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Smart Grid — Different flavors for different tastes

By Jeff Buxton and Mehrdod Mohseni

SMART GRID IS A TERM THAT IS USED REGULARLY IN TODAY’S UTILITY LEXICON.

Like many often-used terms, with broader use it begins to lose its precision in defining something specific and universally understood. In fact, as smart grid programs continue to evolve, the definition of what a smart grid is meant to accomplish may become more unique with each particular utility.

The underpinning electric transmission and distribution infrastructure will experience numerous changes as countless new technologies are developed, tested and deployed. This influx of new technology, combined with new regulatory drivers and network standards, will shape the new utility landscape. Figuring out how to best play and compete in this new landscape is key to success; but the answer, more often than not, will be different for each utility.

A Range of Integrated Systems

A smart grid implementation includes a range of integrated systems such as advanced metering infrastructure (AMI), meter data management systems (MDMS), home area networks (HAN), supervisory control and data acquisition (SCADA), distribution management systems (DMS), distribution automation (DA) systems and other essential utility systems. Yet each utility has its own focus—or areas of prioritization—for its smart grid initiatives, based on its unique business drivers and starting point. For example, regulators, legislators and utility managers are promoting smart grid initiatives that focus on:

- ▮ Renewable energy
- ▮ Customer empowerment
- ▮ System reliability
- ▮ Deregulated markets
- ▮ Operations excellence
- ▮ Energy efficiency and demand response

DIFFERENT STROKES

The definition of smart grid has been discussed and debated in convention halls, meeting rooms and utility board rooms across the nation. Here, Jeff Buxton and Mehrdod Mohseni posit the theory that the definition of what a smart grid is meant to accomplish may become more unique with each utility as smart grid programs continue to evolve.

The driving impetus for each smart grid initiative forms the basis of business case elements, program design, and technology selections. It is important to ensure that these drivers are satisfied and the goals of the programs supported. A balanced smart grid program is a complex weighing of many competing drivers, stakeholder interests and financial considerations.

Although each utility may arrive at the doorstep of a smart grid initiative from a different starting place, they must all consider and incorporate both short-term needs and longer-term opportunities to provide the greatest benefits to the utility, the ratepayers and society at large. The overall smart grid strategy may need to include a long-term phased approach with appropriate consideration for technology selection, program rollouts, functional competencies and business case elements to ensure that the starting point is fully satisfied while not unduly prohibiting the long-term goal.

There are various utility objectives.

Renewable Energy Focus

In many states, legislators and regulators have instituted progressive requirements for utilities to incorporate significant portions of their generation portfolios as renewable resources. Hence, dozens of states are moving rapidly toward implementing renewable portfolio standards (RPS). For example, California’s RPS mandates 33 percent production of energy from renewable energy sources by 2030 while Maine’s RPS requires 40 percent production by 2017. Some states have set voluntary goals for adopting renewable energy instead of portfolio standards with binding targets. Smart grid initiatives focused on increasing renewable energy will concentrate on enabling the incorporation of dispersed renewable energy into the supply portfolio and the complex transaction management systems required to

support it. The challenge utilities may face will be with the manner this integration takes place such that it does not become disruptive.

Customer empowerment focus

Customer-focused utilities and regulatory bodies view the smart grid as holding great potential in changing the public’s relationship with their individual energy usage. The objective is to equip the end user with enough real-time signals, such as market prices, consumer load, environmental impacts and comparative information, to influence the consumer’s usage pattern. But this type of smart grid program must provide consumers with tools to provide easy-to-understand information, innovative rate designs, and customer empowerment to affect load patterns. The first steps are well under way with the deployment of smart meters, providing real-time energy usage.

But this alone will do very little to alter the consumer’s behavior. Continued advancements in information presentment, through the full breadth of media and communications channels, will make the availability of information ubiquitous and the ability to control usage convenient. The next wave of technology deployments around advanced home energy management systems, home area networks (HAN), consumer communications, automated controls and other new applications, must first take place, before benefits can be achieved for both the consumer and the utility. Thus, utilities focused on the customer empowerment objective will need to consider the incorporation of these technologies into their smart grid architecture as well as the business model implications of extending their responsibilities into the consumer environment.

System reliability focus

The deployment of intelligent devices to the far reaches of the distribution system provides visibility and insight into the operation of the grid. This greater awareness of the grid provides utilities with improved knowledge of potential grid failure points and enables proactive maintenance and reliability planning practices. This is particularly valuable when one considers that the average age of most grid equipment in the United States is already around 40 years. Furthermore, by leveraging embedded sensors and high-speed communication networks, utilities can better detect network disturbance, outages, power quality and power flow problems. Finally, with the advent of electric vehicles and grid storage technologies, the potential evolution into the distributed utility paradigm, with distributed generation, distributed storage, and distributed load management will dramatically alter the operation of a traditional utilities distribution system. Utilities that are operations driven may focus on the microgrid architecture or a self-aware, self-correcting distribution system to manage this new dynamic grid.

Deregulated focus

Electricity is currently deregulated



in 13 states and the District of Columbia. Eighteen states and the District of Columbia have deregulated gas, and another five states have instituted partial choice for gas. In states with competitive energy markets, smart grid technologies can further enable the richer, and more real-time, information that will allow more liquid and better informed market decisions and market participation by third-party suppliers and contracting energy users. Utilities that participate in these markets will focus on the data types, data volumes, data formats and data-quality requirements of supporting the various market players and their ratepayers.

Operations excellence focus

Utilities’ traditional responsibility is the distribution and delivery of power to consumers in the most efficient and reliable way possible. This includes investing in significant physical assets to enable that delivery. Smart grid technologies enable dramatic improvements in the planning and utilization of those grid assets. Utilities that are focusing their smart grid investments

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on operations excellence are tailoring their smart grid architectures around using grid sensors and improved grid measurements to re-examine their distribution planning processes, asset management improvements, distribution management and preventative maintenance programs and, ultimately, improvements to their overall operational efficiencies. This will drive a specific initial system architecture, integration plan and data availability approach for their smart grid initiative.

EE + DR focus

Many regulators and legislators have implemented stringent energy efficiency requirements for energy utilities. These

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include both energy efficiency (EE) and demand-response (DR) requirements. Examples of state legislated energy and demand reductions include:

The EmPOWER Maryland Act, signed in April 2008, sets a target to reduce energy consumption by 15 percent by 2015. It directs the Maryland Public Service Commission to require each electric utility to achieve 5 percent demand reduction by 2011, 10 percent reduction by 2013, and 15 percent reduction by 2015 (from 2007 per capita peak demand).

Ohio's Senate Bill Number 221, signed in May 2008, stipulates that each electricity distribution utility shall implement "peak demand reduction programs" that reduce peak demand by 1 percent in 2009 and by an additional 0.75 percent each year through 2018.

Pennsylvania's Act 129, signed in October 2008, directs the Pennsylvania Public Utility Commission to require that electric distribution companies meet established electricity consumption reduction targets of 1 percent by May 31, 2011, and 3 percent by May 31, 2013.

Utilities deploying smart grid systems with a focus on EE and DR must determine the mix of programs to deploy using dedicated systems versus those that are expected to leverage smart grid technologies. Further, the development of voluntary programs, automated programs, load shifting programs, rate-based programs or energy reduction programs all become part of the planning of the smart grid strategy and the sequencing of technology deployment.

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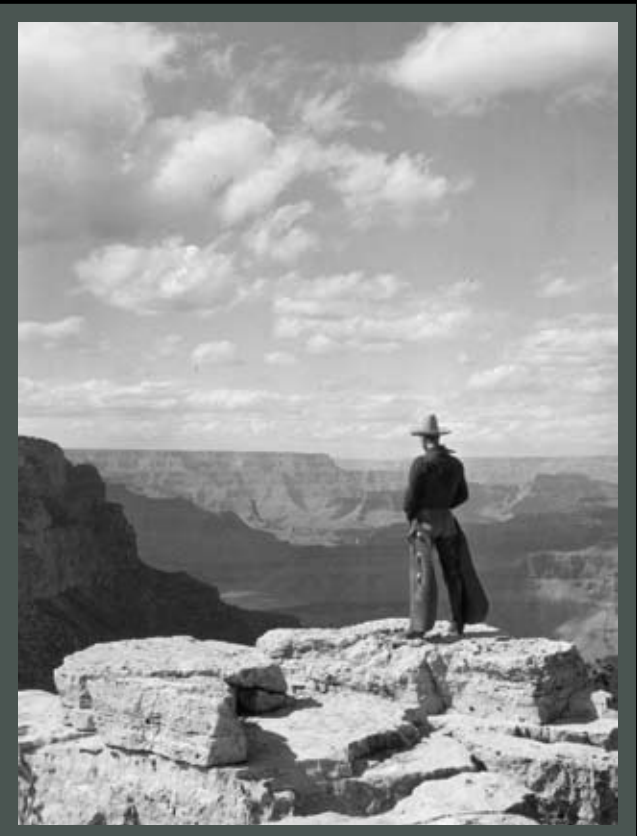
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Strategic plan needed in all cases

No matter which perspective drives a utility's smart grid program, a targeted, specific and measurable strategic plan is needed. Utilities need to build smart grid strategic plans that are designed to satisfy near-term drivers, capture medium-term benefits, and also position for long-term opportunities.

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The smart grid from various utility perspectives

Smart Grid Focus	Objectives	Strategy Elements
Renewable Energy	<ul style="list-style-type: none"> • Enable the integration of large-scale and/or small-scale renewable generation sources as reliable resource • Enable measurement, transaction management, and reconciliation of renewable sourcing 	<ul style="list-style-type: none"> • Renewable resource plan <ul style="list-style-type: none"> • Renewable resource contribution to overall portfolio planning requirements • Sourcing, reliability, and reconciliation of renewable sources • Large-scale versus small-scale resources; geographic dispersion and impacts on system design • Distributed supply models • Program design <ul style="list-style-type: none"> • Regulatory support strategy • Communications plan and positioning strategy; media and customer education plans • Smart grid architecture <ul style="list-style-type: none"> • Grid planning design and power flow measurements • System controls to enable the incorporation of dispersed and intermittent renewable energy • Grid storage considerations to enhance the reliability of renewable energy sources • System design to measure and reconcile bi-lateral flows, and institute complex billing systems to handle the various charges, counter billing, and netting for multiple sourcing of energy generation
Customer Empowerment	<ul style="list-style-type: none"> • Change the public's understanding and relationship with their individual energy usage 	<ul style="list-style-type: none"> • Data flow models and utility requirements for acquisition of data, conversion into usable information, and interpretation to provide customer insight • Information presentation and communications channels to the customer • Position of third parties and incorporation into the smart grid data model • Program design and innovative rates to take advantage of improved insight and controls • Consumer strategies and potential utility business models
System Reliability	<ul style="list-style-type: none"> • Provide visibility and insight into the operation of the grid, through deployment of intelligent devices 	<ul style="list-style-type: none"> • Prioritization of reliability drivers; supply diversity, system monitoring, predictive systems, grid controls, demand management • Smart grid impact and targeted architecture • Security, evolution, and expansion
Deregulated Market	<ul style="list-style-type: none"> • Empower customer choice • Support more liquid markets and broader participation • Further enable the information needed for competitive market decisions and market participation by third party suppliers and contracting energy users 	<ul style="list-style-type: none"> • Market positioning in retail choice • Data provision to third parties (how much VEE, how much interpretation, how clean, how frequently, how much historical data, what formats?) • Customer communications strategies for information delivery • Regulatory requirements • Customer transaction strategies and requirements • Rate design and enablement
Operations Excellence	<ul style="list-style-type: none"> • Technology-enabled operational efficiencies 	<ul style="list-style-type: none"> • Distribution automation strategy, converged or separate communications systems, relationship of AMI system to DA system requirements • Risks/benefits of smart grid as a grid-monitoring system, an additional layer of system controls on top of SCADA, or a self-actuating distributed intelligence control system • Smart grid architecture required to enable DA capabilities and capacity (scope, speed, pace) • Business model options for smart grid system components • Reliability, security, and operational efficiency benefits in smart grid requirements
Energy Efficiency and Demand Reduction	<ul style="list-style-type: none"> • Address growing EE/DR requirements • Create a reliable demand response resource based on customer-driven programs 	<ul style="list-style-type: none"> • Mix of programs to deploy using dedicated systems versus those which are expected to leverage smart grid technologies • Regulatory/decoupling strategy • Benefits and business case impacts of EE versus DR • Program design: voluntary programs, automated programs, load shifting programs, rate-based programs, or energy reduction programs