

Global Energy Management System Implementation: Case Study: Nissan North America

United States of America

Nissan North America

NNA achieved a 13.8% reduction through the implementation of an Enterprise-wide EnMS



Nissan is the first passenger vehicle manufacturer to achieve ISO 50001 and U.S. Superior Energy Performance (SEP) certification at all of its sites in the U.S.

Business Case for Energy Management

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. The Nissan Green Program promotes sustainability and sets ambitious environmental goals including an 80% reduction in CO₂ per vehicle by 2050, which reinforces the company's reputation as a responsible steward of the environment. The most recent Nissan Green Program milestone was 2016 with Nissan achieving the target to reduce CO₂ emissions by 27% across all Nissan manufacturing facilities (based on tons of CO₂ per vehicle compared to fiscal year 2005). Nissan North America supports this program by pursuing 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 that can be achieved by implementing an Energy Management System (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.

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.

These drivers for energy management continue to challenge the Nissan team. Nissan has turned to ISO 50001 to promote continued improvement, accelerate behavioral change, and sustain long term energy management success. Nissan was an early adopter and pilot with the U.S. Department of Energy's (DOE's) Advanced Manufacturing Office (AMO) to implement an energy management system that meets all requirements of ISO 50001.

At its vehicle assembly plant in Smyrna, 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. The success in Smyrna enabled Nissan to expand the management system to include the other U.S. manufacturing sites.

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

—Mike Clemmer – Director, Mfg Engineering

Case Study Snapshot

Industry	Automotive
Product	Nissan and Infiniti
Locations	Decherd, TN, Canton, MS, and Smyrna, TN, USA
Energy Management System	ISO 50001
Energy Performance Improvement Period	3 Years
Energy Performance Improvement (%) over improvement period	13.8%
Annual energy cost savings over improvement period	\$9.42 Million
Cost to implement EnMS	\$98,000
Total Energy Savings over improvement period	1,514,624 GJ
Total CO₂-e emission reduction over improvement period	132,199 Metric tons

Business Benefits Achieved

The Enterprise-wide EnMS approach allowed Nissan to use sampling for the ISO 50001 audits with Smyrna and Canton undergoing the certification audits. The audits were successful with no major or minor findings, but several Opportunities for Improvement that will help continuous improvement. The implementation process at Canton and Decherd was much less resource intensive than the original implementation at Smyrna. Examination of internal and external costs yields an estimated reduction of \$19,000 per site.

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 Energy Performance Indicators (EnPIs) enabled the 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 ISO 50001 implementation, Nissan primarily used its sub-metering data to allocate costs among departments. The EnMS requirement to identify savings from specific actions or projects helped the plants 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 used as EnPIs have proven to be excellent instruments for analyzing energy savings and achieving continuous improvement in its complex manufacturing plants. Nissan expanded the use of the EnPIs to various shops and processes within the manufacturing plants—outside the scope of the initial EnMS. The plants 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.

Each of the Nissan plants in the U.S. has achieved Superior Energy Performance certification as a result of the Enterprise-wide EnMS. Canton and Smyrna have achieved SEP Platinum with verified improvements of 20.9% and 17.7%, respectively. Decherd achieved SEP Silver with an 8% verified improvement.

EnMS Development and Implementation

Organizational Structure

The ISO 50001 certified EnMS for Smyrna was the basis for the Enterprise-wide Energy Management System. Since Nissan does not have a corporate energy function for manufacturing, the Smyrna Energy Team serves as the Central Office.

Many of the documented procedures for Smyrna were easily transitioned to serve as NNA procedures since all sites already had similar practices for energy management (Energy Baseline, Energy Objectives and Targets). The team used the need for revised documents

due to the Enterprise-wide changes and new revision to ISO 14001 as a chance to integrate energy with environmental. These integrations reduced the documentation requirements as several of the procedures were duplicates with one for energy and one for environmental (policy, management review, communication, etc.). Management was in support of this integration as it simplified and standardized the EnMS and EMS while being less-intrusive to core business operations.

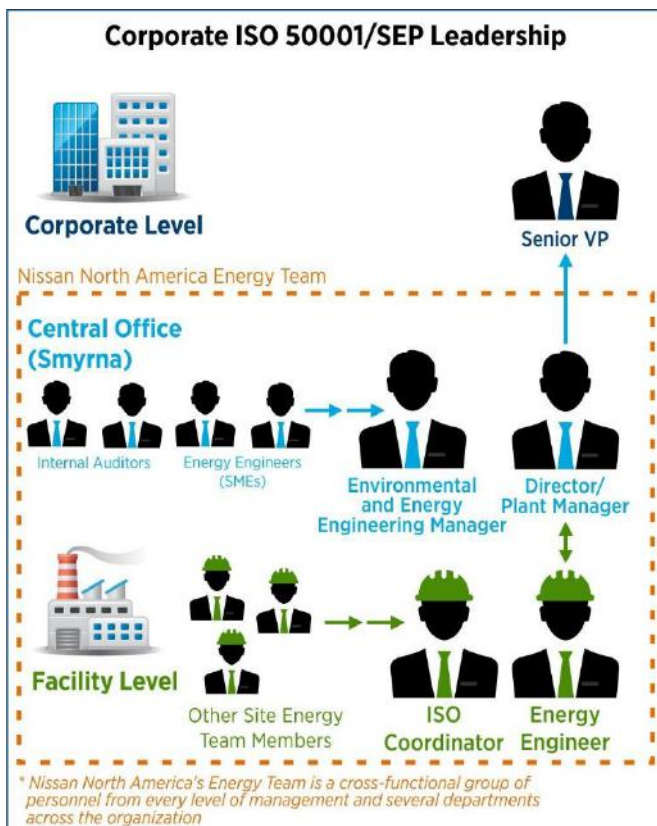
The Central Office team developed milestones and task lists with each site in order to achieve the desired Enterprise-wide certification by the end of 2016. The sites implementing ISO 50001 did not have to spend time developing procedures, so they were able to focus on implementing and improving practices relating to energy management as required by ISO 50001 and SEP.

Energy Team

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).

Nissan’s management system for quality (ISO 9001) and its prior work with ENERGY STAR® also proved helpful in implementing the EnMS. Nissan’s energy and



environmental team then developed an environmental and energy management policy (nationally applicable) and set objectives for improving its energy performance.



Members of the Nissan North America Energy Team

Energy Monitoring

Nissan 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 ISO 50001'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 Opportunities

In order to increase employee engagement in energy management, the Nissan team began a formal Energy Treasure Hunt program by adapting ENERGY STAR's guidelines for Energy Treasure Hunts in order to fit

company culture and opportunities. Nissan piloted the process in Smyrna as the Central Office, and then it was deployed across North America. Through January 2018, nine Energy Treasure Hunts have been completed resulting in identification of over \$2.9 million in annual savings. This process has already realized more than \$600k in annual savings.

During the development of the Energy Treasure Hunt process, the team discovered a need for an easy to use energy savings estimator. Therefore, the NNA Energy Calculator was developed, which has prepopulated energy rates for each site and includes all of the information required for capital or TdC (Total delivered Cost) project submissions. This has resulted in increased accuracy, consistency, and standardization of energy savings estimates enabling more thorough reviews.

Energy Review

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 manufacturing plants, as required for SEP certification.

The biggest energy users at Nissan plants are the vehicle painting process, which now consists of body paint plants and fascia paint plants. These 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 energy performance improvements qualifying each of the Nissan North America plants for Superior Energy Performance certification.

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 three years. Since inception of the policy, Nissan North America has invested more than \$5 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 and 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.

Management 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.



The all-electric Nissan LEAF is built in Smyrna, TN with the electric motors built in Decherd, TN.

Professional Expertise, Training & Communications

In addition to the benefits of working directly with the U.S. DOE and Georgia Institute of Technology (Ga. Tech) experts during the development stages of the EnMS, Nissan has gained valuable experience and training.

During the initial EnMS implementation stage, Nissan utilized the services of locally trained and certified professionals. ISO system experts at the Tennessee Tech University Industrial Assessment Center served as lead auditors during the initial internal auditing phase. Energy Team members at Schneider Electric (also an EnMS pilot program organization) provided internal audits until Nissan built enough expertise internally.

Since 2012, Nissan has had several team members complete training related to ISO 50001. As part of the Enterprise-wide EnMS, ISO 50001 training was added to the existing annual training for ISO 14001 coordinators.

This has enabled some of the team to be certified as a Certified Practitioner in Energy Management Systems and/or Superior Energy Performance Verifier.

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 on 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 results is confirmed by a "bottom up" analysis using the expected result from each project implemented.

Lessons Learned

Nissan North America implemented enterprise-wide ISO 50001 and SEP as a key strategy in meeting its energy and environmental goals. Corporate leadership and strong collaboration at all levels led to the following lessons learned:

- Integrate with existing management systems when possible.
- Set a certification target date at the beginning of the process in order to keep the team focused.
- Extensive sub-metering adds value and enables the plant to conduct bottom-up energy consumption analysis. This data 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 process. It provides an energy savings target that drives to increase the level of effort.
- Free tools provided by U.S. Department of Energy 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 energy project list during the energy management development stage was extremely helpful in verifying results.

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.

