

Global Energy Management System Implementation: Case Study

United States

Nissan

Automaker improves energy performance 25% over Six Years with SEP



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

Collectively, in support of corporate environmental CO₂ reduction and SEP targets, the capital and operations projects implemented at the plant are saving Nissan \$4.6 million and 876 billion Btu per year.

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

"With third-party verification, we can now prove our savings. The ISO 50001 and SEP process is much more disciplined and removes extraneous factors."

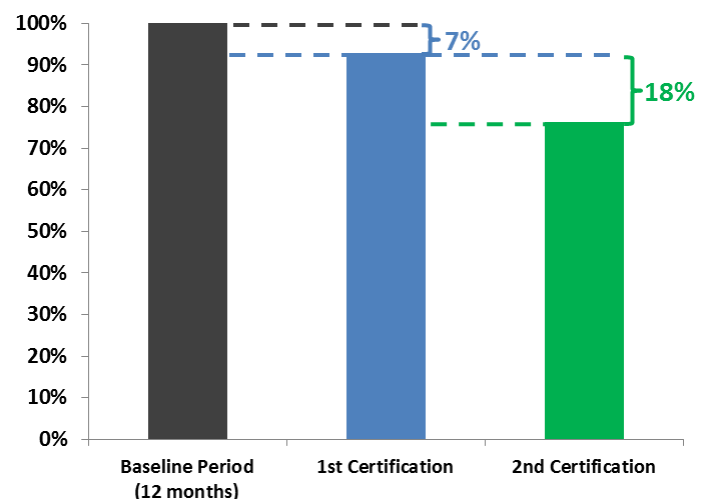
—Nissan North America Energy Team

Business Benefits Achieved

Nissan worked with the U.S. Department of Energy's (DOE's) Advanced Manufacturing Office (AMO) to implement an energy management system (EnMS) that meets all requirements of Superior Energy Performance (SEP) and ISO 50001. At its vehicle assembly plant in Smyrna, Tennessee, the company established an energy baseline and assessed opportunities to save energy within its major energy-using systems. Implementing the identified opportunities and EnMS improved the facility's energy performance by nearly 25% in total through their recertification cycle.

Nissan's Smyrna plant recertified to SEP in 2015, becoming the second facility in the nation to do so. This recertification elevated the plant from the Silver to the Platinum level, as its energy performance increased by an additional 17.7% over two years.

Normalized Facility Energy Consumption (source energy)





Case Study Snapshot

Industry	Automotive
Location	Tennessee, USA
Energy Management System	ISO 50001
Product/Service	Passenger cars and SUVs
Energy Performance Improvement (%)	24.9%
Annual energy cost savings	\$4,624,000
Capital Investment	\$158,231,000
Total Cost of Implementing EnMS & SEP	\$187,000

Company (or Facility) Profile

Nissan is a world leader in the automotive business. The company operates three manufacturing facilities in the United States, two of which are in Tennessee and the other in Mississippi. The Smyrna plant is the largest of the three, producing Nissan’s Altima, Maxima, Rogue, Pathfinder, the Nissan LEAF and Infinity QX60 models. While Nissan’s global corporate headquarters are in Yokohama, Japan, its U.S. branch, known as Nissan North America, Inc., is based in Franklin, Tennessee. This case study focuses primarily on Nissan’s vehicle manufacturing and assembly operations in Smyrna; it excludes energy used for lithium ion battery plant operations.

Business Case for Energy Management

Corporate goals and customer expectations: Although Nissan’s energy costs represent only 3.3% of total manufacturing costs, corporate goals and customer expectations drive its strong commitment to energy efficiency. Nissan’s corporate Green Program 2016

promotes sustainability and sets ambitious environmental goals—reinforcing the company’s reputation as a responsible steward of the environment. The Green Program 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). The U.S. branch pursues this goal through both technical improvements (capital projects) and operational improvements (which typically require little or no capital investment).

Cost savings throughout the supply chain: The cost savings that can be achieved by implementing an EnMS provide another important driver. Nissan’s innovative supply chain partnership program requires the companies in its supply chain to demonstrate their commitment to energy efficiency, and Nissan understands the value of leading by example or “walking-the-walk” within its own operations.

Overall Opinion and Brand Strengthening: Excellent overall opinion (OaO) is one of the key performance indicators at Nissan. It is a measure of brand health from our customer’s perspective. External recognition for EnMS and SEP certification is a key pillar to support OaO improvement.

Keys to Success

- Extensive sub-metering adds value and enables the plant to conduct bottom-up energy consumption analysis. This equipment is used to verify energy savings specific to an individual process or piece of equipment.
- SEP provides rigor, analysis, and guidance throughout the energy management s process. It provides an energy savings target that drives the level of effort.
- Tools provided by SEP empower the plant to be more disciplined and prove the impacts of specific activities or projects. The EnPI tool is 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.

EnMS Development and Implementation

Nissan's commitment to energy efficiency started long before its adoption of the EnMS. In 2006, Nissan became a partner in the ENERGY STAR® program and established the Nissan North America Energy Team to achieve corporate energy reduction goals in its U.S. region. This cross-functional team is led and supported at the executive level by Nissan's Sr. Vice President and Director/Plant Manager. This executive-level support has been critical to the success of Nissan's energy efficiency efforts. The team, which meets weekly, is drawn from every level of management, including the production, maintenance, legal, facilities engineering, corporate communications, purchasing, finance, environmental, and contract services departments. The Energy Team proved essential in establishing and employing the EnMS.

Nissan's Energy Team, with support from the plant's Facilities Engineering department, modeled the EnMS after its existing management system for the environment (ISO 14001).



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

Nissan's management system for quality (ISO 9001) and its prior work with ENERGY STAR® also proved helpful in implementing the EnMS. Nissan's Smyrna facility then developed an energy management policy (nationally applicable) and set objectives for improving its energy performance.

In the most recent certification period, Nissan developed a new energy profile for the site, calculating its energy baseline from the 12 months ending 2012. Third-party auditing of the plant's performance certified the facility for both ISO 50001 and SEP Platinum (17.7% Improvement) in May 2015.

Managing Energy Better

Nissan's Smyrna plant has used a sophisticated sub-metering system since 2006, thanks to a senior management initiative to reduce energy use and a well-executed data visualization project that made the data accessible to everyone. Nissan upgraded the system in 2010 in preparation for SEP's rigorous verification process. To better measure, calibrate, and verify energy consumption values, the sub-metering system was retrofitted so that significant energy uses in the plant were connected to robust calibration and verification matrices. In addition, Nissan invested \$21,000 in 2011 to monitor newly installed equipment and processes that use significant amounts of energy.

The EnMS has helped plant personnel recognize the impact of their actions on energy use. The system has also prompted Nissan to more closely consider the energy impacts of new design projects and facility/equipment modifications.

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.

On the basis of these assessments and later studies, energy capital programs were developed to replace aging equipment, improve energy efficiency and support CO₂ reduction. In 2013, Nissan replaced its coal

fired Boilers with a new efficient gas fired Boiler plant. During this period, Nissan also replaced its oldest Paint plant with a new plant that including many energy efficient features; including compact booths and the recycling of 75% of booth air. The company continues to build on these successes and identify energy-saving opportunities, both capital projects and operational improvements through ongoing use of its EnMS.

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. 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. Nissan's staff attended training in these techniques, then developed historical EnPIs for the Smyrna plant, as required for SEP certification.

The Smyrna plant's biggest energy user is its vehicle painting process, which now consists of four paint shops: two body paint plants and two plastic fascia paint plants. These four paint shops, consume approximately 70% of the plant's total energy, and are hence offer a large potential for energy improvement.

Internal and Third-Party Audit Certification

As Nissan was already familiar with internal audits from 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 upon the timing of

requirements for other certification programs and corporate initiatives, the interval between Phases I and II of the third-party SEP verification process 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 17.7%, qualifying Nissan for SEP certification at the Platinum level (achieved energy performance improvement of 15% or more).

"SEP adds rigor, analysis, and gives good guidance. It's one thing to have a target and objective, but ISO 50001 and SEP gives tools that empower you to be more disciplined and prove the impact certain activities have."

—Nissan North America Energy Team

Business Benefits & Organizational Support

Setting the goal of achieving Platinum level performance, streamlined the energy team's focus to create projects that would produce large energy improvements, reduce CO₂, and improve financial performance. To fund and support the Energy Team's projects would require confidence in the Team's ability to evaluate and deliver savings and performance. The most limiting condition for investment was the then one year payback period for capital investment.

Working with industry peers, the Nissan Energy Team benchmarked funding practices for energy efficiency projects. As a result of benchmarking, the team discovered that current policies were too conservative, limiting the ability to advance energy savings projects. Based on the benchmarking study, the Team was able to extend the payback period from one year to 3 years. Since inception of the policy, Nissan has invested more than \$2.6 Million in energy projects.

Each year, the company develops capital and operational programs that will reduce energy use and CO₂ emissions. The performance of these reduction programs are tracked monthly, reported locally and globally so that managers, including top management,

can provide support and additional resources as needed to achieve Nissan's energy reduction goals.

Energy Review

Annually, representatives from the Energy Team, the Energy Management Representative (EnMR), and the plant Managers, review the prior year's performance and plans for improvement for the coming year. At this meeting, expectations for capital projects, changes in operations, possible baseline adjustments, introduction of new products, new on-site suppliers and any other opportunities or challenges are discussed to define what will be necessary to achieve the goal.

Professional Expertise, Training & Communications

In addition to the benefits of working directly with the DOE and Georgia Institute of Technology (Ga. Tech) experts during the development stages of our EnMS, Nissan has gained valuable experience and training. Since 2012, Nissan has had several team members complete ISO 50001 Lead Auditor, Certified Practitioner in Energy Management Systems, and Process Heating Assessment training.

During the EnMS implementation stage, Nissan utilized the services of locally trained and certified professionals. ISO system experts at the Tennessee Technology University Industrial Assistance Center served as lead auditors during the initial internal auditing phase. Energy Team members at Schneider Electric (also an EnMS pilot program organization) provided M&V auditing services of Nissan's energy performance.

Tools and Resources

Nissan's automotive plants include extensive sub-metering complete with software tools to access and analyze performance of individual power feeds as well as hourly use of other utilities, including natural gas, compressed air, chilled water and hot water. Nissan makes extensive use of the U.S. DOE's and Ga. Tech's EnPI tools for multilinear regression analysis of energy performance.

Operational Control & Sustained Performance

As a result of implementing ISO 50001 Objectives and Targets, the Utilities Engineering department created a series of Energy Instructions (EnI's) documenting standard operating procedures for routine regional and global reporting activities.

To progress energy efficiency "upstream" in Nissan's planning process, the Energy Team created a virtual learning course titled, "*Energy Consideration in Design.*" This program provides instruction to all engineering groups how to prepare energy life cycle calculations for new processes and equipment. Additionally, all purchase requisitions (over a predetermined spending threshold) impacting energy use are evaluated and approved by Energy Team members.

Processes and systems identified as a Significant Energy Use (SEU) now employ continuous measurement of performance. For example, performance reporting is available via Nissan's intranet, to all employees, for Smyrna's first SEU – the Paint System 2 E-Coat Oven (KPI – gas use per vehicle).

Nissan makes use of multivariate statistical models to develop baselines using statistically relevant factors, estimating changes in performance. Additionally, performance based on model studies is confirmed by a "bottom up" analysis using the expected result from a direct calculation.

"ISO 50001 and SEP are worth the effort as it brings structure and discipline to the program. Nissan values third-party validation and the external recognition for being an environmentally friendly manufacturer."

—Mike Clemmer, Director /Plant Mgr. Paint

Lessons Learned

Nissan management understands the value of energy efficiency improvements, yet the finite funds available to invest in energy efficiency each year must compete for priority with other important business drivers (quality, new program models, etc.). 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 over \$67,000 in annual energy savings.

In developing energy action plans to achieve energy savings targets, Nissan found that strong metrics help in implementing the activity and verifying results. Prior to 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.

Multi-linear regression models such as the EnPI tool have proven to be excellent instruments 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 to help meet CO₂ reduction targets.

Nissan found that by integrating an EnMS into the 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 consumption levels.

Moving Forward

Motivated by the benefits that ISO 50001 and SEP brought to the Smyrna facility, Nissan is scaling SEP across additional facilities through the SEP Enterprise-wide Accelerator. This DOE program allows Nissan to test strategies that demonstrate enterprise-wide implementation of SEP to achieve greater energy cost savings—also enabling the company to benefit from economies of scale. Nissan is implementing an enterprise-wide ISO 50001 EnMS and energy performance is verified at the facility level.

Nissan enjoys the respect and recognition it has earned through its EnMS and SEP certification. The company will continue to communicate the importance of energy management to its customers and suppliers. Achieving continuous improvements in environmental performance and the efficient use of energy and other resources is a core value reflected in Nissan’s corporate structure and environmental philosophy: “Toward the symbiosis of people, vehicles and nature.”

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.

