Written by Anthony Tiso, Schneider Electric
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Doing more with less seems to be the order of the day (and the future) for most companies. Technology that helps you kill several birds with one stone is a good way to be getting it done.

The cost of doing business is not getting any cheaper, especially for energy-intensive industrial businesses. To remain competitive in an environment of ever-increasing operational costs, large processing plants and factories are finding new ways to do more with less.

Whether processing petroleum or manufacturing automobiles, the goal is the same: improve efficiency, reduce costs and increase productivity. One way to do all three is through improved electrical energy management practices. Although the cost and quality of electricity can significantly affect operations and profits, it has traditionally been accepted as a non-negotiable business expense—the utility bill is paid each month without question and the cost goes unchallenged. But energy is not a fixed cost—it can be controlled. In fact, recent advances in enterprise energy management ("EEM") technology are helping businesses to control costs, optimize processes and prevent downtime.

Energy management systems use a combination of advanced metering hardware and software to monitor a facility's electricity usage, identify inefficiencies and pinpoint potential threats to reliability. This type of system can provide facility managers with the information to make informed decisions, from both a functional perspective and a financial one.

On the functional side, plant managers can efficiently monitor power quality and energy usage in real time to increase productivity, improve efficiency and maintain reliability. On the business side, corporate energy managers can review the historical consumption data provided to predict energy usage for the month, allocate costs by department and identify waste. A detailed understanding of the facility's electrical energy requirements over time also can help managers spot recurring trends, simulate alternative rate structures and negotiate better power-supply contracts.

Regardless of the type of facility monitored, the tools used to effectively manage and control electrical energy usage on a full-time basis usually consist of three main components: meters, software and communications.

EEM system components

An enterprise energy management system typically consists of a network of intelligent energy meters linked to a centrally located server running the EEM software.

Each meter monitors a specific location or activity, while the head-end software continuously retrieves, aggregates and processes the information.

The system logs the information in an historical database, responds to any alarm conditions by relaying notifications to operations personnel and displays the real-time status of each monitored area on the screens of one or more networked workstations. In short, the software compiles and analyzes data from multiple sources and acts as the central intelligence for the entire system.

The type and location of each meter is determined by the electrical system itself. For example, an advanced, utility-grade meter can be installed at the main substation to verify the quantity and quality of power delivered to the site. Simpler sub-metering devices can then be installed at key points around the facility to monitor individual buildings or processes.

Typically, the distributed meters communicate with the head-end software across the facility's existing Ethernet-based local area network. If, however, the operation is geographically dispersed over great distances, telephone, wireless, even the Internet can be used. In some cases, the meters can use e-mail to send system updates or alarm notifications directly to facility personnel or even host a built-in web page accessible over any standard web browser.

Understanding how a factory or plant is currently using electrical energy is the first step to controlling the cost, quality and reliability of its power.

Controlling energy costs

The benefits of informed energy management increase with the amount of energy used and the relative cost of any interruption to productivity. By their very nature, industrial applications tend to incur considerable electrical energy costs during the course of business—with energy-intensive operations such as aluminum and chemical processing plants experiencing energy costs between five and 10 times higher than industry averages (Source: Department of Energy, Office of Industrial Technologies). Like any large business, industrial plants and factories need to take active charge of their electrical energy management and procurement,

but however, to do so requires a full understanding of ongoing energy needs, and the ability to manage its use.

Relatively few facilities have the ability to verify the billing statements from their energy suppliers or to allocate the appropriate amounts to specific cost centers or processes within their operations. An EEM system can deliver the information needed to accurately represent the true cost of doing business, and help to identify procedures or areas that exhibit energy inefficiencies or waste.

With a high-accuracy revenue meter located at the utility service entrance, an EEM system can "shadow bill" overall electrical energy consumption. Automated reports can then help to verify utility bills, and identify any over-billing errors.

By allocating energy costs by department and using automated reports and alarm options to keep staff aware, an EEM system can help everyone actively reduce electrical energy consumption, increase efficiency and minimize costs within their individual departments.

With a network of meters reporting to one or more energy-management workstations, corporate energy managers have the tools to identify and monitor electrical energy requirements across the entire enterprise. This information can then be presented as a load profile—basically a snapshot of electrical energy consumption at all monitored locations throughout a typical day, week or month.

A load profile can illustrate how electrical energy is used throughout the facility, providing a valuable baseline that can help identify inefficiencies and evaluate improvement efforts. With an accurate understanding of electrical energy consumption, facility personnel can normalize usage patterns in conjunction with variables such as temperature, production rates and hours of operation to accurately benchmark and project electricity requirements.

An EEM system also helps energy managers analyze historical energy trends to accurately predict needs. With this information, "what if" scenarios can be developed to help managers optimize loads or processes and even negotiate better energy contracts. Accurate information on usage trends also can help discover unused capacity, which in turn can defer capital investment decisions such as building additional onsite generation.

Depending on the location, there may also be an opportunity to take advantage of demand response or load curtailment programs offered by electrical energy suppliers. These programs offer price concessions to the consumer, in return for the consumer agreeing to reduce its load anytime energy consumption across the power grid is at a critical peak. In this way, the consumer can also avoid incurring penalties from the utility for exceeding a maximum power demand level during peak times.

All of these opportunities are dynamic in nature. When electrical energy prices are high, or demand is rising too quickly, an EEM system can start a generator or dynamically shed non-essential loads to reduce the electrical energy drawn from the utility.

Furthermore, because utilities may also bill an additional surcharge for consuming electrical energy inefficiently below a minimum power factor level (typically caused by large motor loads), an EEM system(such as the one pictured in Fig. 2) can intelligently control capacitor banks to correct low power factor and again avoid penalties.

Power quality and reliability

When it comes to power quality, the cost of harmonics, sags, transients and outages can quickly become very expensive, not to mention disruptive.

Data may be lost, equipment damaged and procedures interrupted, resulting in costly downtime. Production lines are particularly vulnerable to power quality problems—power sags, transients and harmonics can result in device malfunction, downtime, damaged equipment and even lost product. Due to the interdependency of functions in a production line, these problems amplify the disturbance by "starving" all peripheral and downstream processes as well. The widespread adoption of automation within industrial processes means many organizations are now more sensitive to the quality of their electrical energy supply and continuous operation of critical equipment.

Recent studies indicate that the average industrial consumer experiences eight power-quality events each year (EPRI CEIDS, Cost of Power Disturbances), costing between $10,000 and $30,000 per event for pulp & paper processes and from $10,000 to $50,000 per event for plastics and semiconductor manufacturers (EPRI, PQ Applications Guide for Architects and Engineers). Affecting everything from computers to controls and motors, the aggregate cost of

power-quality events is estimated at $300 million each year for continuous-process manufacturers (EPRI CEIDS, Cost of Power Disturbances). This represents a considerable opportunity for improved electrical energy-management performance.

When electrical quality problems occur, portable power-monitoring equipment can sometimes help locate the problem, but for a large facility, an EEM system with its network of permanent-mount meters installed at key locations can verify power quality around the clock. This solution combines fast desktop access to status information for the entire electrical system, with the ability to receive early warning alarms anywhere by e-mail, pager or cell phone.

Much like the "black box" used by the airline industry, the EEM system provides valuable forensic data after an event, to help personnel identify the source of an electrical disturbance, and take corrective action to help prevent a reoccurrence. Detailed power-quality reports also can help personnel correlate poor electrical power quality with negative impacts on operations and processes.

To help maximize efficiency, on-site generators can help cut costs by "peak shaving" peaks in demand and even converting waste heat to electricity through co-generation. A clear understanding of generator processes is crucial to the efficient and economical operation of the facility. In this context, an EEM system can provide a simple and efficient way to manage on-site generation assets, by profiling electrical energy requirements and managing generators or loads based on power reliability or economic conditions.

Conclusion

When considering ways to improve efficiency, reduce costs and increase productivity across a large industrial campus, sound energy management practices should be a priority.

By monitoring consumption on an ongoing basis, corporate energy managers can predict electricity costs for the month, avoid penalties and verify each bill. Threats to reliability can be identified and corrected proactively, and poor power quality or disturbances can be dealt with promptly and efficiently to help prevent downtime.

A network of meters installed on enterprise-wide basis can help to allocate costs by department or function, and verify the impact of any new energy initiatives. Automated reports can keep

staff informed, so they can actively participate in programs to reduce energy consumption, increase efficiency and minimize costs within their individual areas. In the long run, a detailed picture of overall energy requirements can help to identify opportunities for better supply contracts, alternative rate structures or new construction, such as on-site generation.

Energy management technology can monitor the overall "health" of an energy system and any related equipment, providing the information needed to prevent avoidable interruptions. In the event of a disturbance, this type of system can supply timely alerts and status reports to help plant managers get equipment up and running as quickly as possible. Afterwards, logged event data can be analyzed to help identify the cause, and thus help avoid future interruptions.

The place to start is with a clear understanding of energy usage across the facility over a given period of time. From there, assessments can be made based on fact, corrective measures can be identified and the relative success of improvements can be verified.

By supporting a continuous cycle of research, optimization and verification, an investment in energy-management strategies can open the door to a more efficient and cost-effective future. **MT**

Anthony Tisot specializes in the topics of energy management and control technology for Schneider Electric. His background includes more than 12 years documenting technological innovations within the public and private sectors.

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