TELVENT

2010 and Beyond:

Next Steps on the Road to a Smarter Grid

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Jeffrey R. Meyers, P.E.
Director, Smart Grid Solutions
Telvent

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The American Reinvestment and Recovery Act of 2009 undoubtedly will be remembered as one of the most significant events in utility industry history. $4.5 billion in federal funding for improvements in smart grid technology, workforce training, resource assessment, analysis of future demand and transmission requirements, and the development of interoperability standards for smart grid devices.
How has this infusion of government money to some – but not all – utilities impacted progress towards a smarter grid? And how should it guide Smart Grid investments that, regardless of government funding, still need to be focused on driving down costs and improving customer service?

In this paper we will address these questions and also provide context for the following recommended "key benefit focus areas" for 2010:

- More efficient network operations
- Demand response/management through customer choice
- Enhancing system reliability
- Integrating distributed renewable resources

Taking Stock in the State of the Grid

An unintended but very real consequence of ARRA was how it actually stalled many of the planned Smart Grid projects in 2009. Big plans made at the beginning of the year remained just that – plans – awaiting word as to whether stimulus funding would be forthcoming. By the time recipients were notified in October, time to implement the plans made earlier in the year had run out.

Another result of the Stimulus program was the priority given to smart metering. Of the total of 100 awards for Smart Grid Investment, 64 were about or mostly about smart metering. From the Department of Energy's point of view, this emphasis made sense. The goal of spending the money on projects that can be started "immediately" (after October 2009) implied that most of the technology already should be well defined. By investing in metering projects, the DOE would be assured that the economic stimulus aspect of the grants was achieved, providing funds for projects that should be able to mobilize quickly.

Given this assessment, and the fact that all grant recipients have been notified, it would follow that 2010 would be the electric industry's breakout year for progress toward the Smart Grid. Although there is some reason for optimism, expectations again need to be managed.

Setting aside the issue of standards development for just a bit, we should expect progress within certain areas of development in 2010, while other critical aspects of the grid will require more work and thought leadership if momentum is to be maintained. Where are the key areas of progress? Have the fundamental business drivers for a smarter grid significantly been changed by the ARRA grant process? And what about the utilities who weren't selected for grant awards?

Market Momentum: What to Look for in 2010

With metering the dominant theme for smart grid investment grants, the industry can expect significant growth in this arena. Project startup requirements, including those for funding and reporting, are gaining clarity. Manufacturers are gearing up to provide hardware for huge implementations like Centerpoint, BG&E, and SDG&E, and many smaller systems for utilities like Central Maine Power, Lakeland Electric, and the Navajo Tribal Utilities Council. Some observers have gone as far as to say that these stimulus-funded metering projects alone could overwhelm vendor capacity, leaving other utilities looking to implement smart metering hanging. A more common concern is that all projects will suffer delays, as customers jockey for leverage with over-taxed suppliers. Most believe that the AMI projects may be slowed somewhat, but that by mid-year or possibly late third quarter, momentum will be established and delays can be managed.

Some of the most interesting projects to receive grant funding use AMI data in ways that support valid business cases. FP&L, DTE and PECo Energy are just three examples of projects geared to implement large-scale smart meters in conjunction with other smart grid technologies to try to leverage AMI data in some cross-cutting ways.

In addition there are other non-metering projects both in the investment and demonstration category that will be interesting to follow in terms of delivering business value. Progress Energy's concept is to implement an advanced distribution management system with improved volt/var control at the feeder, enabling the utility to eliminate the need for up to 350MW of added fossil-based generation. Through feeder conditioning and improved real-time analysis and control (using current, accurate distribution system data), Progress Energy will replace future generation needs by improving delivery efficiency. The term 'virtual power plant' has become commonplace, with any number of different definitions, but the Progress Energy project promises to be an exceptional test bed for reducing generation, thereby delivering smart grid business value.

In summary, 2010 should be a year of steadily gathering momentum in the smart grid market. There are a number of projects to watch on the basis of stimulus grants alone. Those that are designed to

How to make smart metering support a valid business case

- Implement it as a part of an integrated distribution management concept
- Use it as a source of valuable data to guide system planning and operating decisions
- Think through the integration required to ensure data will be accessible for use in engineering and operations as well as billing
- Ensure that current, accurate models of the distribution system are available to consume that data and support real time and off-line analysis and control

use information in cross-cutting ways to support advanced analysis, engineering and operations, as opposed to those that are focused on deploying a lot of technology, will probably be the ones ultimately to deliver on the promise of the smarter grid.

Business Benefits Going Forward

Despite these impacts of ARRA funding – both positive and negative – it is important to realize that the fundamental business drivers for improving the grid remain pretty much the same.

1. Deteriorating electric power network in most developed nations. The aging power delivery infrastructure, with its resultant poor reliability and high cost of operations, needs both reinforcement and expansion to meet growing demand. Meanwhile capital for investment is limited, and rate increases in most markets are very difficult if not impossible, to implement.

2. Growing peak demand is stressing generation and transmission capacity in many regions and has or will reach its limits in the near future. Consumers, conservation advocacy groups, and shareholders are calling for environmentally-friendly alternative energy sources. As energy costs rise, smaller distributed generation sources become economically viable. Regulators are driving the discussion from the need to reduce consumption through energy efficiency and demand response. Utilities are faced with the need to increase generation and transmission capacity to meet rising demand, while staying in step with regulatory direction and aligned (as much as possible) with consumer desires for low-impact sources.

3. Increasing customer expectations of power quality and reliability. Residential, commercial, and industrial consumers have come to depend and insist on highly available, consistent electrical energy for all loads, not only those deemed mission critical. Regulatory pressure in the form of service level or performance based rate structures adds to the business drivers for reliable supply.

4. Aging of workforce with critical institutional knowledge. Overlaying all these external elements is the fact that many members of the work force with critical institutional knowledge are themselves at or near the time of retirement.

In the face of these, and perhaps other, business pressures, new and emerging technologies offer hope for improving network monitoring and control, and enabling customer-level energy demand management. Available hardware and communications technology can distribute the monitoring and control options at a greatly reduced cost. Communications technologies can permit connection of a network of

Smart Grid Business Drivers

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2. Growing peak demand stressing generation and transmission capacity
3. Increasing customer expectations of power quality and reliability
4. Aging of work force with critical institutional knowledge

distributed devices to support decision-making on a centralized or de-centralized model, providing a comprehensive picture of the operating state of the network that has never before been available. Consumers can deploy, or use devices deployed by the utility, to gain access to energy usage information that will enable them to control many aspects of home demand. Smart appliances are starting to appear in the market, holding great promise for energy efficiency.

Each utility is faced with meeting at least some of these challenges, but even these high-level drivers are not universal. There are many choices to be made, and regional and political/regulatory factors to be considered. Still, most companies would be well served to focus in on one or more of four key benefit areas.

2010 Key Benefit Focus Areas

More efficient network operations. Utilities with capacity limitations resulting from generation, purchased power, transmission, or distribution issues would be well advised to look into the possibility of reducing load by improving the efficiency of delivered power. Through tightening down volt/var control, including flattening the voltage profile along many feeders, some utilities have been able to use distribution system demand response (DSDR) to anticipate peak demand reductions of 5 to 7 percent. Efforts at improving distribution system operations will require investment in analysis and likely some capital for feeder ties, regulation and capacitance. These may include improving distribution system data and implementing a distribution management system (DMS) application, providing for near-real-time control of key components. But those costs likely are to be pretty small in comparison to a full-blown smart metering system, making DSDR an attractive choice for reducing peak demand. And by developing the models and control for DSDR, utilities can set the stage for even more efficiency and functionality in future applications.

Demand response/management through customer choice. Companies with the need to reduce demand, and especially those with significant commercial and industrial loads, also might focus on implementing a customer-facing demand response program. Demand response (DR) offerings come in many forms, but if a company already has plans to invest in AMI, or already has a well-implemented rate structure such as time-of-use (TOU) or critical-peak-pricing (CPP), then DR can make economic and customer-service sense. By giving their customers the ability to reduce demand at certain times, many utilities feel that they can make the consumer a part of the solution, as well as offer them the opportunity for significant savings. Some believe that DR programs can be effective while operating in almost standalone mode; that is, by simply selecting available consumers and communicating reduction requirements through some form of interface. However, a

more sophisticated approach that recognizes the topological location of targeted load reduction, supports less invasive or repeated requests for interruption, and provides some feedback as to the actual load reduction has a greater likelihood of success. Such a system would require integration with other key components like a meter data management (MDM) system, and maybe an improved distribution system network model.

Enhancing system reliability. Improved switching and sectionalizing offers some utilities the opportunity for significant benefits, especially those faced with poor or deteriorating performance and regulatory pressures. Technology is available today to permit automated switching sequences that enable portions of the distribution system to 'heal' themselves. Self healing is accomplished by executing a pre-designed sequence under fault conditions to isolate faulted segments and restore service to unfaulted segments. While advanced switching apparatuses and the high-speed communications infrastructure required are commercially-viable today, an automated switching scheme probably should start with careful analysis of reliability information and a detailed model of the distribution system. Approaching this problem holistically can help to avoid the 'squeaky wheel' syndrome, such as over-investing in areas of the system with more recent but less substantial reliability problems.

Integrating distributed renewable resources. One idea that is gaining momentum in the power industry for improving system performance, reducing capacity requirements, and improving reliability is to provide locally-generated or stored power, especially from renewable sources such as:

- Photovoltaic (solar)
- Wind
- Storage
  - — Thermal devices
  - — Electric vehicles

Non-renewable distributed sources such as micro turbines also are being developed and deployed. Integration of these resources is nontrivial, but providing a localized power source has the potential to improve delivery efficiency and enable significant peak shaving, if reliable renewable sources and interconnection standards can be developed to meet utility-grade operating requirements. This topic certainly bears more thought and discussion. At the risk of being redundant, integration and safe operation of distributed energy resources will require more complete system modeling and real-time analytics.

Summary

The 2009 Smart Grid Stimulus initiative may have slowed some projects, and could even be said to have placed an undue influence on smart metering, but the fundamental business drivers for a Smarter Grid are unchanged. Utilities that can focus their efforts on these four key areas of benefit, concentrating on effectively integrating information and automation, will move the grid forward in 2010, benefiting customers and shareholders alike. ■