

Nissan Improves Energy Performance 24% over Six Years with SEP¹

Nissan's vehicle assembly plant in Smyrna, Tennessee, improved its energy efficiency by 24% over six years by participating in the U.S. Department of Energy's (DOE's) Superior Energy Performance® (SEP™) program. The plant first earned SEP certification at the Silver level in 2012 and was recertified to SEP at the Platinum level in 2015. Annual energy cost savings following Nissan's initial certification amounted to nearly \$1 million. After recertification, the Smyrna plant is now saving nearly \$2.4 million in annual energy costs.

The Smyrna plant achieved these savings by implementing a robust energy management system (EnMS) that meets the requirements of SEP and the ISO 50001 energy management standard. The Smyrna plant's initial certification recognized a 7.2% improvement in energy performance, whereas the SEP recertification achieved Platinum level in 2015 recognizing an additional 17.7% improvement in energy performance. This improvement during recertification reflects \$748,000 in annual energy cost savings from no-cost/low-cost measures attributable to ISO 50001 and SEP and another \$1.6 million from capital projects. Cumulative operational energy cost savings over both SEP certification cycles (6 years) are now estimated at \$1.7 million per year.

¹ Energy performance improvement is estimated based on results from two SEP certification cycles spanning 6 years. Plant energy performance was re-baselined at the initiation of the recertification process.



Nissan's vehicle assembly plant in Smyrna, Tennessee, was the first U.S. passenger vehicle plant to achieve ISO 50001 and U.S. Superior Energy Performance certification.

“With third-party verification, we can now prove our savings. The SEP process is much more disciplined and removes extraneous factors.”

—Nissan North America Energy Team

Project Summary		
Industry	Automotive	
Facility location	Smyrna, Tennessee, USA	
Energy management system (EnMS)	ISO 50001	
SEP certification level	Silver (initial certification)	Platinum (recertification)
Energy performance improvement	7.2% over three years (initial certification)	17.7% over two years (recertification)
Annual energy cost savings	\$938,000 (operational savings) \$0 (capital project savings)	\$748,000 (operational savings) \$1.62 million (capital project savings)
Cost to implement	\$116,000	\$71,000
Payback period on EnMS implementation*	Six weeks	Five weeks

* SEP marginal payback is based on operational energy cost savings attributable to the SEP program.

Business Benefits Achieved

To earn the initial SEP certification, Nissan's Smyrna plant invested \$116,000 to implement the EnMS. The resulting \$938,000 in annual energy cost savings yielded a payback period of just six weeks. To take a conservative approach, the SEP marginal paybacks (for both certifications) are based on operational energy cost savings attributable to the SEP program.

Following the initial three-year SEP certification cycle, the Smyrna facility pursued recertification and saved an additional \$2.4 million in annual energy costs, including \$748,000 in no-cost/low-cost savings. Nissan invested \$71,000 to recertify—nearly 40% less than the cost of the initial SEP certification—resulting in a payback period of just five weeks. The two-year recertification process helped the facility achieve the highest level of SEP status: Platinum Certified Partner.

Overall, the Smyrna facility's certification to ISO 50001 and participation in the SEP program have led to an estimated \$1.7 million in annual energy cost savings—all from no-cost or low-cost measures. Energy cost savings from capital investments implemented during the SEP recertification cycle help the plant save an additional \$1.6 million per year on its energy bills.

The Smyrna plant's experience demonstrates that large plants can reap significant benefits by implementing an EnMS that meets ISO 50001 and SEP requirements. Plants that install a rigorous business system that proactively manages their energy resources can achieve significant savings, sustain these improvements, and continue to strengthen their energy performance in the future.

Business Case for Energy Management

Nissan implemented an EnMS that meets the requirements of ISO 50001 and SEP for several reasons:

Meeting Corporate Goals and Customer Expectations

Corporate goals and customer expectations drive the company's strong commitment to energy efficiency. Nissan aims to reduce CO₂ emissions by 27% across all Nissan manufacturing facilities by 2016 (based on tons of CO₂ per vehicle, compared to fiscal year 2005). Implementing an EnMS is a critical step toward reaching that goal.

Reducing Energy Costs

Although Nissan's energy costs represent only 3.3% of total manufacturing costs, the company recognized that becoming more energy efficient could have a significant positive impact on its bottom line.

Benefits of SEP and Keys to Nissan's Success

SEP provides numerous advantages for all participating companies. For Nissan's Smyrna plant, these included the following:

- ▶ Extensive sub-metering enabled the plant to conduct bottom-up energy consumption analysis.
- ▶ SEP provided rigor, analysis, and guidance for Nissan throughout the energy management implementation process. It also provided an energy savings target (Platinum, Gold, or Silver performance levels) that determined the level of effort.
- ▶ ISO 50001 and SEP certification provided Nissan with external recognition of its EnMS and verified energy savings.
- ▶ Tools provided by SEP empowered the plant to be more disciplined and proved the impacts of specific activities and projects. The EnPI tool was useful for discovering hidden energy waste and other low-/no-cost improvement areas.
- ▶ Nissan found that developing a strong measurement plan during the energy management development stage was extremely helpful in verifying results.

Leading By Example

Nissan's innovative supply chain partnership program requires the companies in its vast supply chain to demonstrate their commitment to energy efficiency, and Nissan understood the value of "walking-the-walk" within its own operations.

EnMS Development and Implementation

Nissan North America Energy Team

Nissan's commitment to energy efficiency started long before its adoption of an EnMS. In 2006, Nissan became a partner in the ENERGY STAR® program and established the Nissan North America Energy Team—led on the executive level—to achieve corporate energy reduction goals in its U.S. region. This executive-level support has been critical to the success of Nissan's energy efficiency efforts. The Energy Team proved essential in establishing and employing an EnMS.

Developing the EnMS

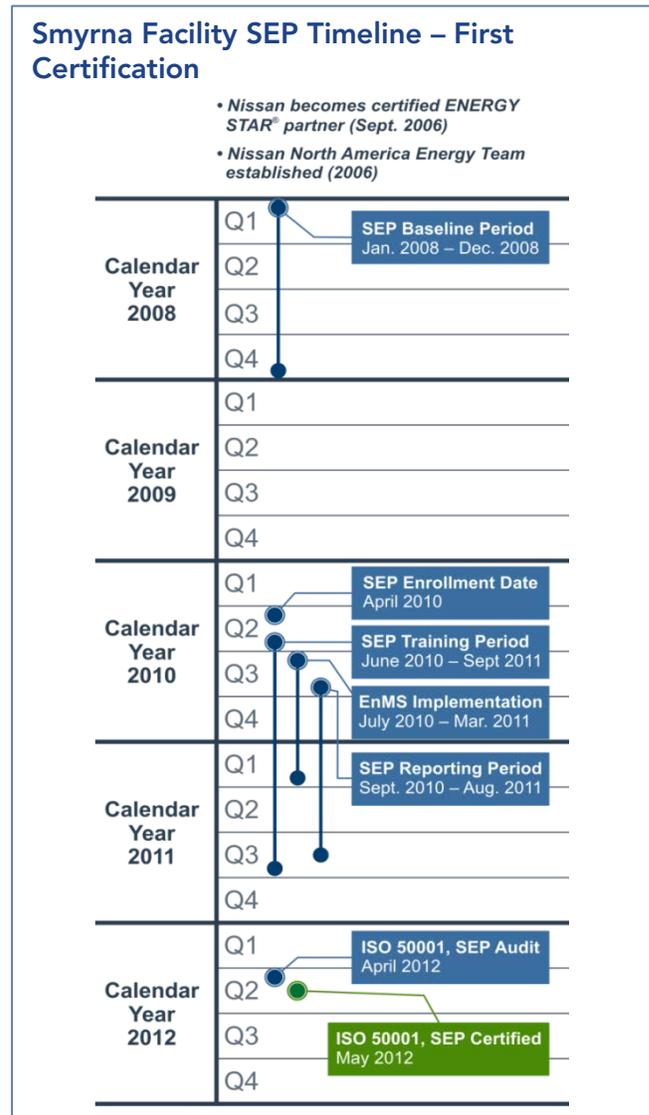
Nissan's Energy Team, with support from the plant's Facilities Engineering department, modeled its EnMS after its existing management system for the environment (ISO 14001). Nissan's management system for quality (ISO 9001) and its prior work with ENERGY STAR® also proved helpful in developing the EnMS. Leveraging guidance outlined by ISO 50001, Nissan's Smyrna facility then developed an energy management policy (nationally applicable), set objectives for improving its energy performance, developed an energy profile for the site, and calculated its energy baseline (2008).

"SEP adds rigor, analysis, and gives good guidance. It's one thing to have a target and objective, but SEP gives tools that empower you to be more disciplined and prove the impact certain activities have."

—Nissan North America Energy Team

EnMS Rollout

Plant staff implemented and began using the EnMS between July 2010 and March 2011. The timeline below is specific to the initial SEP certification process.



Achieving ISO 50001 and SEP Certification

During and after its EnMS rollout, Nissan took several steps in preparation for pursuing its initial ISO 50001 and SEP certification, which it received in May 2012:

Sub-Metering

Nissan upgraded its sub-metering system—which monitors energy use by individual pieces of



Members of the Nissan North America Energy Team at the Smyrna, TN facility. Photo: Nissan Motor Company, Ltd.

equipment or processes—in 2010, in anticipation of SEP’s rigorous verification process. To better measure, calibrate, and verify energy consumption values, Nissan retrofitted the sub-metering system so that significant energy uses in the plant were connected to robust calibration and verification matrices. In addition, the company invested \$21,000 in 2011 to monitor newly installed equipment and processes that use significant amounts of energy.

Energy Savings Assessments

Nissan’s Smyrna plant participated in three energy savings assessments. 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 process heating system.

Energy Profile

To measure and track improvements achieved across the facility, Nissan used the DOE Energy Performance Indicator (EnPI) tool, which provides a plant-wide energy profile. To learn how to use the tool and assist with EnMS implementation, Nissan’s staff received DOE-sponsored training through the [Georgia Tech Energy and Sustainability Services](#). Nissan then used the tool to develop historical energy performance indicators for the Smyrna plant, as required for SEP certification.

The Smyrna plant’s biggest energy user is its vehicle painting process, which consumes around 70% of the plant’s total energy. Using the EnPI tool, Nissan determined that there is significant potential for improvement in energy use in this process.

Internal and Third-Party Audits

Nissan’s Energy Team conducted an internal audit of its adherence to ISO 50001 and SEP to prepare for the third-party verification of its energy savings. Because Nissan had conducted internal audits during its experience with ISO 9001 and 14001, completing the internal audit for ISO 50001 was a familiar exercise. Where the requirements of various ISO programs overlapped, Nissan recognized opportunities to adjust or realign activities to avoid duplication of effort (e.g., CO₂ reduction goals under ISO 14001 align well with energy management criteria under ISO 50001).

The third-party verification process is made up of two stages: Stage I, the ISO 50001/SEP “readiness review” audit, and Stage II, the on-site ISO 50001/SEP audit. For Nissan, the Stage I audit involved an offsite review of the energy savings model, internal audit results, and major energy projects and energy uses, as well as a management review. Depending on the timing of requirements for other certification programs and corporate initiatives, the interval between Stages I and II can be extremely busy for plant staff. The Nissan team met this workload challenge, and the SEP and ISO 50001 audits successfully verified an energy performance improvement of 7.2%, qualifying Nissan for SEP certification at the Silver level (achieved energy performance improvement between 5% and 10%).

Evaluating the Costs and Benefits of Implementing SEP

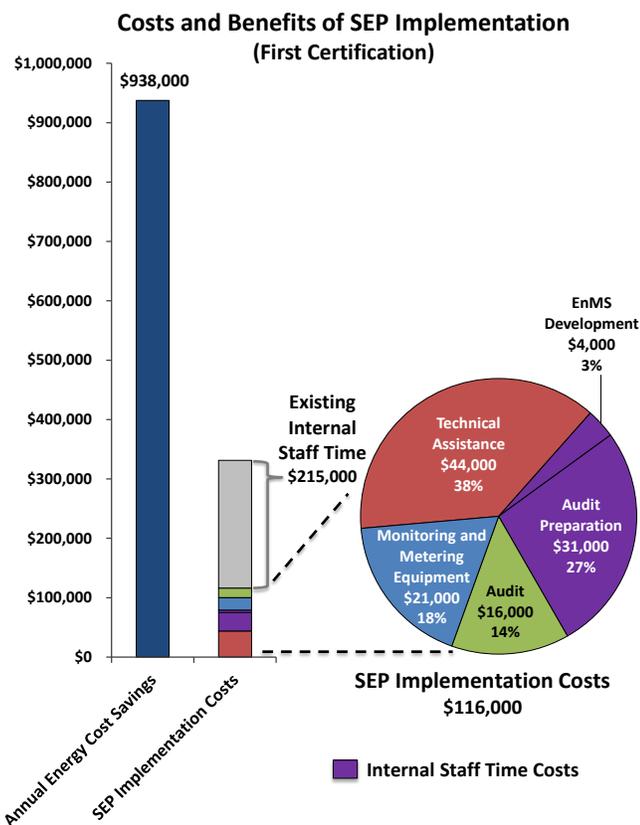
A detailed follow-up analysis quantified the costs and benefits associated with implementing SEP/ISO 50001 at the Smyrna plant. As shown in the pie chart (see figure on page 5), this analysis considers five categories of program implementation costs:

- 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 (at right). Thus, although the total cost for the facility’s internal staff to develop the EnMS was \$219,000, the EnMS was developed almost entirely by staff members already engaged in energy management, and the analysis considers only the \$4,000 to cover the time of other internal staff not previously engaged in energy management activities.

To help isolate the impacts of energy efficiency measures, the 2008 baseline was adjusted to align with production levels and operations during the impact reporting period (see timeline for initial SEP certification on page 3). Energy and cost savings were then calculated using utility data. This analysis shows that the plant’s \$116,000 investment in no-cost and low-cost actions to improve energy performance saves



2012 COST-BENEFIT ANALYSIS: Cost, Savings, & Payback of Nissan’s First Certification	
Total Cost for Implementing SEP	\$116,000
Internal Staff Time	\$250,000
EnMS Development and SEP Data Collection	\$219,000
SEP/ISO 50001 Audit Preparation	\$31,000
Existing Internal Staff Time ¹	-\$215,000
External Technical Assistance	\$44,000
EnMS Monitoring and Metering Equipment	\$21,000
SEP/ISO 50001 Audit (3 rd party auditor)	\$16,000
Total Annual Energy Savings (Attributable to SEP)	\$938,000
Annual Operational Improvement Energy Savings (Attributable to SEP)	\$938,000
Annual Capital Project Energy Savings (Attributable to SEP) ²	\$0
SEP Marginal Payback³	6 weeks

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 Capital projects occurred prior to the start of the SEP Training period, which demarcates pre- and post-SEP actions.

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

\$938,000 per year, paying back the EnMS investment in just six weeks. See cost-benefit results for this facility's SEP recertification on pages 7 and 8.

Barriers

Securing Funding

Nissan's management understands the value of energy efficiency improvements, yet the company has finite investment resources, meaning that EnMS implementation, ISO 50001 and SEP certification and energy efficiency projects must compete with other important business drivers (quality, new program models, etc.) for funding. Investments in operational and capital projects must also be justified in payback increments of 1–3 years. To justify projects at the Smyrna plant, proposals are submitted for global funding consideration. They are ranked and ultimately selected globally, based on available funding, payback, and level of projected CO₂ reduction.

Achieving Buy-In

Shifting the culture and convincing plant officials to invest in energy efficiency initially posed a major challenge. Some believed the company had already seized all opportunities to reduce energy usage; however, the EnMS and the EnPI tool enabled discovery of correctable, previously undetected energy losses. For example, the Nissan Energy Team reexamined practices at the central chiller plant and identified no-cost measures that delivered more than \$67,000 in annual energy savings.

Correcting Calculations

Adjustments to the baseline complicated the analysis of energy performance, and significant effort was needed to distinguish the effects of changing the computer models from energy impacts of manufacturing activities.

Lessons Learned

An EnMS Raises Awareness of Energy Use

Although in its infancy, the EnMS has helped plant personnel recognize the impact of their actions on energy use. The system has also

prompted Nissan to closely consider the energy impacts of new design projects and modifications to the facility or equipment. Nissan will continue using the EnMS at its Smyrna plant as well as extend energy management to its other facilities.

SEP Increases Value of Sub-Metering Data

Prior to implementing SEP, Nissan primarily used its sub-metering data to allocate costs among departments. The SEP requirement to identify savings from specific actions or projects helped the plant make better use of this data. Nissan also learned that extensive sub-metering makes it much easier to verify and quantify the results of energy conservation measures. It allows staff to make process- or equipment-specific "sanity" checks from the bottom up to verify overall, top-down energy savings.

EnPI Tool Improves Analysis

Nissan found the EnPI tool to be an excellent instrument for analyzing energy savings and achieving continuous improvement in its complex manufacturing plant in Smyrna. Nissan expanded the use of the EnPI tool to various shops and processes within the Smyrna plant—outside the scope of the initial EnMS. The plant can now successfully analyze, track, and compare energy performance (e.g., of divisions, pieces of equipment, and processes, as well as over time) to help meet CO₂ reduction targets.

An EnMS Provides Structure

Nissan found that by integrating an EnMS into the Smyrna plant's normal business systems, it introduced measures to improve operations that can effectively sustain valuable energy savings. The company recognized that its EnMS provides the discipline needed to monitor its energy usage data and take the necessary actions to maintain reduced use levels.

SEP Recertification in 2015

Drivers for Recertification

Nissan's interest in recertification was driven by internal and external factors—and the value of the SEP process itself. Internally, Nissan's global

environmental goals understandably reinforced efforts to increase energy efficiency at the plant. Externally, certification gave customers and potential partners greater confidence in the efficient operation of the plant—enhancing its business stature. In addition, the rigor of the SEP verification process gained the respect of Nissan’s senior management; the discipline of maintaining the EnMS and complying with SEP imposed a sound framework for making well-informed, strategic business decisions.

The drivers mentioned above and a better business environment led Nissan to move beyond the exclusive reliance on operational energy savings that had enabled its 2012 SEP certification. To meet CO₂ reduction targets and gain recertification in 2015, the company invested in several capital projects at the Smyrna plant, and the facility’s EnMS helped to economically justify these investments. Prior to SEP, Nissan had required capital projects to show a one-year simple payback. After SEP-verified results bolstered management confidence in projected energy savings, the company has approved energy savings projects with payback periods of up to three years. At the sub-plant level, the EnMS also helps estimate future costs, identify savings opportunities, and analyze the return on planned energy activities.

Recertification Process

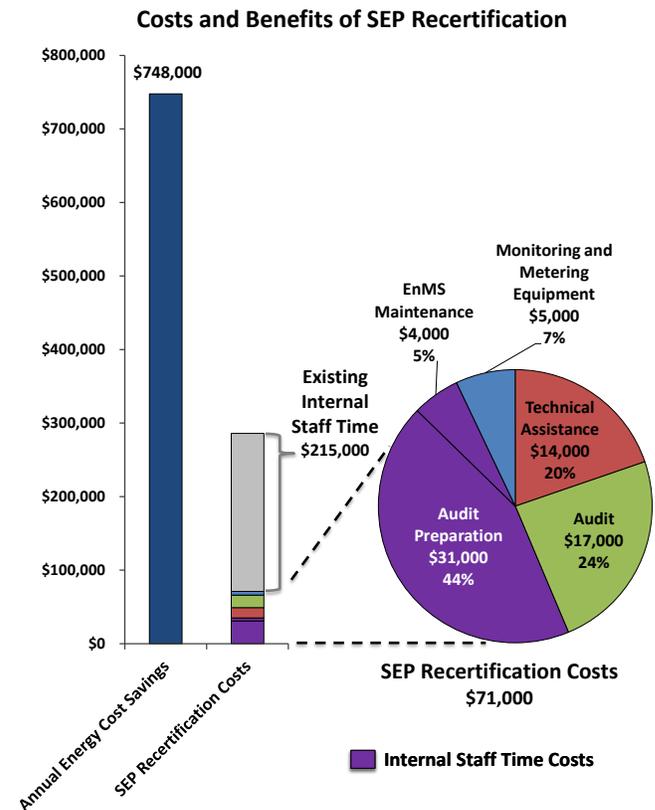
A DOE-funded analysis found that Nissan’s familiarity with the EnMS and experience with the initial SEP certification process helped significantly lower the cost and level of effort for certification the second time around. This analysis considers the following five categories of program costs:

- Internal staff time to maintain the EnMS
- Internal staff time to prepare for the SEP/ISO 50001 audits
- Technical assistance
- Monitoring and metering equipment
- The third-party audit

Recertification cost the company about \$71,000,

which is nearly 40% less than the initial cost of certification. This decrease is attributed to the reduced need for external technical assistance and for additional EnMS monitoring and metering equipment.

Nissan management also notes that participation in the initial SEP certification process delivered clear and substantial benefits both within and outside the company. Corporate staff gained valuable insights beyond those previously acquired through participation in the Better Buildings/Better Plants program, the Carbon Disclosure Project, and ENERGY STAR®. Internal staff determined that the marginal extra reporting effort to obtain SEP recertification was well worth the investment.



Benefits

The Value of SEP

While operational changes at Nissan’s Smyrna plant save \$748,000 in energy costs annually, that amount represents only about 30% of the total energy cost savings verified while recertifying the

plant to SEP. The larger share of energy cost savings are attributed to large capital projects that the plant undertook independently from SEP. Using the SEP M&V protocol, however, the Tennessee Valley Authority's (TVA's) third-party verification body confirmed that a paint plant project costing over \$155 million cut energy consumption in the paint plant by 40% (exceeding the 30% projected). This finding highlights the value of the M&V protocol in rigorously examining energy performance.

COST COMPARISON: Initial SEP Certification and SEP Recertification		
Total Cost of Implementing SEP	Initial Cert.	Recert.
	\$116,000	\$71,000
Internal Staff Time	\$250,000	\$250,000
EnMS Development and SEP Data Collection	\$219,000	\$219,000
SEP/ISO 50001 Audit Preparation	\$31,000	\$31,000
Existing Internal Staff Time ¹	-\$215,000	-\$215,000
External Technical Assistance	\$44,000	\$14,000
EnMS Monitoring and Metering Equipment	\$21,000	\$5,000
SEP/ISO 50001 Audit (3 rd party auditor)	\$16,000	\$17,000
Total Annual Energy Savings (Attributable to SEP)	\$938,000	\$748,000
SEP Marginal Payback²	6 weeks	5 weeks

¹ The time expended by plant staff already engaged in energy management is considered a sunk cost.

² SEP marginal payback is based on operational energy cost savings attributable to the SEP program.

SEP Enables Eligibility for Financial Incentives

As a further financial benefit of SEP participation, the Smyrna plant received \$1.1 million in incentives from TVA for the paint plant project. The utility's third-party contractors and verifiers unlocked this seven-figure incentive by validating the plant's quantified energy savings. Nissan's energy management team remarked upon the potential energy impacts nationwide if other utilities were to adopt similar incentives.

The SEP Brand

In addition to the tangible, plant-level benefits of SEP (see bar chart below), Nissan's energy team supports wider adoption of SEP, citing the broad potential benefits to be achieved by raising awareness of the SEP brand. Recognition programs such as the Clean Energy Ministerial's Energy Management Leadership Awards can enhance SEP's brand value both domestically and internationally. These efforts also highlight SEP's potential in helping organizations and countries meet national energy goals.

Moving Forward

Motivated by the benefits that SEP brought to the Smyrna facility, Nissan is scaling SEP across additional facilities through the SEP Enterprise-wide Accelerator. Nissan and four other companies are working with DOE to test strategies that demonstrate enterprise-wide implementation of SEP to achieve greater energy cost savings. Nissan is implementing an enterprise-wide ISO 50001 EnMS. The enterprise-wide EnMS is applicable to facilities seeking SEP certification, and energy performance is verified at the facility level. The enterprise-wide implementation approach expands the number of SEP-certified facilities over time by streamlining the certification process across similar plants, thus reducing costs. Please visit the [SEP Enterprise-wide Accelerator](#) website to learn more.

The Smyrna plant's EnMS success has led Nissan management to encourage its Mexico-based plants to enroll in the SEP program. The company also plans to encourage the adoption of SEP throughout its supply chains.

