Envisioning the Grid of the Future

“Prediction is very difficult, especially if it’s about the future,” said Danish physicist and Nobel Prize winner Niels Bohr back in 1922. With today’s potential for quantum leaps in technology, seismic shifts in economics and rapid changes in political pressures, this statement has perhaps never been so true. Yet we can’t prepare for a future we can’t imagine. So when it comes to the smart grid, we’ll dare to extrapolate from trends inside and outside the utility space – including current challenges, technological advances and consumer behaviors – to glimpse into the world of tomorrow. Change is coming to all branches of the energy industry, including generation, transmission and distribution, with many impactful changes emerging in the generation, storage and distribution of energy. Because all parts of the grid affect one another, these changes will need to be viewed from a holistic perspective as they evolve.

Overcoming Generation and Storage Gaps

Few things in power generation and transmission have garnered as much attention in the past as the development of nuclear power. Though nothing quite so dramatic is on the immediate horizon for generation and transmission, important changes are nonetheless underway. Consider these developments:

1. **Alternative energy.** As power plants age and environmental concerns grow, it will become ever more expensive – and unpopular – to extract energy from historically popular fossil fuels. When technology has made the necessary advancements and the cost and benefits become more balanced, we’ll see a large increase of renewable and non-traditional energy sources. Diverse ownership models will evolve to meet different needs but will include consumer-owned, community-owned and utility-owned renewable energy deployments. These changes will drive changes in other parts of the grid, particularly distribution, where new metering requirements will emerge, along with new regulations associated with this type of generation.

2. **Smart storage technology.** In today’s electrical, grid most energy must be consumed soon after it is generated. With the development of new storage technologies, utilities will be able to capture and store energy at the time of production and then deliver it when it is needed most. This technology evolution will force changes in utility business and operational models as this impacts the foundation on which existing models were built.
3. **Sharing the load: Distributed generation and microgrids.** Most energy is currently generated in large utility-owned facilities. However, we will see a growing number of businesses and consumers independently producing power. Thus, generation will be "distributed." At the same time, we can expect the emergence of microgrids: small, self-sufficient regions—from industrial parks to entire cities—that independently produce and consume their own energy. This evolution will change the way consumers and utilities view, measure and bill energy consumption and will fuel the growth of new technologies to safely manage and connect these new sites to the central grid.

4. **Wide-scale transmission grid monitoring and stability enhancements.** Very high-speed sensors today monitor key points on the transmission grid. Just as distribution will see a significant increase in the intelligence and pervasiveness of metering and sensing equipment, so too will transmission. Synchrophasor deployments will increase as a strong focus on transmission grid stability continues.

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**A New Dawn in Distribution**

Perhaps no part of the grid will undergo more change in the future than distribution. Consider the following:

1. **Ubiquitous sensing and communications.** As Moore’s law continues to drive down the cost of industrial grade processors, wide-scale application of advanced metering and communications networks will create an unprecedented level of distribution grid awareness. Meters with multiple, integrated communication technologies will become more pervasive, with use cases extending far beyond traditional service point billing and control. Advanced metering, coupled with multi-network communications infrastructures, will form the base of a truly interconnected and ubiquitous smart grid. This will allow advanced user applications to evolve, driving the conversion of large amounts of smart grid data into well-informed decisions.

2. **Multi-dimensional interoperability.** Enabled by rapid technology advances, and driven by a need to extract greater value from resources, interoperability of components throughout the distribution smart grid value chain will leap forward. Multidimensional interoperability, with three dimensions of freedom across devices, communications and software applications, will drive greater collaboration among vendors, utilities and energy end users.
3. Smarter transformers, grid edge devices and applications. As distribution transformers age, utilities will replace them with smart transformers capable of detailed self-monitoring. Numerous existing transformers, particularly in critical location and high-density deployments, will be equipped with smart monitors which provide real-time visibility of the transformer’s health. This will allow utilities to make proactive decisions to repair assets before they fail. Likewise, other distribution grid monitoring and control equipment will be replaced or retrofitted with greater measurement and control capabilities, with advanced multipurpose communications. More intelligence will be pushed into the devices on the edge of the grid, with localized decision making in real time becoming more prevalent. Convergence of historically disparate utility operations will advance, such as the convergence of IT and OT, and the convergence of distribution automation and electricity metering.

4. Meters become multifunctional and much more intelligent. Metering with multi-purpose, integrated communications will become pervasive, and metering capabilities will undergo significant advances. Advanced metering and integrated communications technologies not previously economically viable will be implemented on a much wider scale. Vastly improved connectivity, device memory and capability will permit a much richer choice of applications. For example, meters with 3G cellular or Ethernet, standards-based mesh communications and ZigBee or other communications for in-premise device connectivity, all in a single integrated board, will become commonplace. Advanced processors coupled with more memory in meters of the future will allow remote downloading of custom embedded applications, including local analytics. This will allow new use cases and field applications to emerge.

Software Applications Transform

As the pace of technology change increases, as information technology advances emerge and as energy operations change, including increased convergence of IT – OT, software applications supporting the grid will evolve as well. Applications will be designed with a true end-to-end solutions focus in mind, interfaces in historically proprietary applications will become much more standardized and applications will be built with greater adaptability in mind. Cross platform-capable applications with streamlined user and application interfaces will allow shorter learning curves for operations and will support more rapid integration of applications with far less customization. An increased focus on usability, supportability and modularity will prevail. Applications will live on premise and in the cloud, including hybrid cloud based applications, with the ability move seamlessly to and from the cloud according to business needs.

Business Models Evolve

The rapid changes in technology, coupled with financial, regulatory and consumer concerns, will drive utility business model evolution. The so-called “death spiral” of utility business models may not be death, but rather transformation. Utility decisions will be based on maximizing value from end-to-end solutions to solve present and future challenges, supported by a thorough and non-biased understanding of all relevant technical and non-technical factors. A holistic 360-degree view involving all stakeholders will emerge, and no longer will technology be acquired based just on its technical appeal.

We Can Get There from Here

Yes, the future is unknowable. But all signs say the tomorrow promised by the smart grid will be light years ahead of today. In a decade or two, we’ll likely all be living in “smart cities,” with meters on every light pole and in every electric vehicle, on every building and in every device, all able to intelligently decide how to shift energy use and protect critical operations. When disaster strikes, we’ll reroute energy in real time to avoid cascading outages and restore the grid quickly and efficiently. When the sun shines or the wind blows, we’ll harness the power and store it on the grid for future use. And when asked to forecast the next phase of the smart grid, industry experts will make predictions we can’t even begin to imagine today.
Driving Value from the Smart Grid

The utility industry’s view of smart grid has evolved from one that is technologically centric and into a more refined awareness of the industry’s needs and opportunities, and how securing benefits, capabilities, and value are addressed by the solutions that are available or in the development pipeline. Too often, the focus has been on specific smart grid technologies and advanced applications themselves. Utility and vendor pilots still tend to emphasize technology performance rather than the extraction or realization of the underlying value to be derived from the technology. Many utility smart grid initiatives continue to favor the more tactical dimensions of the next generation of automation or application capability.

It is not that this technological proving ground should be discounted or abandoned. However, it must be equitably balanced by refocusing on the value proposition that the smart grid holds for utilities, customers, and society. Smart grid solutions, by definition, are not point solutions, but part of a web of integrated technologies and applications that enable more complex decisions to drive greater value and occur faster with improved accuracy or granularity to create greater value. This value requires utilities to develop, maintain, and strive for achievement of longer-term goals.

The focus must be on what are the fundamental needs of the utility, customers, and stakeholders? Or, alternatively, what value does a smarter grid provide that is unattainable without it? These are the strategic questions that will drive greater value through solutions that more finely align and link investments with a utility’s mission or vision statements. Is the focus on improving the livability of a city, the security of its citizens, or minimizing its environmental footprint? If so, the solutions must drive to this purpose delivering on the desired value. The benefit is not developing solutions that, for example, simply monitor streetlights, but instead create the ability to provide a higher degree of safety, more efficiently and effectively. The value is what utilities create from these technologies, the data, the information delivered, and improved decision making.

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About the Author

Ron Pate heads up solutions and product management for Elster’s global Electricity Business Unit (BU). In addition to overseeing Elster’s extensive metering and smart grid solutions portfolio, Ron works closely with the leadership of the BU regions to align best-of-breed technologies across all of Elster’s global operations. Ron received a BSEE (honors) from North Carolina State University and has worked for Westinghouse / ABB, Ohio Transformer and Elster. He has extensive experience with electric utilities since joining Westinghouse in 1989 and has been involved in the engineering development, marketing and sale of instrument transformers, power transformers, electricity meters, and smart grid systems. Ron is a published author and sought after speaker on a variety of grid modernization topics.

About Elster Solutions

Elster Solutions is the North American electricity business unit of Elster, a multi-national, 7500-person company providing electricity, gas and water meters and related communications, network and software solutions to customers in more than 130 countries. Headquartered in Raleigh, NC, Elster Solutions is focused on delivering the vital connections utilities need to achieve the greatest possible value from their meter data.

From smart meters and other grid sensors, to advanced metering infrastructure (AMI), meter data management (MDM), network communications, data analytics and pre-integrated, partner-based solutions for sophisticated grid power management, Elster’s solutions unlock the data stored in electric, gas and water meters. By transforming meter data into meaningful grid performance information, Elster helps utilities and their customers improve system reliability, enhance operational efficiency, enhance customer service and reduce their carbon footprint.