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Smart Grids: Strategic Planning and Development

Introduction

Smart Grids¹ help utilities respond to a variety of emerging customer and community needs. But utilities may miss many of the benefits if they regard Smart Grids as primarily evolutionary steps in consumption measurement and grid monitoring.

The Smart Grid is, in fact, an information revolution with implications for virtually every utility department and function as well as every customer.

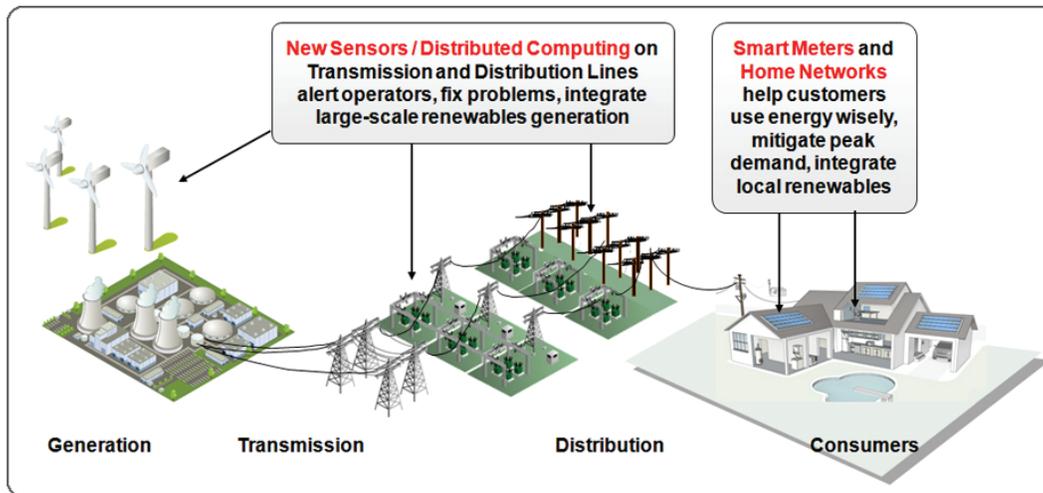
Utilities that permit just one or two departments to control Smart Grid design almost invariably discover that projects fail to provide optimal return on investment. In fact, without strategic executive leadership and involvement of all departments, utilities embarking on Smart Grid projects risk near-term revenue loss, less-than-optimal service delivery, and long-term excessive IT costs that customers and communities may not tolerate.

¹ The term “Smart Grid” generally designates a vision of linked technologies and programs that help utilities supply cleaner energy more efficiently to customers who use it more wisely. Utilities will adapt this vision to the specific needs and circumstances of the communities they serve. They will move toward the vision at different rates. And they will achieve specific Smart Grid objectives via different technology paths.

This paper uses the term “Smart Grid” in the singular to indicate the overall vision and “Smart Grids” in the plural to indicate the anticipated diversity in utility initiatives and results.

Smart Grid decision-making

Smart Grids link customers to electricity. They infuse the distribution grid and metering system with a full range of computer hardware, software, and communications networks to increase the intelligence of utility business processes and help customers use energy wisely.



A Smart Grid links customers to electricity via an information-rich network.

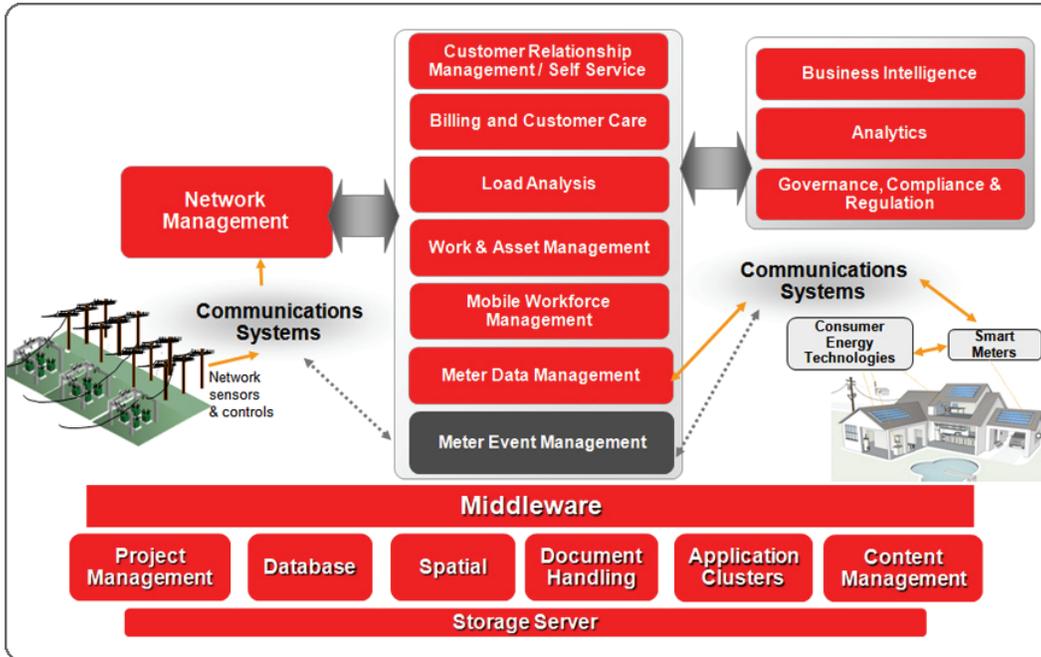
Initial utility discussions of Smart Grid projects frequently focus on need to bring together the activities of grid engineers and field/metering experts to ensure a smooth meter-to-grid operational flow. Utilities are discovering, however, that continuing this two-group view is a strategic error.

Smart Grid technologies affect how virtually every utility department accomplishes its work. They can and should involve the reengineering of multiple utility business processes. They can and should revolutionize the way utilities relate to their customers.

Smart Grids are, in short, transformative. Limiting planning and development to one or two organizations limits potential and can negatively affect long-term outcomes.

This paper explains why many utilities have initially elected “bottom up” approaches to Smart Grid design and the problems they have encountered as a result. It then explains the business benefits that accrue from top-down, executive-led Smart Grid initiatives that address, from the outset, the many different issues and multiple stakeholder needs ultimately affected by Smart Grids.

Appropriately developed, Smart Grids work seamlessly across the entire utility, encompassing all aspects of the power-to-customer business process.



Smart Grids encompass multiple aspects of the utility business.

Bottom-Up Smart Grid Design

Why utilities may elect bottom-up Smart Grid designs

At first glance, Smart Grids may appear to be the joint concern of two long-established utility organizations: metering and grid engineering.

Metering

Metering the consumption of gas, water, and electricity has long been an important but routine utility function. Metering discourages waste and spreads system costs appropriately across the customer base.

The advent of Automated Meter Reading (AMR) permitted utilities to reduce the labor costs of meter reading and speed the meter-to-cash process. As a hardware-and-communications solution, AMR was centered, appropriately, in the “meter shop.”

Advanced Metering Infrastructure (AMI)—today more commonly known as Smart Metering—facilitates consumption measurement in intervals (typically 15 minutes to an hour for electricity). Many utilities have begun Smart Metering initiatives with metering departments in the lead role. This can be a strategic error. Smart Metering is a transformational technology. It reaches far beyond the metering department, providing data quantity and quality that profoundly change the way utilities collect revenue, interact with customers, and deliver services.

Grid operation and maintenance

Smart Grids also have a clear relationship to distribution engineering departments, where SCADA (Supervisory Control And Data Acquisition), Distribution Automation, Outage Management, and Distribution Management have already significantly improved grid reliability and efficiency. But Smart Grids go far beyond these foundation applications. Thus, while distribution engineers, like metering experts, must play a strong role in Smart Grid development, they are generally not equipped to lead such projects.

Problems in bottom-up design

What happens when utilities fail to fully understand Smart Grid implications and assign planning to a department with a limited view, like grid engineering or metering departments? Almost all quickly realize that they have made an expensive mistake. Utilities that have launched Smart Grid projects from narrow platforms typically discover that the initial design has:

- Destroyed the ability to use data for additional purposes.

In an effort to limit the cost to send interval data from meter to utility and to process and store all that data, some utilities have installed meters that process and summarize data before sending it. Unfortunately, while this pre-processing may be suitable for applications like billing, it is likely to eliminate data needed to analyze grid operations or to refine supply portfolios. Pre-processing data significantly reduces the long-term potential of Smart Grids to contribute to more efficient utility business processes.

- Failed to provide for the long-term data storage.

Far too many utilities have embarked on Smart Meter projects by storing data in the billing system and then purging it after 90 days. Data worth millions of dollars to asset managers, supply portfolio directors, and grid engineers has simply evaporated.

- Assigned tasks to applications unable to perform them efficiently.

Bottom-up Smart Grid planning may, for instance, use the billing system to store interval data. But even billing systems that can handle the volume are unlikely to store it in ways most useful to network management, outage, or mobile workforce applications. Fewer still can provide portfolio managers and grid analysts with prompt and efficient data access. Should the billing

department attempt to honor the demands of other departments, it may significantly slow bill processing, placing a utility's financial integrity at risk.

- Launched the utility on a series of unplanned, overlapping, and costly application replacements.

Smart Grid leaders with limited views may focus on a specific proposed program, such as demand response. They may then select applications that facilitate that program without assessing the needs of multiple programs and multiple departments to use the collected data. Utilities may find themselves saddled, for instance, with a meter data management application that preprocesses and stores the data for the billing system but that fails to supply data in appropriate formats to the asset management system, mobile workforce, or outage system. Utilities that make this mistake commonly face a choice between two costly alternatives: customize the current application to accommodate emerging needs or replace the system.

Smart Grid top-down design

The litany of problems above can be readily avoided through top-down planning of Smart Grids that:

- Brings all parties to the table for initial discussions and agreements.
- Starts with a strong enterprise information management strategy that can collect and store all data and that can manage it through the Smart Grid life-cycle.
- Ensures equal access to data by all departments.
- Chooses new applications that, at a minimum, use industry standards for easy integration with existing and other new applications. Pre-integrated applications have the potential to speed implementation and lower short- and long-term costs.
- Examines and plans replacements for current applications in light of emerging customer, regulatory, community, financial, and environmental demands.

Top-down Smart Grid design ensures that:

- Every organization within the utility can use Smart Grid data.
- Organizations receive information processed to address their needs.
- Information moves seamlessly from node (meter or sensor) to utility organization.
- Consumer energy technology integration is addressed by both technical and marketing relationships.
- Security, information management and operational technology governance are fully addressed as part of the initial smart grid development

- Departments modify business processes to take advantage of Smart Grid data. Field crews, for instance, can use Smart Grid data to check meter function. Credit and collections departments will want to take advantage of Smart Grid data's theft-detection and remote disconnect potential.

Top-down design participants

Metering and grid experts will clearly play a strong role in Smart Grid decision-making. But it is crucial to involve additional stakeholders.

Business units

Smart Grids and their programs affect not just grid and meter operations but also every aspect of the meter-to-cash process; the customer- and asset-lifecycle processes; governance, compliance, and security; and the financial reporting and investment processes. Involving stakeholders across the utility is the only way to ensure that the utility's full knowledge is brought to bear on issues and processes that will ultimately determine a Smart Grid success or failure.

Customers and customer service staff

The advent of Smart Grids greatly expands opportunities for new customer energy technologies. But adoption of these technologies depends in large measure on utilities' ability to answer such customer questions as:

- What is the payback if I install a specific technology like rooftop solar photovoltaics or a combined-heat-and-power co-generation water heater?
- Will my utility provide favorable electric vehicle charging rates if I purchase a PHEV? Where and when will these charging rates apply? At what cost? With what restrictions?
- Will I work with my utility or a retailer to install a Home Area Network (HAN)? What kinds of pricing signals will the utility provide so that I can take full advantage of my smart appliances? What are the up-front costs and set-up time, and how much time and money will it take to keep the system operating? Will my HAN work with my iPhone? How will I find out about utility or retail programs I can take advantage of to save some money?
- Can I install an electricity storage device, somewhat similar to my home PC uninterruptable power supply (UPS), to offset critical peak pricing costs?

Within the utility, the business organizations most closely associated with customers are best positioned to look at Smart Grid issues from the customer point of view and help ensure that Smart Grids respond to customer needs. They are also best prepared to conduct customer surveys and outreach programs as needed.

Retailers

In competitive markets, utilities and retailers jointly serve many customers. Including retailers in Smart Grid planning adds additional perspectives on ways the Smart Grids can evolve to serve customers and enable new technologies. Including retailers in the discussion also helps to surface questions about new business structures and opportunities. Retailers will want to know, for instance:

- Will opportunities emerge for aggregating the output of rooftop solar photovoltaic generation or the emergency supply output from plug-in electric hybrid vehicles?
- Will there be opportunities to enter competitive businesses around electric vehicles?
- How can retailers profitably pass a utility's demand response incentives on to customers?

Regulators

The Smart Grid vision frequently precipitates new questions about the definition of the electric utility and the products and services it provides.

In the past, regulators and utilities have changed definitions to accommodate changing customer needs. In the past, for instance, many regulated utilities sold and serviced appliances; today, most do not. In the past, most utilities had monopoly power over generation, transmission, distribution, metering, and retail services; today, generation, metering, and retail services are, in many regions, partly or fully competitive.

This evolution of utility roles will almost certainly continue in the Smart Grid era. Regulators and utilities will need to re-evaluate today's assumptions about the nature and limits of utility business. They will also need to examine assumptions about what types of customer and utility behavior to encourage and how to attain social goals at optimal cost. Difficult judgments lie ahead:

- Should we encourage small-scale renewables generation by extending net metering requirements to competitive energy retailers?
- Is the provision of in-home consumption and pricing displays a utility or a retail business? If the former, should utilities be permitted to "grow" the display into a Home Area Network? If the latter, should utilities endorse a limited number of HAN suppliers so that consumers have confidence in their products and buy them?
- For what purposes should utilities use text messages (also called Short Message Service or SMS)?
- Should we permit utilities to offer special off-peak charging contracts to electric vehicle owners? Should they include "roaming PHEV charging services" for vehicle owners outside their home territories? Are there other business models that might better encourage the adoption of electric vehicle technology?

The need for utility executive leadership

Only dedicated executive leadership of the highest order can bring clarity and harmony to the many viewpoints that will contribute to Smart Grid success. Providing that leadership can ensure that:

- Short-term and long-term benefits and goals receive appropriate weighting.
- The many parts of a Smart Grid project are implemented in an order that parallels a utility's priorities.
- Smart Grid teams have long-term and strategic information to which individual employees may not be privy.
- Timeframes for implementation and benefit realization are realistic.²
- Goals are clear and appropriately evaluated.

Conclusion

Utility missions are changing. Yesterday, they focused on delivery of reasonably priced energy and water resources. Tomorrow, they will encompass both supplies and the services that facilitate sustainable use.

Complicating this revolution in the utility mission are such challenges as growing populations, escalating commodity costs, and rising standards of living that increase per-capita peak demands.

Few utilities can hope to address these changes with the legacy applications and data design structures currently in place. Smart Grids are a sensible response to these emerging challenges. Executive leadership and top-down design of Smart Grid projects can ensure maximum benefits at minimum long-term costs.

² For a list of the benefits at which executives should aim, see Oracle's white paper *Smart Grid Benefits*.



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