

What Smart Grid Means to You

Challenges and Opportunities for CIOs and IT Departments, Consulting and Specifying Engineers, Facility Managers, Telecom Providers and Solar Power System Integrators



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Introduction

■ The core framework of the nation's electrical grid was established in the late 19th century. Considering that, it should come as no surprise that the power grid has become technology outdated. It is no longer capable of addressing the unique demands and challenges of a next-generation power infrastructure.

This fact rings particularly true for the country's rapidly growing information technology and telecommunications industries, which require a secure grid capable of reliably accommodating alternative energy solutions as they are implemented in the 21st century and beyond. To address these critical infrastructure vulnerabilities, the concept of a new *Smart Grid* was introduced.

At its core, a Smart Grid can be characterized as a decentralized power infrastructure that facilitates the delivery of electricity from suppliers to consumers via two-way digital-control technology. *According to the U.S. Department of Energy's "Vision for the Modern Grid,"* a Smart Grid will offer seven key enhancements over the existing grid to enhance reliability and minimize environmental impact:

- **The grid will encourage active consumer participation.**
- **The grid will accommodate all generation and energy storage options ("plug-and-play" compatibility).**
- **The grid will enable new products, services and markets.**
- **The grid will operate efficiently and optimize the utilization of existing and new assets.**
- **The grid will anticipate and respond to system disturbances in a self-healing manner, operating resiliently against physical/cyber attacks and natural disasters.**
- **The grid will provide the power quality required for a digital, computer and communication-based economy.**

Managing and monitoring the power infrastructure from the point of generation to the point of consumption requires the development and implementation of a new generation of communications-enabled equipment and devices. Emerson Network Power is leading its industry in the development of new technologies that facilitate the adoption of sustainable best practices, including Smart Grid integration. In this eBook, Emerson Network Power experts share their technology expertise to help prepare the country's IT and telecom decision-makers for the transition to a Smart Grid.

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What Smart Grid Means to CIOs and IT Departments

- As IT moves to align with the business functions it supports, it's increasingly important for CIOs and IT departments to find ways to provide higher service levels at lower costs. Smart Grid has great potential to aid in that pursuit.

The data center, in particular, has become the hub of information technology and has seen a dramatic increase in the density and quantity of devices it supports. This has created a situation where energy costs are now a significant component of overall operating costs, and power management is critical to capacity management and resource utilization. Smart Grid will enhance the information available about power costs and usage in critical IT facilities, allowing you and your internal customers to make decisions guided by insight into real-time capacities and electricity costs.

Smart Grid will create a new layer of data to support critical decision making. Using the information captured from Smart Grid, IT management can schedule non time-critical tasks at off-peak energy use hours. For example, batch processing can easily be done overnight, when overall demand for energy is lower, reducing energy costs.

In addition, IT departments that charge back costs – a growing number as IT is increasingly viewed as a strategic resource – will be able to bill customers at different rates for peak and off-peak consumption.

Smart Grid also has the potential to increase the value of energy generated onsite through generator plants or alternate energy sources. With Smart Grid, you can choose to shed non-critical loads when energy costs are at their peak to offer additional cost savings to your department or your internal customers. You can also choose to move less critical loads to a power supply generated onsite during peak energy-use times. Business-critical IT functions can be maintained with the full integrity they require, while non-critical loads can be treated with more flexibility. Accordingly, those departments that require maximum availability can be charged for it, while departments with less stringent IT availability requirements can see some cost savings.

Smart Grid introduces more powerful information to power-usage decision making. Shrewd CIOs and IT departments will capitalize on this information to improve efficiency and performance.

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- Smart Grid, while promising energy users more control over their consumption and associated costs, will mean additional considerations for those who design and equip the facilities that will “plug in” to Smart Grid. Among this group are consulting and specifying engineers. While many organizations have adopted a wait-and-see approach to Smart Grid, the increased focus on energy efficiency and the move toward government subsidies and credits for efficient and green energy use have convinced others that planning for Smart Grid integration is worth the time and effort.
- **Monitoring Becomes Paramount**
In the past, the efficiency discussion focused on data center power and cooling. Recently the focus has started shifting to monitoring and managing energy use. As a result, you now will be encouraged to specify monitoring and measurement at the device-level in addition to the facility-level. More broadly, communication throughout the grid community will require a standard protocol, and the development of that protocol is likely to involve the community of consulting and specifying engineers.
- **On-site Power Generation Expands Its Role**
Smart Grid will allow for onsite power generation from both traditional and alternative sources, such as solar arrays and wind turbines. Consequently, building in capabilities for onsite generation should be considered in the ROI model.

Many facilities currently have some form of onsite power generation, most commonly a generator. However, its use is often limited to emergency back-up power in case of utility power interruptions. As Smart Grid becomes a reality, the traditional generator plant will also be used to power the facility during times when energy costs are at their peak, or even feed energy back to the grid in exchange for financial compensation. The availability of real-time cost information will drive this change.

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All facilities that have their own power sources will be empowered to make make-buy decisions based on up-to-the-minute electricity prices. This means you'll want to configure the power system by levels of criticality and prepare the system to easily enable onsite generation to take over pre-designated loads (see "What Smart Grid Means to Facility Managers" for more details).

The demands placed on energy storage devices, like batteries, will also change, making new technologies like lithium ion batteries more attractive. Lithium ion batteries have a higher energy density and they have a longer cycle life—better for daily cycling. This capability will also make it possible to shift energy usage from peak periods to off-peak periods.

■ **Additional Surge Protection Considerations Arise**

The importance of protecting power quality is heightened because Smart Grid, by definition, means enhanced integration and interconnection; therefore, problems at one facility are more likely to affect another facility. Sensitive equipment will be subjected to lightning strikes and all of the other typical elements along the power path that create noise and can damage circuitry. Because of this, new components added to a facility to enable Smart Grid in most cases will need to be protected by a surge protection device in the same way the utility service entrance, servers and desktop electronics are protected. At any given location or facility, surge or power-quality related issues that damage the fundamental communication and metering components upon which the Smart Grid is based could compromise the effectiveness of the overall Smart Grid and negatively impact other members of that grid community.

The Institute of Electrical and Electronics Engineers (IEEE) is aware of this issue and has formed committees to address the unique surge requirements for solar and wind-power generation.

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- Smart Grid will bridge the communication gap between supply and demand, spanning from power plants into our homes, businesses and data centers. Utilities, as well as government and industry leaders, see it as the ideal vehicle to enable utilities to enhance and better manage power distribution, while giving end users the ability to monitor and control their power usage in an effort to reduce energy costs.

The development of a Smart Grid promises a number of benefits for facility managers, including greater control of power consumption, energy efficiency and cost reductions. To realize these benefits, you will need to significantly alter the way you think about energy usage and management.

As part of this shift in thinking, there are factors you should consider to better position your company to take advantage of the benefits, as well as make smarter decisions about energy usage.

■ **Consider Renewable Forms of Onsite Generation**

Many facilities have some form of onsite power generation; most commonly a generator. However, its use is often limited to emergency back-up power in case of interruptions of utility power.

As Smart Grid becomes a reality, new technologies such as smart-generation control systems will enable you to better balance your load needs by allowing you to integrate and utilize renewable forms of electricity generation, such as high-efficiency wind turbines and photovoltaic solar arrays.

It will be possible to network together these renewable forms of electricity generation using advanced power distribution systems, allowing you to obtain high efficiencies. Integrated grid interface controllers will also work in conjunction with a smart meter to respond to time-of-day pricing signals, as well as indicators of the grid's level of stress. The total system will improve the economics of power distribution and minimize wide fluctuations in your electricity demand and supply.

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■ Determine Allocation of Criticality

To realize the benefits of a Smart Grid, facilities will need to initiate a stronger delineation between types of loads, such as non-essential, essential and critical, and then manage the load types by policy. A non-essential load might be the lighting in unused parts of the facility. Essential loads could be hallway or office lighting, while critical loads could be data centers or emergency lighting systems.

Delineating between types of loads and managing by policy will enable you to easily plan and select loads that can be appropriately shed. Smart utility meters will communicate with monitors to provide real-time tools to gauge usage and associated costs, allowing you to make informed decisions based on energy costs and load criticalities to manage or reduce those costs.

Most facilities with critical-power needs currently have some type of building automation system (BAS) that controls most elements of the facility. These systems provide an easy way to connect to demand-response programs many utilities are beginning to put in place. These programs allow you to work with utilities to turn off or shed designated, non-critical loads if certain conditions exist or during peak demand times.

For example, the utility would alert you if the rate of electricity increases to a certain level. Your BAS would then shed load by taking predetermined actions, such as turning off lights that have been designated non-essential, or moving the air conditioning set point up one or two degrees.

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■ It is Important to Prepare Now

It's important to prepare now for our Smart Grid future. A number of technologies are available that will help you gain a better understanding and control of your energy consumption. You will be able to make smarter decisions about energy consumption and management as Smart Grid becomes a reality.

Below are five key steps a facility manager can take today.

- **If you are not already doing so, begin talking with your utility about their Smart Grid initiatives, plans, incentives, and timelines.**
- **Consult with an energy management specialist to evaluate your current and future energy needs, consumption levels, and patterns.**
- **Evaluate your current building automation and infrastructure management systems, as well as your onsite generation capacity, if applicable.**
- **Develop a strong delineation for facility load types (critical, essential and non-essential) and a policy for prioritization.**
- **Stay current with local and federal government mandates and regulations relative to the Smart Grid as well as onsite power generation.**

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- The benefits of the development of a smart power grid are mostly easy to understand. A Smart Grid will enable power producers to enhance and more effectively manage distribution while giving end users the ability to monitor and control their energy use. Three main benefits to the application of Smart Grid technologies are alignment of power distribution with demand, improved management of energy peaks, and an overall reduction in energy consumption.

While each of these benefits is attractive to telecom service providers, the impact is harder to gauge. At a basic level, telecom providers have concerns about ensuring network reliability when allowing the kind of external visibility and control needed to integrate with a true Smart Grid. Telecommunications networks are private systems, and each power load-point across a network is owned by the telco. Surrendering control of that incoming power stream to the utility isn't an appealing strategy when your business is based on reliability of service.

So does that take you as a telecom provider out of the Smart Grid business? Not exactly.

In fact, the best way to take advantage of a Smart Grid is to structure your networks as your own private Smart Grid. This is possible through implementation of technologies developed for the Smart Grid in a strategy that mirrors the basic Smart Grid approach. That is, using these technologies within your networks to achieve the same benefits we expect to see with a national Smart Grid.

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Let's look at examples of how these benefits may be realized within your networks:

- **Distribution aligned with demand:** In an urban area with a particular zone covered by three to four cell towers, you may make the choice to shut down a portion of one or two cell sites during nighttime hours when network demand is low. But you must first have the technologies in place to fully understand your network activity and power requirements.
- **Improved management of peak loads:** Through the monitoring of network infrastructure elements, demand models can be created to anticipate the timing of peak loads. Once energy demand is anticipated, you can select the most cost-effective source of energy from open-market sources.
- **Reduction in energy consumption:** Overall energy consumption can be reduced with better information about the point of use and maximum loading conditions. For example, network operators can more accurately size the equipment they buy and decommission equipment that is oversized for near-term growth expectations. Also, power consumption by idle equipment can be eliminated if equipment use can be anticipated using intelligent monitoring and controls.

Technologies developed for the Smart Grid already are being adapted for use in telecommunications networks. You can leverage these technologies to manage power usage in both the central office and the outside plant (OSP), albeit in different ways. In the central office, facility-wide consumption information can be used to manage the power and cooling requirement for independent areas.

OSP nodes are different. They are located far from human intervention or observation and do not consume much power—less than an average household. But taken in aggregate, the energy consumption of all the OSP nodes in a network can be significant. The strategies available to you for managing that energy consumption range from the familiar – turning off air conditioning when demand is low – to the creative – using solar cells to power the node when the sun is out.

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Perhaps the most significant challenge to widespread adoption of Smart Grid strategies in the OSP is understanding the projected ROI on the technology investment to ensure the investment is worthwhile. The key is moving that discussion beyond the per-site ROI and looking instead across the network. When considered in this context, the savings generated can make the ROI more attractive.

Ultimately, the potential savings will drive your organization to adopt some Smart Grid strategies within your networks. The best way to prepare for and begin that transition is to make your networks more intelligent by increasing the monitoring and intelligence capabilities of equipment throughout the network. Understanding power use at the component, cabinet, site, and building level will enable you to better provision power throughout your network and apply elements of various Smart Grid strategies on micro (single site) and macro (network) levels.

With a better understanding of power use and requirements, it also is possible to effectively incorporate renewable sources of energy throughout your network. Putting a plan in place to take advantage of any available source of energy—solar energy, for example—can further reduce your overall utility power draw. In many cases, there are government incentives for the deployment of renewable technologies, making the investment worth considering. Taking that a step further, using renewable systems, such as solar panels, with an inverter as part of a fully interfaced network can allow you to send excess power from that solar panel back out to the network “grid.” This is a strategy likely to be employed across a national Smart Grid.

Development of a Smart Grid is an important step in moving toward the next generation of power distribution and management. And the technologies used to make it possible will be at the heart of the next generation of telecommunications infrastructure.

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- The Smart Grid will open up new opportunities for solar power by creating a completely new energy value chain that links renewable and traditional power generation to improve reliability, reduce pollution, and enhance utilization. The Smart Grid will help streamline the ability of rooftop solar arrays to feed electricity into the grid during daylight to help meet peak demand. As a result, homeowners and businesses that invest in solar power will find it much easier to sell the power they generate back to the local utilities – and defray their energy costs, or even earn a profit.

Given that potential, the new energy value chain may drive significant demand for solar power system integrators and rooftop solar arrays that are Smart Grid-ready. Today’s traditional electricity value chain includes centralized power generation, transmission, distribution, and consumption. In the future, the Smart Grid will link power generation from distributed sources, such as rooftop solar arrays, together with traditional power plants. Electricity will be delivered to homes and businesses through an intelligent transmission and distribution network that supports:

- **Advanced monitoring that allows end users to make smarter decisions regarding energy usage**
- **Two-way communication between customers and their power provider**
- **Support for peak demand from distributed power sources**
- **Rapid response to peak-load conditions**
- **Lower energy costs, and**
- **Variable rate pricing.**

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As outlined by the U.S. Department of Energy’s National Energy Technology Laboratory, the Smart Grid “will seamlessly integrate all types and sizes of electrical generation and storage systems using simplified interconnection processes and universal interoperability standards to support a ‘plug-and-play’ level of convenience.” To ensure you are designing systems that will capitalize on the Smart Grid’s potential, there four steps you should take:

- **Work with end customers to gain a better understanding of the data they want and need from Smart Grid.** In talking with customers and prospects, you will gain insight into their energy needs, consumption levels, and their preferences for monitoring and controlling energy usage.
- **Actively monitor the debate on Smart Grid consortium standards related to Advanced Metering Infrastructure (AMI).** The AMI standards now in development are critical to determining how end users will interface with the Smart Grid. The AMI standards will have a major impact on issues such as communications protocols, customer billing and hardware.
- **Ensure that system components are compatible with Smart Grid standards.** For instance, you should work with vendors to make sure they are developing power architectures, inverters and energy monitors that can communicate and are compatible with Smart Grid standards. Wireless-mesh network standards are also critical.
- **Design solar power systems that are compatible with Smart Grid standards.** To help your customers thrive with the Smart Grid, you will need to design systems that can distinguish types of loads (non-essential, essential and critical) and manage usage based on end users’ typical consumption patterns. Your customers will be able to more effectively manage electricity usage and rates. At the same time, the utility can better respond to demand by taking into account the electricity generated by alternative energy sources, such as rooftop solar arrays.

While full deployment of the Smart Grid is still years away, you’ll want to start planning now to ensure your products and services address the market demand that the new energy value chain is likely to generate.

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While the implementation of a nationwide Smart Grid is expected to result in dramatic economic and environmental benefits, there is still much work to be done to ensure that the transition from concept to reality is executed smoothly and comprehensively.

As we have discussed in this eBook, there are many groups that will be affected by this transition and numerous factors to consider and steps that can be taken now to prepare. These preparations will ultimately play a key role in establishing the groundwork for a 21st century power infrastructure.

Additional Resources

If you're interested in learning more about the Smart Grid and how it will impact technology providers, utility companies and other stakeholders, *check out these primers* from the U.S. Department of Energy. To get the latest information on Smart Grid-related news and events, *check out the Smart Grid Collaboration Wiki* sponsored by the National Institute of Standards and Technology (NIST).

For discussions with Emerson Network Power executives on how you can prepare for the Smart Grid, *check out the Smart Grid Video Series*.

If you have specific questions about what steps your company should take to prepare, *click here to locate and contact* a certified Emerson Network Power professional who can help.

Finally, be sure to follow *Emerson Network Power on Twitter or Facebook*, visit the *Emerson Network Power YouTube Channel* to be one of the first to know company news or view new white papers and case studies. For more on Emerson's connection to Smart Grid, visit EmersonNetworkPower.com/SmartGrid.

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