

## Nissan North America: How Sub-Metering Changed the Way a Plant Does Business

At its largest U.S. auto manufacturing facility in Smyrna, Tennessee, Nissan discovered a wealth of savings opportunities through the plant's sub-metering efforts. The process of connecting all of the plant's large, energy-consuming pieces of equipment to sub-meters and a central software system was initially met with some reservation by plant staff because it was viewed as a time-consuming project. However, once the plant was fully metered and reports of end-use energy consumption profiles were generated, the value of the new system and its capabilities were immediately recognized by staff and corporate leaders alike.

### Identifying the Need for Sub-Metering

In 1992, Nissan adopted a new environmental vision that led the company to closely re-examine the impact its processes were having on the environment. Since that initial evaluation, Nissan has strived to better understand energy use at the company's three U.S. manufacturing plants and to identify and implement projects that will achieve energy savings. After implementing lighting improvements at Nissan's Smyrna, Tennessee, manufacturing plant, energy team members identified a missed opportunity to address utility usage at the facility. In order to make progress



Nissan Plant in Smyrna, Tennessee.

*Photo courtesy of NissanNews.com*

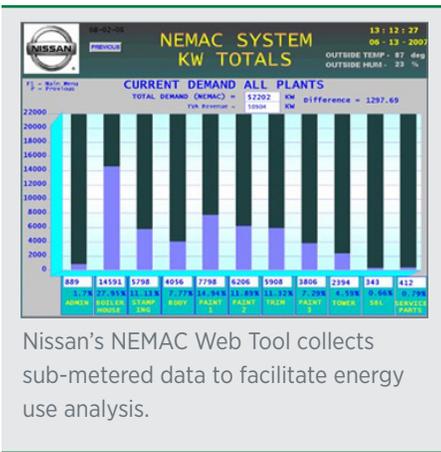
toward achieving the company's energy efficiency goals, the energy team recognized the essential need to measure how much energy the plant was using and when. One challenge the team encountered was not having an effective method to monitor and manage detailed energy use throughout the facility. Additionally, the plant lacked a way to share energy consumption data with stakeholders throughout the organization.

The Smyrna plant's original metering system was antiquated and lacked data collection capabilities for critical analysis of energy use. In fact, the rudimentary process required manual updates to Excel spreadsheets, which did not yield detailed data. It was not until the facility installed more advanced technologies, including newer meters and a centralized software system, that employees began to recognize the system's full energy efficiency potential.

# NISSAN

An automaker with production facilities in 20 countries, Nissan has established itself as a premier manufacturer at the forefront of the energy efficiency movement.

Nissan has three manufacturing facilities located in the United States—two in Tennessee and one in Mississippi. The Nissan Americas headquarters is located in Franklin, Tennessee, with staff responsible for coordinating the company's operations in the United States, Canada, Mexico, and South America. The second Tennessee plant, located in Smyrna, is Nissan's largest facility and among the largest manufacturing plants in the United States. The plant produces the Nissan Altima, Nissan Maxima, Nissan Xterra, Nissan Frontier, and Nissan Pathfinder.



Screenshot courtesy of Nissan North America

### Deciding on a Solution

During the Smyrna plant’s construction in 1981, a rudimentary data collection system was installed—the Nissan Energy Management and Control (NEMAC) program. However, the system had minimal reporting and networking capabilities. Following the 2005 hurricane season, which deeply affected energy costs, Nissan decided to enhance its focus on energy management. At this time, company leadership recognized the need to improve the methods used to monitor energy consumption at the Smyrna plant. Shortly thereafter, Nissan’s controls engineering staff began collaborating cross-functionally with other plant personnel and the facilities engineering staff. Together, they worked to build upon the existing NEMAC framework and to automate

the company’s data collection process, which was previously performed manually. Enhancing the NEMAC system was a critical first step in helping Smyrna’s staff to realize the full potential of sub-metering to improve energy management and achieve energy savings.

Smyrna’s sub-metering project was developed in two phases. First, engineers had to assemble an inventory of existing meters within the facility and determine what additional equipment was needed. Installation of new metering was either integrated into regularly scheduled maintenance or implemented as small, incremental projects.

Nissan decided to integrate all of the meters into the existing NEMAC system, which proved to be a great challenge. The plant’s facilities and maintenance teams had to learn how to operate and fully utilize the system. The company took full advantage of the resources made available by the U.S. Department of Energy’s (DOE’s) Industrial Technologies Program, including Energy Savings Assessments, certified trainers, and DOE tools, such as the Process Heating Assessment and Survey Tool. In addition, the company utilized resources from the U.S. Environmental Protection Agency’s ENERGY STAR® partnership, such as the Energy Performance Indicator and Portfolio Manager. Through this

partnership, Nissan participated in benchmarking activities with peer automakers and other industries, which helped accelerate the learning process for Smyrna’s technicians.

### Utilizing Sub-Metered Data

Nissan uses its sub-meters to measure a range of variables at its U.S. plants, including electricity, natural gas, city water, compressed air, and both high temp and chilled water. The NEMAC system automatically collects sub-metered data every 6 seconds and aggregates it every 15 minutes. Throughout the day, the sub-metered data is reviewed by plant staff and any issues of over-usage are addressed in real-time. The manager of each plant shop receives weekly reports, as well as a monthly report to help monitor energy use. Both types of reports are delivered to Nissan’s Vice Chairman of the Americas, Bill Krueger, who serves as Nissan’s formal energy team leader. Attached to the weekly report is a scorecard that displays the plant’s energy performance in easy-to-read red, green, and yellow symbols. Visually representing the energy efficiency of the plant’s operations in this way provides a regular check-in for both plant managers and corporate leaders to enable quick-course corrections when needed.

*“Because Nissan was able to leverage existing metering equipment within the facility, the cost of the upgrade was accomplished using internal expense funds; Nissan did not need external funding or incentive programs for sub-metering projects.”*

**Steve Smith,**  
NNA Controls Engineering

**Plant Electricity Use Scorecard**

	Weekend Use		Weekend Use
Stamping	●	Stamping	▲
Body	✘	Body	●
Paint 1	●	Paint 1	✘
Paint 2	◎	Paint 2	●
Paint 3	◎	Paint 3	●
Trim	▲	Trim	✘

Previous Week (Ending 11/7)                      Current Week (Ending 11/14)

Where:

◎ = Best (< 5% Base Use)	▲ = between 5% - 8% Base Use
● = within 5% Base Use	✘ = > 8% Base Use

Each week, this electricity use “scorecard” is presented to management representatives within each plant. Scores that show up as “yellow” or “red” are discussed to identify possible course corrections.

Screenshot courtesy of Nissan North America

During the weekends, when production schedules differ and fewer staff members are on hand, Nissan implements a real-time alarm system. Any demand that exceeds configured energy thresholds will generate an alarm and notify the appropriate personnel, enabling them to make necessary adjustments to bring the plant's operations back within the proper threshold.

## Engaging Employees in Sub-Metering

Even after Nissan identified sub-metering as a promising solution to discover new opportunities to reduce energy consumption, there were still other hurdles the company had to overcome, including employee culture challenges, technical conflicts, and maintenance and production issues.

When Nissan's upper management made each plant division responsible for its own utility budget, plant managers quickly re-prioritized

the significance of energy throughout their respective plants. Nonetheless, it took some time for employees' mentality about using sub-metered data to change. Plant managers and their staff had to overcome the mindset of "this is how the plant has always run." There were instances of significant pushback from plant staff that believed equipment failure would occur if there were shutdowns between shifts and on the weekends in order to conserve energy. In addition, some staff members believed that they had already employed all reasonable energy conservation efforts and were reluctant to seek other methods of reducing consumption. Encouraging employees to not only change the processes and procedures they were used to, but to also embrace the new sub-metering technology required strong support and communication from a respected leader.



A Nissan employee monitors equipment to ensure it only runs when needed.

*Photo courtesy of Nissan North America*

In 2009, Nissan's President and Chief Executive Officer, Carlos Ghosn, visited the Smyrna facility. Mr. Ghosn spoke directly to plant staff about moving away from a status quo state of mind and moving toward a mindset of continual improvement. He also addressed concerns about the effects sub-metering would have on equipment following conservation shutdowns, emphasizing the importance of letting data drive decision-making.

## 'Green Weekend' Delivers Early Successes

In the early days of Smyrna's sub-metering efforts, the plant achieved an unexpected success that proved it was on the right track. The paint division, which is one of the most energy-intensive departments at each of the automaker's manufacturing facilities, had an air dryer that was known for being an extremely reliable machine, rarely garnering attention from plant staff.

Once Nissan started monitoring data from the sub-meters on a regular basis, plant staff noticed a significant spike in energy use every four hours. The staff utilized a 'green weekend'—one weekend a month when the plant ceases all production and only conducts emergency work—to expose the cause of these regular spikes. Staff were able to identify the air dryer as the cause and immediately contacted the manufacturer to implement a solution.

The dryer had an optional control function that could utilize a dewpoint sensor to regulate dryer operations. In the absence of this function, the dryer defaulted to a cyclical operation regardless of humidity conditions.



*Screenshot courtesy of Nissan North America*

*"By adding dewpoint controls, the machine went from cycling on every four hours to only four times a week. The \$1,500 Nissan spent for parts and installation paid for itself in just six weeks."*

**Wade Royal**  
NNA Energy Engineer

Mr. Ghosn's final message was to remember that with new processes come learning opportunities and the chance for additional improvement. As the functional leader of the energy team, Mr. Krueger provides support and encouragement for plant staff. Like Mr. Ghosn, Mr. Krueger is a strong proponent of sub-metering and has infused excitement about the project throughout the Smyrna plant.

## Benefiting from Sub-Metering

After embracing the new data system, plant staff quickly realized the benefits of understanding the facility's energy use and having a working process in place for utilizing the sub-metered data. The data collected through the new process helped staff more easily identify opportunities to reduce equipment maintenance, which allows them to adjust production schedules to enable optimal energy use. The plant is now able to identify machines that are running constantly with no output value, or that have inefficient on/off cycling. Using this knowledge, engineers have curtailed equipment usage and increased the efficiency of the plant's operations. Putting a cost to energy usage resonated with the machine operators who had previously lacked a vehicle for understanding the true cost of running equipment.

*"The only disadvantage [of sub-metering] is that now we can't imagine doing without it!"*

**Ken Roden**  
NNA's Energy Team Facilitator

The Smyrna plant has now moved beyond its initial energy goals, finding many more opportunities for improvement than first predicted. For example, the new system has taught plant staff about how equipment throughout the facility responds to different weather conditions, allowing them to adjust production accordingly. In addition, sub-metered data is used to identify equipment that is running more often than necessary. (For a more in-depth look at one such project, please read about the "Green Weekend.")



Manufacturing - Smyrna plant.

*Photo courtesy of NissanNews.com*

The Smyrna plant has more than 3.6 million square feet of manufacturing network wireless coverage. This coverage has allowed Nissan to develop and pilot advanced alert applications that notify plant personnel via e-mail or text message when configured energy thresholds are exceeded. In addition, the Smyrna wireless infrastructure has allowed the energy team to study the implementation of wireless energy meters. This flexibility could enable cost-effective energy metering at the device level, as well as energy metering in remote areas of the Smyrna campus.

Further, employees at other Nissan plants are utilizing sub-metered data to identify opportunities to reduce energy consumption. For example, Nissan's Decherd, Tennessee, facility has saved thousands of dollars each month by shifting demand loads to off-peak hours for electricity. Specifically, the plant moved to an earlier start time, which relieves afternoon peak demand when utility rates are typically higher. Nissan continues to examine energy consumption at all of its plants, making appropriate adjustments as data sheds light on new opportunities.

Sub-metering has had a very positive impact on the Smyrna plant's energy consumption through the identification and shutdown of unnecessary equipment. However, the greatest benefit of sub-metering is the data itself, which has helped Nissan achieve greater efficiencies and reduced costs. Data adds credibility to project ideas and increases the likelihood of gaining senior management support.

## Conclusion

Although Smyrna employees were initially reluctant to change, they have found great value in sub-metering. Reviewing data and visualizing energy use across the production process—and eventually the entire plant—has awakened a number of possibilities for energy efficiency improvements. For Nissan, letting data drive decision-making has empowered and energized plant staff, helped senior leadership understand the bottom-line impact of proposed projects, and produced meaningful energy savings. Ultimately, Nissan has found sub-metering to be a powerful and successful tool.