon-neutrality through a performance-based approach. Essentially the pursuit and adoption of the EnMS provided HARBEC with the tools, resources, and discipline to obtain a clear understanding of its energy baseline. Further, the EnMS provided the framework by which energy data could be gathered, reviewed, analyzed, and reported on internally and externally.



HARBEC’s CHP Plant Emissions Reductions 2009-15.

The EnMS provided the backbone by which HARBEC could accurately account for its energy use, energy efficiency, and energy reductions. As a result, HARBEC

was able to transparently report on the progress it made with consistent energy reductions. As shown in the chart below, HARBEC has steadily decreased its carbon emissions over the past seven years.

Keys to Success

- **Energy Conscious Culture** – 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.
- **Senior Level Commitment** – President Bob Bechtold’s desire to run a carbon-neutral company was key in HARBEC’s committing to the EnMS and earning SEP certification.
- **Outcome & Impact Driven Tools** – SEP provided HARBEC with the tools to monitor and verify energy reductions.
- **External Verification** – Third-party verification under SEP provides evidence of proven energy savings.
- **Software, Measuring Tools, & Accountability** – HARBEC’s ISO 50001 is being integrated with an ERP software system. ISO 50001 provided an invaluable set of measuring tools that supported HARBEC’s ability to baseline energy use, maintain accurate records, and reinforce its eco-conscious culture.
- **Data Transparency & Reporting Discipline** – ISO 50001/SEP provides a structure to account for and transparently show progress toward energy and carbon reduction goals.

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 to the right).

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.

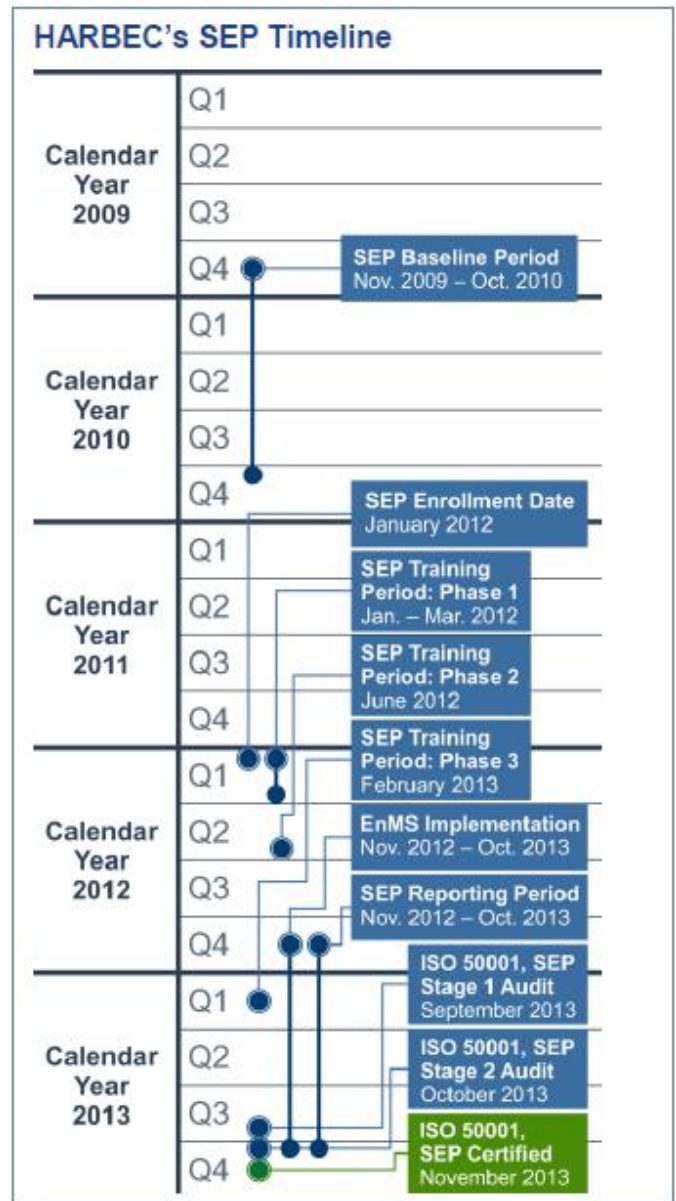
Prior to this operational changeover to running the CHP plant in “thermal following mode,” the plant had generated a fixed power load regardless of demand, and unused thermal energy had been dumped or wasted. Completion of this action plan saved 5,717 MMBtu and \$43,000 annually at prevailing energy prices—with no capital investment.

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.



Bob Bechtold (left), energy management representative, Amy Bechtold (middle), and energy manager, Jeff Eisenhauer (right), make up the energy team at HARBECE. The team is shown next to the plant’s CHP unit.

Photo: HARBECE, Inc.

Achieving ISO 50001 and SEP Certification

Training HARBECE Staff

While the HARBECE 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 HARBECE facility. This training described the ISO 50001 standard and, using input from HARBECE, 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 to other companies. The session helped increase employee engagement and participation in facility efforts to improve energy efficiency. Conformance to the ISO 50001 standard has helped HARBECE 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.

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, HARBECE uses Energy Management Live software to post its real-time, system-specific energy consumption data. These data are accessible on the HARBECE [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
HARBECE, Inc.

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.

Measurement & Verification (M&V) Protocol

Historically, HARBECE 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. HARBECE exported, and continues to export hot water from their CHP units to a neighboring facility, which runs their entire heating and cooling system. HARBECE spent an additional \$4,000 to meter this exported hot water. 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. HARBEC already held management system certifications in ISO 9001 (for

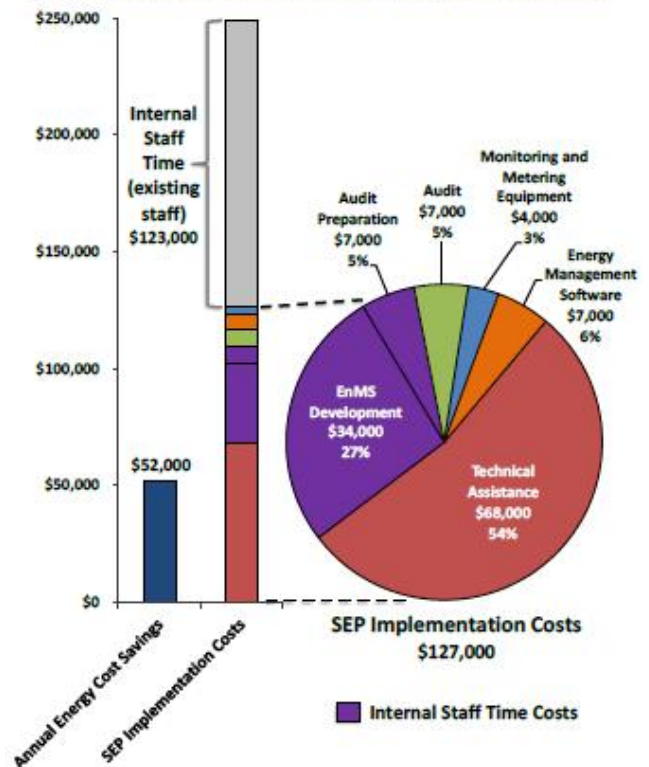
product quality) and ISO 14001 (for the environment). The ISO 50001/SEP readiness review audit of the plant was completed in September 2013, and the 16.5% improvement in source energy performance was ultimately verified at the Stage II audit one month later—qualifying HARBEC as an SEP Platinum Certified Partner (attaining an energy performance improvement of 15% or more).

Evaluating the Costs and Benefits of Implementing SEP

A detailed analysis quantified the costs and benefits associated with implementing ISO 50001/SEP 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

Costs and Benefits of SEP Implementation



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 below). 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.

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.

“HARBEC’s experience implementing the EnMS was invaluable. It provided us with a data-driven disciplined approach to see where we can have the greatest impact on our bottom-line. Further, it’s opened our eyes to a whole world of eco-economic potential.”

—Bob Bechtold, President HARBEC, Inc.

Committing to an Aggressive Schedule

Making the time to go through the learning process was a project challenge. 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.

Barriers

Initial Out of Pocket Costs

The initial upfront costs can be perceived as a barrier to project implementation. In HARBEC’s experience however, the short-and-long term economic value of this project far outweighs the out of pocket expenses.

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 Payback³	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.

The simple economic payback on this project was 2.4 years. There are however a number of high-value benefits to HARBEC’s EnMS implementation that have added additional value to the business including: Achieving Carbon-Neutrality.

- Reinforcing its eco-conscious business culture.
- Putting a process-and-performance based discipline in place for continuously driving resource efficiency and process improvements.

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 EnPI tool.

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.

On the heels of implementing the EnMS and discovering its tremendous value and the opportunity for continuous improvement, HARBEC sees potential for several additional energy opportunities including:

Lessons Learned**EnMS Encourages Persistent 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,¹ and now a Platinum SEP-Certified Partner with DOE. The SEP certification validates HARBEC's systematic approach to reducing energy consumption and associated emissions.

- **Water Neutral Goal** – HARBEC has, from its experience with EnMS, determined that there are water saving opportunities at its facility that will also drive significant energy and carbon reductions. HARBEC will attain its goal for water neutrality into 2016.
- **Carbon-Positive Operations** – HARBEC is investigating 'carbon positive' and attaching possibility of buying additional carbon credits or pursuing additional projects to positively impact carbon (based on percentage of profits).
- **Sustainable Industrial Park Model** – HARBEC's EnMS implementation also indirectly exposed HARBEC to other business and operating opportunities including the potential to upgrade the CHP system to use thermal more completely (and efficiently) and to tie in neighboring businesses to implement a micro-grid model, along with district heating loops. This model is demonstrating a Btu efficient solution of over 70% compared to the U.S. national utility average of 25% to 30%.

Through the 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. The EMWG was launched in 2010 by the Clean Energy Ministerial (CEM) and International Partnership for Energy Efficiency Cooperation (IPEEC).

For more information, please visit www.cleanenergyministerial.org/energymanagement.

