



The Utility of the Future

AN EMERGING VISION TAKES SHAPE

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Unprecedented Challenges and the Forces of Change

The electric power industry faces challenges that rival those of any period in its history. Among these challenges, and the many debates about how to move forward, a vision is emerging that will transform the utility industry. Utility “Smart Grid” and advanced metering infrastructure (AMI) initiatives are introducing advanced digital technologies into the power delivery system and end-user interface, driven by numerous industry factors. Consensus is growing that real-time pricing and load management, as well as integration of behind-the-meter distributed generation and other services, are essential to economic growth and environmental well-being.

The major drivers of this trend are well known: rising fuel prices and security concerns, aging delivery infrastructure and human assets, rapidly increasing deployment of renewable resources, especially solar and wind, and introduction of new technologies such as LED lighting and high-tech electricity storage. With carbon mitigation regulation and legislation already occurring at the state level, and likely to occur at the national level with a new administration, the power industry will likely face fundamental shifts in the economics of power supply and delivery. Other shifts in the overall energy environment will add to increased power demand and delivery complexity. One of these shifts is the

appearance and penetration of plug-in hybrid electric vehicles (PHEVs), with the potential of power grid applications and integration. Another shift lies in the high potential for fuel switching of domestic and commercial heating, as well as in some industrial processes, from fossil fuels to electricity.

Utilities' business models have largely been less dependent upon the Internet-driven transformation of so many other sectors of the economy. However, the proliferation of distributed generation and Smart Grid enabled consumer interaction with the utility system is going to bring utilities into the new world, ready or not.

By contrasting the utility of the future with the utility of today, as shown in the table "Today vs. Tomorrow," it becomes evident that the role of the regulator and customer in relation to the utility will undergo a fundamental shift from "the regulator as the ultimate customer" to "the customer as the ultimate regulator."

Today vs. Tomorrow

DIMENSION	UTILITY OF TODAY	UTILITY OF THE FUTURE
Product Offerings	Standard offerings	Niche of one customization
Revenue Model	Average cost-based commodity pricing	Service-driven revenues
Product Life Cycle	Many years	Several months
Market Environment	Closed regulatory eco-system	Dynamic environment – regular appearances and merging of partners and competitors
Market Growth	Increase to CapEx base	Grow customer base
Customer Satisfaction	Regulatory-defined formulas and steady targets	Customer-defined and moving metrics

There are also, however, other key issues that are constants across the transition to the utility of the future:

- Current utility-driven total solution and systems integration will morph into a more complex integration of multiple technologies.

- Utility-provided, long-term financing for capital intensive transmission and distribution (T&D) infrastructure remains the same, but the utility will also have to manage technology obsolescence for the customer.
- The utility is the ultimate guarantor of safety, reliability, and sufficiency, but "sufficiency" may become "viability."
- The utility manages the supply chain for customer value, but customer value is defined more broadly than before.
- The utility "obligation to serve" becomes an obligation to offer solutions to all classes of customers.

One other constant is that state regulatory bodies will not disappear nor abdicate responsibility or authority. However, utilities will seek to transform and manage the regulatory relationship for increased flexibility and rapid decision-making, in order to support all the above objectives.

Directions Forward – Open Season on Customers

The massive investments that will be required for renewable resources, Smart Grid, and the replacement of aging infrastructure will strain utilities' ability to obtain financing, not to mention straining regulators' willingness to allow rate-based recovery. The

simple need to attract "outside" or "risk" capital means that other financing providers will be allowed, if not encouraged, to enter the distributed-generation, energy-storage, and load-management arenas. These stakeholders will likely include major corporations with strong credentials in the consumer and commercial markets who are skilled at marketing, product management, supply chain and partners/channels management, and at managing rapidly changing markets and technologies. Faced by these formidable new competitors, utilities will need to carefully formulate their future vision for the grid and their business models.

While utilities have options for shaping their future business, the strategy they should avoid is one that maximizes current cash flow by minimizing investments and defending the current business model. As new technologies enable customers to opt out of traditional grid connectivity and service delivery, this strategy could lead to a declining rate base and an economic demise.

A potentially attractive strategy in the short run is for the utility to "opt out" and abandon the retail space entirely, becoming a

pure delivery company focused solely on maintaining a rate-based delivery business. This avoids the competitive pressures and a need for change, and can be financially viable. However, it risks a future in which the delivery company owns a passive infrastructure that is increasingly irrelevant in the new world.

The utility of the future is a vision wherein the utility embraces the new challenges, deploys Smart Grid and related technologies, and determines how to change itself and its business to exploit new technologies and compete with new entrants on equal or advantageous terms.

Competing Visions

As utilities focus on developing medium- to long-term strategic plans, four to six competing visions have emerged as alternatives to meet U.S. energy needs over the coming decades. Each utility will have to develop its own mix of these options depending on geography, demographics, the economics of its service territory, existing generation and fuel portfolio, regulatory environment, and existing and potential capital sources and structure.

As a simple example, centralized renewable generation (CRG) composed of wind, central solar, and central photo voltaics (PV) are attractive if siting is feasible, transmission to load centers exists or can be feasibly extended, and climatic conditions support acceptable capacity factors and volatility. For other utilities, CRG implies solving transmission to remote locations and possibly implies that the resource is not under utility ownership, either as a regulated or unregulated asset. From this scenario a number of high-level conclusions can be drawn.

Energy efficiency and conservation

Energy efficiency (EE) and conservation will be an increasing focus of U.S. and state legislatures, regulators, investors, and consumers. This will lead to electric supply fuel switching, which will accelerate with investments in renewable, distributed generation as part of energy efficiency building upgrades and construction. When coupled with population growth forecasts and long-term GDP growth estimates, even if overall energy usage is constrained by energy efficiency and conservation programs, electric demand will likely increase. Today's typical load curve will be dramatically affected, not always conveniently.

Smart Grid investment

Accommodating energy efficiency, demand side management (DSM), and distributed generation (DG) will drive utility investment in Smart Grid with electrical reliability, market integration,

and DG integration as primary drivers and enablement of EE / DSM integration "behind the meter" as a corollary objective.

Financing distributed generation

The pressure on utility capital structure and rates implied by Smart Grid and other infrastructure investments such as transmission to access renewables, coupled with nonutility DG providers entering the market, may make it attractive to regulators and utilities to encourage some degree of financial participation of nonutility organizations and customers in financing DG. Managing this process and maintaining a key role in the capital and operating side of resource supply will be a key strategic question for utilities. Utilities will retain responsibility for the integrity of the grid and the new Smart Grid infrastructure but will have to incorporate third-party DG and demand response (DR) solutions and technologies.

Technology roadmap and business models

Both renewable DG and Smart Grid technologies are evolving rapidly as a result of intense venture capital and supplier driven investment, government sponsored research, and the confluence of technologies from the communications, IT, and materials sectors. Penetration of PHEVs over the next five to ten years could advance utilization of energy storage technologies on the electric distribution system, pose new technical and operational challenges, and provide new opportunities for revenues and earnings for utilities and other energy service providers. All of this holds out great promise for the future, but also poses major technology obsolescence risks for what will be large investment decisions. This makes development and ongoing management of a technology roadmap consistent with a resource development viewpoint a critical competence for the utility.

The consumer satisfaction of early adopters must be good and must improve as DG

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moves from early adoption to mainstream use. This is the key success factor for any business models proposed for DG deployment, ownership and operation. Technology product management from awareness, planning and adoption cycles, to integration and service decisions about whether to own, rent or buy will be critical. Historically, utilities have not had to think about technology management in terms of the rapid decision cycles that are typical of many commercial industries today.

Utilities that survive and thrive will acquire technology and product management skills from other high-tech industries including information technology, communications,

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materials, and consumer products. Because so many Smart Grid and behind-the-meter devices will have embedded intelligence and communications capabilities, how the utility thinks about and manages its communications network and IT systems will be critical. The right mix of ownership versus service models over time will be more difficult than ever. While actual asset ownership may not be necessary in all cases, control and operation of the energy communications network will be a key business advantage, if not mandatory for surviving through the transitions ahead.

New generation technologies

The long-term future of generation resource development is almost unknowable today. It is possible to speculate that by 2050 coal generation may be in decline, and it is easy to forecast greater penetration of renewable resources both

as central generation and distributed generation. However, by 2050 a variety of new technologies will be available and forecasting what will succeed where is almost impossible. For this reason, investments in power system and IT technologies that can adapt to a new generation of any technology located anywhere, no matter what its operational characteristics and limitations, is a critical action today. The longevity of the power system assets compared to the rapid pace of technology change in generation can be looked at as a hedge against an unknowable resource future. This may be the single most important message of this paper.

Regulatory, political and consumer support

Building regulatory, political, and consumer support for the resource vision and the technology roadmap, including capital needs and financial consequences as well as enabling legislation and regulatory decisions, will be a critical activity without which no vision

for the utility future can be realized. In an era of increased customer expectations, regulators will be increasingly sensitive to customer issues. To satisfy customer demands, utilities will have to modify the “standard offering” to deal with a “niche of one” and provide flexible customization. Maintaining the ability to respond quickly to changing customer demands will require utilities to continuously educate regulators about the environment.

People and transforming the organization

Finally, the utility of the future will need a fully digital workforce that is able to keep pace with ever-evolving Smart Grid technology and business. Continuous training, recruitment, and retention will all be requisite. Managing the transformation to a new smart grid-capable workforce will be a major management challenge.

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This article is excerpted from KEMA's book on planning for the utility of the future.

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