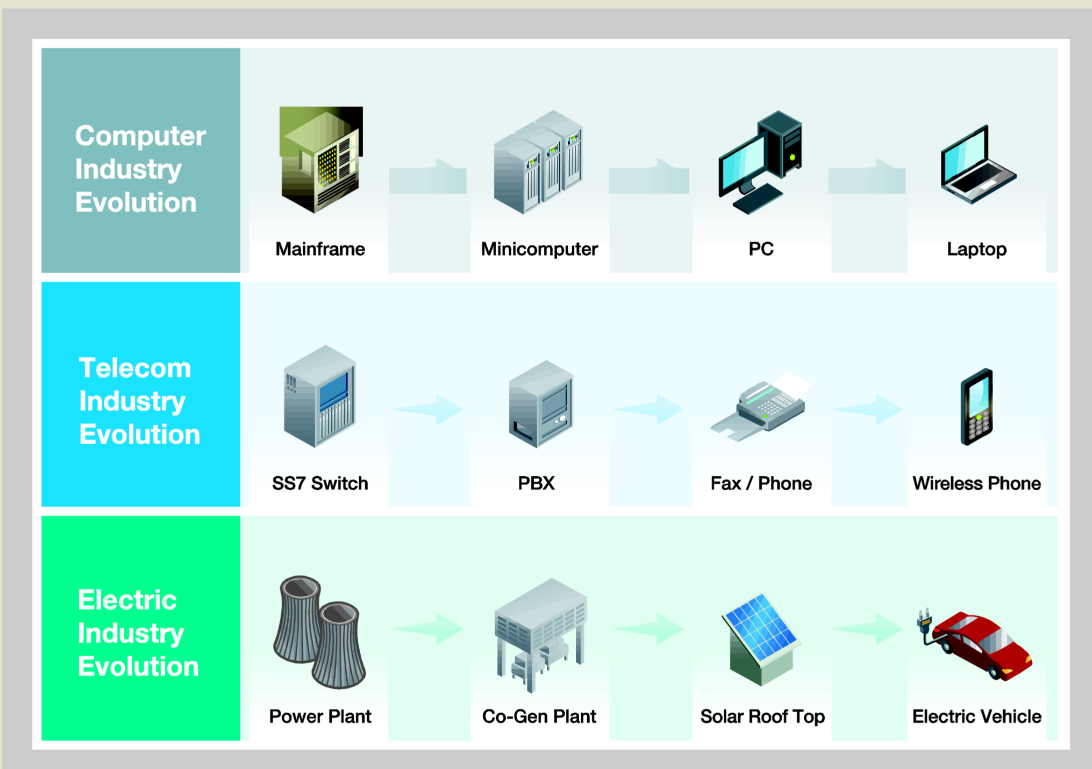
White Paper

Disruption Becomes Evolution: Creating the Value-Based Utility



Disruption Becomes Evolution: Creating the Value-Based Utility

This paper was written for power and energy executives and regulators faced with rationalizing the rapid and numerous changes currently pressuring the traditional structure of the utility industry. It shows how disruptive change in other industries caused the "rules of the road" to be changed, and how the lessons learned from those experiences can be applied to the utility industry.

New business models and cutting edge technologies such as distributed solar and CHP, demand response, microgrids, energy storage, electric vehicles, cyber-security, advanced wholesale markets, and new competitive retail markets are all impacting the traditional regulated utility industry. Generation, grid operations, and wholesale and retail energy sales are being transformed by innovation and competition, forcing utilities faster than ever to make critical choices about business models and technologies.

In this white paper, CMG experts answer a fundamental question – "How do we create better customer experiences, products, and services in response to the multiple drivers that are changing the rules and status quo?"

CMG experts bring their deep professional experience and a global view of these trends and opportunities to suggest how the market can accelerate its digitalization and transformation toward a truly robust and sustainable energy future.

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Executive Summary

Innovations in the 20th century drove the fastest and most disruptive transformations in economic history. The automobile devastated the horse-and-buggy industry, railroads consumed large market share from shipping, and airplanes later took passenger and freight business away from railroads. Assembly lines and engines that ran on fossil fuels enabled great leaps forward in manufacturing productivity.

The computer and telecommunications industries also advanced rapidly, likewise propelled by disruptive innovation. As it is illustrated on the cover page image, computers advanced from room-sized mainframes to smaller and more easily deployed minicomputers. Then to personal computers which automated previously manual tasks and finally to portable laptops which enabled computing to move out from the office and into every location of the world. Similarly, telecommunications equipment went from circuit switches, to PBX systems for offices, to fax machines for business or personal use enabling the transformation of how we used data, and finally to the smart phone that we can not live without a single moment today. The important common trend among then, and coming soon to the energy industry, was the movement from centralized capacity controlled by a few to distributed capacity independently controlled by anyone and costing a fraction of the traditional cost.

The power sector has moved forward at a much slower pace, when compared to the Computer and Telecommunications industries. After the late 19th century transition from DC power to AC power generation, the advent of steam-powered generation, and the industry consolidation led by Commonwealth Edison, the electric utility business continued expanding over the next century based on slow incremental change.

Today, after more than a century of slow evolution and little power system changes, a confluence of factors within the industry now result in electric utilities now facing multiple technological and business disruptions that in many ways mirror the evolutions of the past in other industries. Technological disruptions include:

1. **Renewable and Distributed Generation** – Continued inaction by the utilities will lead to an increased potential for an unstable grid. The distributed energy resources (DER) ship has sailed, buoyed by social and environmental pressures. Accordingly, utilities have to accommodate rapidly increasing DER on the grid in a safe, reliable, and affordable way.

   Utilities should plan new and innovative architectures that integrate DER into their dispatch equation as part of their portfolio rather than treating DER as a standalone initiative. The NY State REV plan provides a forward-thinking approach on this regard.

2. **Demand Response** – Utilities tend to implement demand response if and only if a regulator asks them to do it, as it places them in the awkward situation of asking customers to use less product. This causes them to miss opportunities to add attractive options for their customers.

   Utilities should work with regulators to make demand response a part of the normal portfolio of products offered to their customers and establish a rate structure that supports it.

3. **Microgrids** – Microgrids today are generally designed and implemented outside the utility planning realm, thereby causing potential serious headaches for utilities long-term. Some microgrid owners expect the local utility to take care of them during emergencies and may have not designed an efficient two-way interconnection.

   Utilities should adopt and advance microgrids as a next generation tool to create a much needed two-way power and data flow smart grid to support the anticipated growing penetration of electric vehicles, solar PVs, energy storage, and dynamic demand response in smart homes and buildings.

4. **Electric Vehicles** – Globally, growth of EVs is expected to accelerate as their prices drop. Today they show up in clusters within the distribution grid. If not managed properly, they can cause reliability issues by creating extended peak periods that further stress the utility's assets.

EVs could nicely counterbalance DER sources (e.g., wind) given their need to consume when wind is most often generating at its maximum rate in the middle of the night. Managed and coordinated properly by utilities, EV's enhance the operation of the grid by smoothing the rate at which power is consumed, while reducing peak loads, providing power to the grid, and helping balance load levels.

5. **Energy Storage** – Utilities and regional transmission organizations (RTOs) or Independent Systems Operators (ISOs) deliver power to their customers based on a consumption cycle that usually has one or more peaks during the day. During these peaks the use of peaking power plants at locations of congestion is very expensive since they are used only for a few hours a day.

   Installing energy storage devices at various points in the distribution and transmission system enables delivery of hitherto "not possible" services. Energy storage can fill the gaps during peak usage for a system originally designed for instant consumption upon generation, and reduce the need for expensive "peaker" generators. Regulators must allow energy storage to be used freely by the wires business.

Each technological initiative is examined in light of its effect on regulated utilities. Similarly, key business trends partially or wholly unrelated to technology also have the potential to disrupt the utility industry status quo:

1. **Retail Choice** – As states move to implement advanced metering infrastructure (AMI), the move toward retail choice is advancing in parallel, allowing new players to enter the market and contract to deliver power to traditional utility customers.

   A "do nothing" strategy is not viable for utilities. Delivering power to an increasingly smaller set of customers enables the profitability per customer to reach a point when the business will no longer be sustainable. Regulators play a vital role in avoiding disruption by loosening restrictions and allowing regulated utilities to embrace new business models.

2. **Product Bundling** – Players from the telecom, Internet, cable, and home security industries are melding into a single group of companies (e.g. Comcast, AT&T, and Verizon) that deliver services bundled to customers. Other than not owning the electric wires, these new entrants appear increasingly to customers as legitimate sources from which to purchase power.

   Utilities must proactively address competitive threats from bundlers by first defining their long-term strategy – wires-only, or both wires and retail customers – and taking appropriate steps based on that strategy.

3. **Municipalization** – Many municipalities are considering the set of steps needed to "secede" from the incumbent utility and become their own utility by owning distribution assets and purchasing transmission, energy, and other ancillary services from the wholesale market.

   The threat to the entrenched utility is the potential loss of a large group of customers who exit the utility and decrease its rate base. Incumbent utilities must respond by becoming more customer-centric and placing a stronger focus on leveraging new technologies and offering new services.

   Cities and communities wanting to own their own power company must get the right strategic business plan, technology roadmap, and advise to succeed.

4. **Nationwide Wholesale Markets** – The US and Canada have taken a Swiss cheese approach to implementing wholesale markets across the country with markets in some areas and none in others – even though all are required to follow the tenets of FERC orders 888 and 889 related to unbundling. While the size and scale of most of these markets is quite large, disparate rules make it impossible for the participants to drive economies of scale across these markets.

   We believe there is a need for a nationwide wholesale market as an alternative to existing regional marketplaces. This would enable, for example, Midwest wind power to be transferred to marketplaces in the east, and initiatives like the Tres-Amigas project that can provide the perfect balancing between the eastern, western and Texas interconnection and others.

5. **New Business Models –** Choosing the right business model is the first step toward becoming a smarter utility, and the answer depends in large part on the current structure of the particular utility, including the level of regulation under which it operates and its management's appetite for change and risk. It requires insight into divestments and investments, and often requires external help to rethink strategies and manage innovation as a competitive advantage.

Utilities may be capable of handling one of these changes on their own, but dealing with all at the same time can quickly overwhelm a slow-moving industry. While some forecast a dramatic decline for regulated utilities, we are optimistic about the future of those willing to embrace, rather than resist, the coming transformation. Preparing for the evolution requires each utility to chart its own course, develop sound a strategic business plan and technology roadmap to serve customers in the most effective and efficient manner, and carefully enable the right business cases and strategies based on their own unique challenges, generation sourcing, and electric network design characteristics.

This white paper concludes with a high-level roadmap that presents an approach for the utility of today to evolve to the utility of tomorrow, which we call "A Roadmap to Utility 2.0". And we offer insights and a set of next steps that utilities can take to transform themselves to ensure continued success. Furthermore, we hope that utilities and regulators will find our recommendations timely and achievable.

Introduction

Electricity is the cornerstone of the U.S. economy. Our modern electric grid is critical to both economic and national security. The National Academy of Engineering has called the North American power grid the "supreme engineering achievement of the 20th century".

Because the electric sector is starting to see change at an unprecedented rate, electric systems throughout the world face many challenges. With most of today's infrastructure for transmission and distribution having been installed in the '50s, '60s, and '70s, many grid components are reaching the limits of useful life, and the new two-way flow of energy between generation sources and consumption also requires system-wide upgrades. Prices are being pressured by increasing commodity costs, growing consumption, and a decline in working inventories, and at this point, no relief is in sight.

Regulatory and legislative regimes are forcing change. Examples include Retail Choice (e.g., Pennsylvania, Texas), Energy Storage (e.g., California), and Demand Response and Energy Efficiency (e.g., Ohio). Other changes driven by consumers, such as the emergence of microgrids, distributed renewables, and electric transportation will also heavily impact the utilities.

Utilities have had to respond; some examples include:

- Changing their business models and investing in energy efficiency and owning assets on the customer side of the meter.
- Deploying smart meters to improve customer services and reduce operating costs.
- Modernizing their outage management systems and starting to deploy distribution management systems.
- Installing new field sensors and controls, e.g. FLISR (Fault Location Isolation and Service Restoration), IVVC (Integrate Volt-VAR Control), and reclosers.

Edison Electric Institute (EEI) published a thought-provoking paper entitled "Disruptive Challenges: Financial Implications and Strategic Responses to a Changing Retail Electric Business" in January of 2013. It suggested that ongoing changes will seriously impact the electric utility business. While it identified strategic and financial threats, it offered no long-term, comprehensive solutions.

Given the utilities industry strong financial position, "Changing Times for Electric Utilities" in the March 7, 2014 issue of *Forbes* offers a glimmer of hope based upon their ability to absorb risk. Missing from the article, however, are the strategic moves needed to redirect utilities toward a stronger long-term investment strategy.

No one disputes that the grid of the future will look radically different in almost every conceivable way. Instead of accepting long-term decline or fighting change, smart utilities will retool their thinking to envision and build toward new business models and new technology architectures. Those adept at change will survive and grow, while those that cling to the status quo will slowly fade and possibly disappear.

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Analysis of Industry Changes

Some changes driving evolution toward the utility of the future are technological, while others are compelling alterations of the utility business model itself. While the discussion of changes below is not exhaustive, it identifies those having the biggest impact and seeks to answer a set of critical questions:

- What are the disruptive characteristics of this change?
- Under what conditions do we see this threatening the utility business model?
- How have other industries addressed such disruptions?
- How should utilities address this threat, and how have some of the leading utilities dealt with it most effectively?
- What are the consequences if utilities do nothing?
- What role can regulatory groups play to positively impact the present situation?

Technological Disruptions

The past 15 years have seen the creation of field area networks (FAN), smart grid applications, advanced metering infrastructure (AMI), home area networks (HANs), electric vehicles (EVs), distributed generation (DG), energy storage, energy efficiency improvements, microgrids, distribution automation, substation automation, and wide-area monitoring, protection, and control. All these advancements draw heavily upon rapid developments in communications, networking, computer processing, and computer memory technologies.

As scientific innovation and mass production shrinks form factors and reduces technology costs, smart grid applications become more affordable. Lower costs enable implementation of bi-directional communication and two-way energy flow into the grid. Enhanced connectivity introduces new capabilities and challenges:

- More clean energy choices for consumers.
- More reliability and resiliency to avoid power outages caused by natural and manmade events.
- More susceptibility to physical and cyber-security threats that require new defensive strategies to defend the security of the grid and distributed energy assets from security threats.
- Redundancy for critical power systems, substation assets and distribution assets.
- Feeder line redundancy by networking the grid farther out toward the customer premises to reduce fault size during outages.
- Greater real-time coordination and critical information sharing between utilities, law enforcement, state and federal agencies, vendors, independent power producers, and customers during emergencies to reduce the duration, magnitude and frequency of power outages.

The five technological changes primarily responsible for the current disruptions in the utility industry are:

1. Renewable and Distributed Generation
2. Demand Response
3. Microgrids
4. Energy Storage
5. Electric Vehicles

Renewable and Distributed Generation

Distributed energy resources (DER) include renewable energy sources (e.g. solar, wind, bio-fuels, pumped hydro, geothermal, tidal wave energy, etc.) as well as small to mid-size natural gas generation (e.g. CHP), energy storage including electric vehicles, thermal storage, flywheels, and other energy storage technologies that deploy much closer to the end-use than for utility grid size. The disruptive attributes of DER that compel utilities to adapt include:

- Ability for consumers or third-party providers to own the DER asset and use it as needed for electricity consumption or revenue generation.
- Reduced dependence on utility distribution, transmission and generation infrastructure.
- Low carbon footprint options for end users driven by environmental regulatory guidelines and targets.
- Added capacity on demand (minimal stranded capital costs from infrastructure).
- Enablement of energy trading markets at the end-use level (microgrids, transactive energy).
- New end-user and third-party revenue streams from ancillary services back to utilities (e.g., PV smoothing, frequency regulation, volt/VAR support, peak clipping and peak shaving).
- Local economy stimulus from manufacturing, installing, and maintaining DER infrastructure as consumers over time become prosumers (i.e. consumers and producers become one in the same).

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DER Benefits and Threats

Utilities accommodate DER because it (1) decreases the need for new centralized generation capacity to meet growing demand, (2) reduces the burden on transmission lines, (3) reduces the net loss of electricity on the distribution system, and (4) helps their environmental PR posture with the regulatory bodies and the end customers they serve. They also benefit from ancillary DER services that mitigate the intermittency of solar and wind on the reduced peak demand, and DER enables deeper demand response penetration.

The benefits, though, are outweighed by the increased cost incurred to provide grid support services for intermittent renewable energy sources, a cost to the utility that can surpass $50 per month per customer. As DER penetration grows, this cost will rise and will need to be subsidized for the utility to remain economically viable.

A second economic threat to the utility business model is the ultimate decrease in kWh sold as more customers leverage DER to meet their electricity needs. Utilities will need to find a new way to pay for the infrastructure cost that is currently recovered through a surcharge on the customer bills. Without this, the end-use customers will enjoy new revenue streams from local transactions of energy and ancillary services between neighboring microgrids, while the utilities are left to absorb all the costs of managing expensive surplus renewable energy from net metering, the growing cost of supporting grid services, and stranded costs of centralized generation and transmission/ distribution system maintenance.

The DER Market

Utilities could co-opt the DER market by purchasing assets in this space, implementing them where it makes sense to keep the grid stable, generating new revenue streams, creating more competition to drive down costs while continuing to provide more affordable, safe, and reliable electricity to customers.

To accelerate their entry into this market and steer DER toward a long-term stable grid, utilities should also consider buying out third-party companies that are doing a good job of providing DER services or providing well-designed subsidies that provide two-way benefits. HECO, SCE and SDG&E are good examples of utilities that are effectively addressing the disruptive threat from DER where its penetration is the highest in the nation due to the availability of solar and the strong environmental and political drivers to reduce dependence on coal and nuclear.

Inaction by the utilities will lead to an increased potential for an unstable grid. As a regulated industry, utilities have a fiduciary responsibility to serve the best interest of their customers. The DER ship has sailed, buoyed by social, environmental, and economic pressures. Accordingly, utilities have to accommodate the new DER on the grid in a safe, reliable, and affordable way. Ignoring the DER threat is no longer an option for utilities if they want to continue their role as a regulated monopoly. The DER competition from end customers and third parties is real and is not going away.

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The Role of Regulators in DER

Regulators need to create a more level playing field with respect to DER by taking three actions:

1. **Decouple revenue from kWh** for utilities across the nation so they do not perceive DER as a direct threat to their economic base. Utilities should be able to generate revenue through delivering better energy efficiency, providing ancillary services, and creating a flat load curve not based on kWh sold.
2. **Open the subsidies market for DER** to utilities, end customers, and third-party companies alike so the competition is fair. Let the entities that provide DER services most reliably, safely and affordably survive in the market.
3. **Make DER more accessible** to consumers. Current DER subsidies favor cash-rich and creditworthy entities and individuals, while income-restricted and credit-challenged people pay for the subsidies for the wealthy without benefiting from DER as their cost of electricity rises. This is an economically unsustainable model for both the lower economic levels of society and the utilities that serve them. To achieve the full impact that DER can have on grid stability and overall infrastructure resiliency, regulators should allow energy transactions to occur at wholesale and retail levels, enabling federated micro grids to come into being. The current regulatory policy restricts DER owners by allowing them to sell electricity to only their utility. This lowers the economic incentive for end customers to invest in DER and increases the burden on utilities that could otherwise purchase inexpensive electricity from customers and sell it at an affordable rate to others who need it.

Demand Response

Wholesale market operators are adversely affected by the addition of grid-scale and transmission-connected renewables such as large wind farms and/or solar installations. Adding centralized intermittent renewables makes the dispatch equation much more complicated and results in either managing larger percentages of reserves or requiring new tools.

Given the current slow economy, utilities should focus on targeting applications that reduce cost by deferring capital investments. "Substitute" technologies need to be cost-effective (i.e., cheaper than existing peak production costs) and commercially available. Utilities that have not adopted a variable pricing program to offset losses from more expensive peak production cycling should look to demand response programs and energy storage devices to reduce production costs and improve asset utilization.

Demand response programs have some of the lowest costs relative to their overall impact, so they should be pursued to improve the return on investment in areas with steep demand curves. Areas that have a more level demand curve may want to focus instead on developing cheaper generation sources and reducing line losses through the use of utility-owned distributed renewables.

Until now, utility dispatch focused on managing supply to meet the changing needs of demand. For the first time, demand response offers utilities the ability to control demand itself, leading to a better and more cost-efficient dispatch of generation sources. As utilities progress to demand response, wholesale market operators (e.g., PJM, NYISO, ISO-NE, MISO) are also adding new tools like demand response to their arsenal to meet the challenge of widespread volatility in their supply portfolio.

This move by the wholesale market operators adds a new dimension to the situation. New non-utility operators such as EnerNOC and Direct Energy are establishing themselves and making direct contact with end-use customers, using aggregation mechanisms to make their load available directly to the wholesale market and making a play in both the energy market and the more lucrative ancillary services market. We believe this is just the first step for the non-traditional vertically integrated utility player to establish their relationships with customers, who until now have been in a direct relationship only with the incumbent utility.

Demand response is also a difficult proposition for the utility. Since it places each utility in the awkward situation of asking customers to use less of its product, utilities tend to implement demand response if and only if their regulator asks them to do it (unless they can see a direct benefit). In so doing, they miss the opportunity to add attractive options for their customers. Utilities should work with their regulators to make demand response a part of the normal portfolio of products offered to their customer and work to establish a rate structure that supports it.

Microgrids

Microgrids are emerging as a new solution for government, industrial, commercial, and residential community power customers to aggregate key loads under a framework that allows them grid autonomy and more control of their assets. The key benefits driving adoption are the freedom to choose, the optimal power source, improved energy security, better reliability, and energy savings.

Microgrid technologies are benefiting from low interest rates for financing, cheap natural gas prices and abundant supply, abundant solar PV supply, and Moore's Law reaching all energy generation technologies. Micro generation equipment keeps getting better and cheaper to deploy as volumes increase.

From the utilities' perspective, this is a perfect storm, since large customers want to avoid increasing outages, long restoration times, decreasing power quality, and increasing security risks. Many customers are rushing to adopt microgrids, especially hospitals, military bases, shipping ports, food stores, food processing companies, chemical companies, data centers, hotels, and many others.

The U.S. Department of Defense, the world's largest electricity consumer, is pushing aggressively to deploy microgrids as part of its overall energy independence and energy security strategy. An aggressive commercial example is the largest private microgrid project in the US at Hudson Yards, New York. It comprises 26 acres in 6 city blocks that are being developed to support 17 million square feet of structures including 5,000 apartments, 20 restaurants, 100 shops, 5 office towers, and one cultural center, all off-grid powered by 13.2 megawatts of distributed generation.

While large customers rush to get off utility grids, utilities have a great opportunity to leverage microgrids as a technological solution to enhance large contiguous grids that have given us so many benefits over the last 100 years.

Microgrids can be a daunting force for utilities to compete against. Instead, utilities should embrace, support, and promote them. In fact, they should acquire them as a next generation tool enabling much needed two-way power and data flow advanced smart grid that would perfectly support large penetration of electric vehicles, solar PVs, energy storage, and the use of dynamic demand response via smart sensors in smart homes and buildings.

As microgrids come online, utilities must stay on top of critical operational issues. For example, interconnection standards are evolving, and engineers must consider the impacts of these new standards when implementing distributed generation systems. Also, if microgrid penetration is significant, utility operations can be impacted either by reduced demand or by performance considerations, such as the voltage fluctuations caused by photovoltaic operations during changing solar conditions.

> Microgrids can be a daunting force for utilities to compete against. Instead, utilities should embrace them, support them, and promote them. In fact, they should acquire them as a next generation tool enabling the much needed two-way power and data flow advanced smart grid.

Microgrids have the potential of delivering true sustainable and unbeatable resiliency, unparalleled system-wide uptimes, and improved power quality delivery that the 21st century power customers will require.

Energy Storage

Traditional transmission and distribution networks allow for the delivery of electricity to end-users over distance. However, distributed or centralized renewables, demand response, and electric transportation have the potential to substantially alter the traditional load/generation balance and profile.

A well-designed energy storage program can address needs in each of these areas by delivering a variety of services, including:

- Flattening the load profile by storing when the generation cost is low and delivering when the generation cost (or need) is high.
- Enhancing reliability through the addition of backup power sources.
- Supporting intermittent generation resources like wind and solar (curtailment avoidance, smoothing, shifting, flexible discharge for peakers).
- Deferring transmission and distribution capital through congestion relief.
- Enhancing voltage support, reactive power support, power factor correction, and power quality.
- Implementing frequency regulation and ancillary services.

For decades, pumped hydro storage and thermal storage were the only forms of energy storage, but they were constrained in where it could be deployed and limited in their applications. Newer forms of energy storage based on battery technologies have the potential to be installed anywhere, from the transmission or distribution system or even at the residential level (community energy storage) and offer many more applications.

The utilities and regional transmission organizations (RTOs) play a unique role in the use and installation of energy storage because of their mandate to deliver the best quality and reliable power at the lowest cost to the customer. Energy storage fills the gap for a technology that has a unique characteristic – instant consumption upon generation. Installing energy storage devices at various points in the distribution and transmission system enables delivery of hitherto "not possible" services.

As increasing amounts of renewable generation hit the grid, on-demand generation capacity that can be idle for extended periods of time is needed to fill the gaps when renewables are unavailable. The threat to the utility business model if they don't act quickly is that a nimble, third-party suppliers will find appropriate locations and install enough storage to fill this gap in the lucrative wholesale market.

Regulators can exploit the potential for this groundbreaking and disruptive technology by encouraging (e.g., allowing for rate-recovery) utilities that create innovative mechanisms to use storage and thus reduce the need to add more costly generation. The California PUC has just done so with an annual mandate for California with a target of 1,325 MW by 2020.

Electric Vehicles

The growth of EVs in the U.S. surpassed 100,000 cumulative units in 2013, and 2014 will likely see an increase of almost 150,000 total units. Total electric vehicles on the road could be at 3 million or more by 2023.

As Tesla, NRG, and others build independent nationwide fast charging stations and as EV unit sales grow, adoption will accelerate. Several utilities are investing in deploying public charging stations within their service territories (e.g. Austin Energy, SDG&E, CPS Energy). As volume grows and charging stations increase ownership convenience, decreasing prices will further accelerate customer adoption.

EVs introduce interesting challenges to utilities as they grow in numbers. Their random concentration behind transformers and feeders could negatively impact the power grid. If EV charging is not managed or coordinated in any way (e.g. load control or price signals), it will introduce serious infrastructure and safety risks that could severely impact power grid availability and quality.

On the other hand, EVs managed and coordinated by electric utilities can enhance power grid operation by smoothing the rate at which power is consumed, thus reducing peak loads, providing power back to the grid, and helping balance load levels. Globally, increased penetrations of wind and solar in specific countries and regions will create a greater need for energy storage to both optimize integration of these resources and balance the frequency disturbances created from their variability in generation.

EV management or coordination is called vehicle-to-grid (V2G). V2G technologies have been in development since the beginning of the modern electric vehicle era, but they are only now beginning to create revenue-generating applications. The market for EVs equipped with V2G technologies, which enable the vehicles to participate in ancillary services for the power grid, is expected to evolve steadily in the coming years. It is subset market from the total EV market, but it is a critical one. Compelling V2G business models are emerging in select markets around the world. Individually owned EVs are expected to participate significantly in grid services during the second half of this decade. According to several reports, more than 250,000 V2G-enabled EVs will be sold worldwide by 2030. Power grids with high percentages of wind resources will likely have higher returns for frequency regulation services. Some predict that global V2G frequency regulation revenue will reach about $190 million by 2022.

The Department of Defense has been a leading proponent of V2G technology. In 2013, they invested $20 million to install 500 V2G-enabled EVs at bases across the US. Additionally, demonstrations and pilot projects using fleet vehicles in the US, in several Western European countries, and in Japan are beginning to show returns, proving that V2G technologies can serve as effective assets for various grid services.

Another key trend driving EV innovation is wireless EV charging, which offers potential advantages over conventional plug-in technology, including increased customer convenience. Although some wireless EV charging systems are currently in the pilot phase, several car companies believe wireless technology could become the dominant technology for EV charging. According to several auto industry sources, a few EV models with built-in wireless charging capability are expected to be available from a few automakers by late 2016, and the global market for wireless EV charging is expected to grow to tens of thousands of locations by 2020.

Business Disruptions

As key technologies can cause serious disruptions to the utility business model, other changes unrelated to technology also have the potential to disrupt the utility industry status quo:

1. Retail Choice
2. Product Bundling
3. Municipalization
4. Nationwide Wholesale Markets
5. New Business Models

Retail Choice

The deregulation trend started in 1998 and is being adopted state by state. Full electric retail choice is currently provided in Connecticut, Delaware, District of Columbia, Illinois, Maryland, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Texas. Customers choose between their old incumbent utility supplier and an array of new competitive suppliers, rather than being captive to a single provider.

Competitive retail suppliers provide a variety of service plans that give consumers and businesses flexibility in their energy purchases. In Texas, retail energy providers (REPs) offer many flavors of real-time pricing, time-of-use pricing, and even free nights and weekends electricity pricing, as part of a package. They may also offer services to hedge against price fluctuations; more choices for alternative energy resources, and newer energy efficiency projects, allowing consumers and businesses to choose the services that best meet their needs.

> We firmly believe that a "do nothing" strategy is not viable unless the utility opts to become a wires-only company and allow others to take away its customer relationships.

An even more disruptive form of retail choice will start to emerge as competitive retailers and new players branch out to offer services nationwide via energy efficiency and distributed generation offerings on the customer side of the meter, even though they are now able to sell KWh from the grid. This trend will eventually force full deregulation nationwide. Retail choice is now primary disruptive business change that is impacting regulated utilities that don't participate and promises to shape what products and services they offer.

> Players from the telecom, Internet, cable, and home security industries are consolidating into a single group of companies (e.g., Comcast, AT&T, Verizon) that deliver services bundled to customers. Other than not owning the wires, these new entrants appear to customers as legitimate sources from which to purchase power.

The type of business disruption that retail choice represents started in telecom in 1996 when deregulation hit that industry. Energy deregulation was approved in several States from 1998 until 2002, but it was stopped in 2003.

How Telecom Dealt with Retail Disruption

In the 1990s and 2000s, the telecom industry faced a threat similar to the one now facing the electric utility industry.

After AT&T broke up and formed a set of regional Bell operating companies (RBOCs), AT&T held the long distance market and the RBOCs provided the local connectivity for telephony and data networking. Several long distance carriers (e.g., MCI, Sprint) competed with AT&T for the long distance market while competitive local exchange carriers (CLECs, such as Level 3, Global Crossing, XO Communications, and others) and other Internet Service Providers entered the local market. Eventually the RBOCs took advantage of existing wiring infrastructure to the household by offering it to competitors in exchange for access charges.

However, in time, the RBOCs started consolidating to form large telecom enterprises with deep pockets to invest in new wireless, fiber, and satellite technologies. This created a threat to AT&T that led to its filing for bankruptcy protection. Its assets and brand name were bought out by Southwestern Bell, which had acquired BellSouth and the Cingular wireless business, and eventually become the dominant provider as the new AT&T.

A similar set of circumstances had earlier impacted the computer hardware industry in the 1980s when it did not recognize IBM-compatible PCs as a disruptive force. Neither the telecom industry nor the computer manufacturers handled disruption of their industry well. They equally ignored early signs of disruption and assumed that business-as-usual approach would prevail for much.

How Utilities Should Deal with Retail Disruption

We believe that the utility industry must learn from these examples of disruption and should take proactive steps to prepare themselves for coming disruption, including:

- Choose a long-term strategy of being either a customer-centric company or a wires-only company. The physics of delivering energy still requires wires, so there is a clear option for a wire-only company for many more decades to come. There are pros and cons to either choice.
- Spend more time and attention on their customers. If they decide to become customer-centric, then it is extremely important for them to develop a customer-centric strategy and focus on all aspects of what it takes to serve the customer. Right now, utilities (with some exceptions) are not known for being customer-centric and neither are they very proficient in marketing.
- Prepare the company to be ready for retail choice so it will be positioned to win the hearts and minds of their customers when the time is right.

A "do nothing" strategy is not viable unless the utility decides to become a wires-only company and allow others to take away its customer relationships. Even then, the advent of microgrids and distributed energy sources will continue to erode their regulated wire-base monopoly. The threat in delivering power to an increasingly smaller set of customers is that the cost per customer can reach a point where the business will no longer be sustainable.

The Role of Regulators in Retail Disruption

Utilities are regulated primarily because an uninterrupted flow of power to businesses and citizens is vital to the operation of the U.S. economy. While that principle must be sustained at all costs, maintaining a level playing field for all participants in the utility industry should also be a goal of regulation.

The regulated utility is currently hamstrung in its ability to spend ratepayer money on business transformation. Regulators can play a vital role in enabling industry transformation and avoiding damaging disruption by loosening restrictions and allowing regulated utilities to evolve new business models.

Product Bundling

A necessary consequence of retail choice is the entrance of players from other industries into the business of selling electricity. Players from the telecom, Internet, cable, natural gas, water, and home security industries are consolidating into a single group of companies (e.g., Comcast, Time Warner, AT&T, Verizon, Sprint) that deliver services bundled to customers. Other than not owning the electric wires, these new entrants appear to customers as legitimate sources from which to purchase power.

The number of new retail entrants in each state is a function of the level of local deregulation. The most deregulated state, Texas, has more than 150. As strong as these competitors are, we believe the most disruptive threat to incumbent utilities comes from the bundlers because of key characteristics they possess:

- They deliver a host of services to a large base of customers. Adding one more service to an existing customer account costs less than the initial setup cost for a new customer of a new retailer.
- Most offer a sophisticated set of mobile and customer-self-service capabilities that the utilities either do not have or are early in the process of developing.
- Companies already in the business of providing multiple services to the home are vigilant about responding to new competitors from other industries (e.g., Comcast providing home-security services in competition with existing home-security services).

This trend is already farther ahead in the UK, Australia, and New Zealand, where energy service providers already bundle Internet, voice, and video services with power, and natural gas, and even water. It is worth noting the Comcast and NRG, via its subsidiary EnergyPlus, are offering such a bundle in several locations in Pennsylvania, as we write this paper. It is also important to note that product bundling is alive and well with many municipalty-own utilities and rural co-ops across the US.

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How Utilities Should Deal with Bundling Disruption

Utilities must proactively address competitive threats from bundlers by first defining their long-term strategy – wires-only, or both wires and customers – and taking appropriate steps based on that strategy. A utility opting to focus on the customer services business needs to:

- Take a broad look at its customer-service strategy and identify the first new services it will offer to its existing customers.
- Assess what their brand represents – in terms of reliability, quality of service and so on – and develop marketing mechanisms to leverage their brand early on to stay front-and-center in the mindsets of their existing customers. This is important because when they approach customers with new services, customers who feel well served by the brand will be more likely to say yes.
- Perform a Scenario Plan and SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats) vis-à-vis competitors and develop a market-facing strategy.

A do-nothing strategy will ensure a steady loss of market share to competitors who provide better customer service. It will also increase costs and create competition for the vertically integrated utility with a monopoly. Competition could take the form of new energy service providers that offer energy efficiency and distributed generation solutions on the customer side of the meter.

Municipalization

Many municipalities are considering the set of steps needed to "secede" from the incumbent utility and become their own utility, owning distribution assets and purchasing transmission, energy, and other ancillary services from the wholesale market. This is not a new phenomenon in the U.S. In fact, utilities such as PG&E routinely face this threat from municipalities in their service territory once every few years or so. The secession of the City of Boulder from Xcel Energy was one of the more recent events that brought municipalization to the forefront of public and industry awareness.

The threat to the entrenched utility is the potential loss of a large group of customers who exit the utility and decrease its rate base. The threat is not significant right now because the municipality must make large investments to purchase the utility's assets and create a utility-trained workforce needed to operate the smaller grid, hence it can be more expensive for the municipality to deliver the same quality of service at a lesser cost. However, a perfect storm is brewing with the simultaneous advent of distributed renewables, microgrids, retail choice, and energy storage, together with the development of newer and more sophisticated technologies to automate, manage, and control them. Eventually, smaller groups of customers will be able to declare secession from the entrenched utility and form their own by purchasing services from other companies including traditional generation and transmission providers. Technically, any microgrid or any sub-development will be able to form their own utility (i.e. Power Municipal Utility District or Power MUD as we like to call them) and create a problem for the entrenched utility.

Because the decision to secede is most often driven by a high degree of dissatisfaction with the entrenched utility by a cohesive group of customers, the utility must become more customer-centric with a strong focus on new services and pricing options. Happy customers will not leave.

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Nationwide Wholesale Markets

The need for an advanced and truly integrated nationwide wholesale energy market increases over time. The courts recently ruled that states could build whatever generation capability they want, but FERC (the Federal Energy Regulatory Commission) has exclusive jurisdiction over wholesale markets in interstate commerce and how power plants participate in the wholesale markets.

Since many of the issues that FERC is responsible for (e.g., building out central generation capacity and natural gas/electric power coordination) require federal and state collaboration, both sides will have to continue to work together like never before to create a nationwide wholesale market, including the need for new Integrated Resource Planning (IRP) efforts, integrated renewable portfolio standard (RPS) goals, and integrated retail markets with demand response, energy storage, and distributed generation.

The old regulation system construct historically led to capacity overbuilds over the years, because the main way utilities grew their profits was by building infrastructure. We currently have a kilowatt-hour volumetric market system that does not compensate for energy efficiency, demand response, end-to-end smart grid controls, and negawatts as capacity.

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Furthermore, we now have abundant and cheap natural gas, stronger environmental rules, and advanced aging of a significant number of central generation plants that are forcing reserve margins to historically thinner levels and the markets at a time when entry of new generation resources is required.

To make matters more interesting, FERC has already added requirements to provide for new approaches and new technologies such as demand response, renewables, and energy storage because they are here and will keep growing at an accelerated pace.

Many crucial questions face the commission and market participants, including this particularly challenging one: How can new central generation resources be compensated fairly when demand response and distributed generation systems make up a significant market share?

The answer is not simple. We must use the market to ensure that central generators are being appropriately valued so resource adequacy is maintained over the long term. We are heading toward the reality that the capacity markets, the energy markets, and ancillary services need to merge into one dynamic market nationwide that expands into real-time control for retail markets and includes negawatts as capacity along with distributed generation as part of the total generation mix.

New Business Models

All these increasingly disruptive forces compel electric utilities to consider modifying how they operate as a business to maintain and grow revenue. In an industry noted for over a century of stability, the drivers of change include:

- Technical advances in the efficiency of renewables and storage.
- Environmental rules forcing closure of coal-fired plants.
- Governmental mandates for the use of renewables.
- Emergence of the smart grid and microgrids.

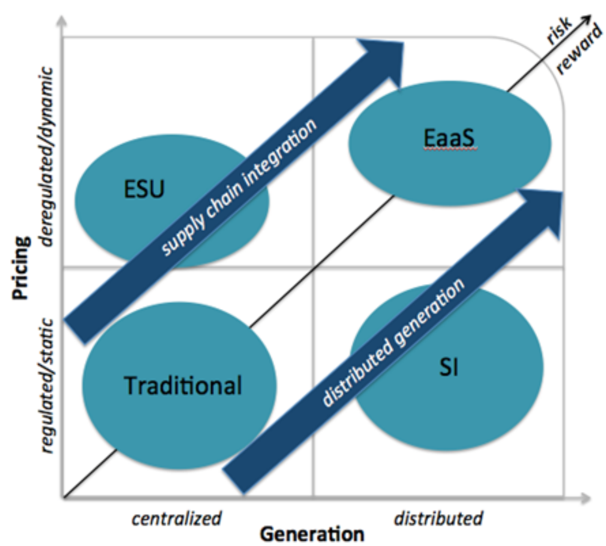
Replacement of an aging distribution system with smart grid technology could cost upward of 600 billion dollars. The move to smart grids requires creation of bi-directional distribution power grids with storage, while overall utility revenue has flattened and threatens to decrease, thus removing the capital required for change. Combined with expanding deregulation that threatens their competitive position, utilities are challenged to succeed financially while continuing to fulfill existing regulatory mandates.

The EaaS model lowers the cost of entry for a customer to become an energy exchange node (i.e., both a consumer and a producer) while growing an annuitized and more predicable revenue stream from customers that preserves the profitability of the entire bidirectional system.

In considering modified business models, the Brattle Group[1] has suggested two rational alternatives: the "Smart Integrator" (SI) and the "Energy Services Utility" (ESU). CMG proposes a third alternative: "Energy as a Service" (EaaS).

The EaaS model is patterned after the SaaS (Software as a Service) model that evolved over the past decade. It lowers the cost of entry for a customer to become an energy exchange node (i.e., both a consumer and a producer) while growing an annuitized and more predicable revenue stream from customers that preserves the profitability of the entire bi-directional system. While it involves significant upfront investment, the resulting system features the ability to become more flexible and responsive to future changes, and significantly, it enables the utility to create a closer bond with users.

Offering migration advisory services to customers is a key component of EaaS. By enabling users to introduce innovative elements smoothly into their evolving energy strategy, the utility grows their value to customers, preserving and increasing per-customer revenue while deepening their relationship with their customers.



The diagram depicts current movement in the utility industry. The high levels of risk and reward associated with these moves slows their adoption by all the industry players, both regulators and regulated alike; nonetheless, the risk associated with not responding to increasingly strong market forces combined with the potential rewards available to those

[1] "The Future of Utilities: Business Models and Strategy," Peter Fox-Penner, The Brattle Group, 2012.

utilities who lead the charge are strong motivators for change.

Any movement to a new business model incurs some level of risk. Both the ESU and EaaS alternatives rely on integrating different elements of the supply chain, e.g., upstream supply, local supply and storage, and the smart grid. The SI model and the EaaS model rely as well upon bringing distributed generation into the mix. The rewards to be gained from making prudent moves in DG and supply chain integration outweigh the risk of doing nothing, and they put the business on the "Smarter Utility" path.

The Smarter Utility comprises a re-design of the business models, business processes, technologies, organizational structures, and applied human capital to seamlessly blend existing and new stand-alone silo trends into a more profitable, faster growing, and customer driven utility reality. Becoming a successful Smarter Utility requires committing to pervasive performance management to help streamline management processes that create a smart, agile, and aligned utility.

Choosing the right business model is the first step toward becoming a Smarter Utility, and the answer depends upon the current structure of the particular utility, including the level of regulation under which it operates and its management's appetite for change and risk. A Smarter Utility requires insight into divestments and investments, and often requires external help to flesh out alternative strategies and manage innovation as a competitive advantage.

One possible new business model to be considered by regulators is the auction of the retail business rights to six to ten retail energy providers by service territory by vertically integrated investor-owned utilities (IOUs), municipality-owned utilities (MOUs) and rural co-ops (Co-Ops) across the nation, making them exclusive wires companies and bringing retail competition to their services territories. The interesting angle of this model is that the auction winners would be financing the investment needed by the sellers to build 100% their two-way power flow and bi-directional data smart grids that the market needs to encourage and optimize the pervasive use of dynamic demand response, electric vehicles, distributed generation, and energy storage nationwide.

A Roadmap to Utility 2.0

Utilities need to evolve with a process and methodology that differs substantially from what they've done in the past. The disruptions that we have outlined are too many and too critical to ignore. Utilities must work with knowledgeable strategic entities with deep domain knowledge and experience to help craft their Strategic Plan and Roadmap. It is clear that each utility will start from a different point, follow a different trajectory to transformation, and reach a different end state. Initiating change begins with a consideration of several important factors:

- A clear definition and understanding of the starting point in terms of current capabilities, financial situation, strengths, and weaknesses, such as, the utility's:
  - Current system reliability
  - Legacy systems
  - Geographic and territorial parameters
  - Types of products offered (e.g. gas, electric, both, or others)
  - Extent of vertical integration throughout the supply chain
  - Regional differences in load profiles and pricing.
- The regulatory climate and regulators' ability to change.
- The nature of the relationships with the state regulatory commissions and the incentives that are in place.
- Timing and scale (price for performance) development of specific technological changes.
- The timing and potential for policy changes either at the state or federal level.
- Understanding and scenario planning of the competitive landscape, both from outside competitors and potential new entrants.

Choosing a path to a successful utility transformation demands extensive scenario planning, and a roadmap created with milestones for the options and recommendations from this white paper. The roadmap should include the current scenario-based findings with analyzed alternate endings, depending upon the timing and scale of each change in the context of each utility.

Once a well-crafted strategic plan has been selected and key performance indicators have been chosen to measure that the desired results are achieved, an updated technology governance program must be implemented to deal with the difficult task of overseeing the process, people and technology design, architecture, purchasing, and deployment needs required in the plan.

In our experience and opinion, it is the delicate balance of process, people and technology transformation empowered by sound technology governance that determines the success or failure of any desired transformation. There is very little time to waste for utilities, as the disruptive trends are growing in popularity and the disruptors are turning crises for utilities into opportunities for themselves.

Conclusions and Next Steps

The "death spiral" for utilities represents one potential scenario, but it is not as inevitable as some would like us to believe. That said, the threats are real, and the utility industry must act now because:

- Utilities are historically conservative and risk-averse. They need to learn to accept more business risks, leverage new technologies earlier and take aggressive steps to alter their business model and improve their customer relationships.
- Utilities are at risk, yet if they adapt intelligently, they can become more viable than ever before with the right strategic plan, roadmap, and technology investments. For example:
  - Rather than dealing with demand response as something that is forced upon them, utilities should lead the way to virtual power plants as part of their portfolio, where and when appropriate.
  - Rather than resist the move to distributed resources, utilities need to incorporate all forms of DER into a new portfolio-based business model, one in which the customer (or prosumer) is treated as an ally rather than as a competitor.

Regulators also must get on board to change the regulatory paradigm that today rewards "only iron in the ground" with the ability to get compensated for some R&D, energy efficiency, and increased use of distributed energy resources. For example:

  - Regulators should explore retail choice for their state, if they don't already have it, and should allow other players deliver services to the customers.
  - Regulators should also figure out how to incorporate DER into their incumbent utility systems and identify mechanisms with which all can be compensated fairly and equitably.

The advent of new technology requires new thinking as an electric utility considers its future. Developments in communication technologies, monitoring and sensing equipment, distributed generation, energy storage, and dynamic customer engagement programs require utilities to reconsider the nature of grid operations and resource planning.

We believe that the right course of action for a utility is to embark on a **Strategic Business Plan and Technology Roadmap development program** via **Scenario Planning** which looks at all threats, technical and business, and to develop a viable plan which takes the inputs from various stakeholders, including those from potential competitors, customers, and regulators.

Scenario Planning is a powerful tool for utilities to learn to use. They are particularly useful in developing strategies to navigate the kinds of extreme events we have recently seen in the world economy. Scenario Planning enables the utility strategists to steer a course between the false comfort of a typical business planning forecast and the confused paralysis that often ensues in challenging times when many external markets start shifting at once. When well executed, scenarios boast a range of advantages—but if not developed and used correctly, they can also be traps for the unwary.

Given the rapid changes taking place in the energy industry today, a utility without a vision, a sound strategic plan, and a technology roadmap for transformation as to what possible alternative futures it might face is at a competitive disadvantage, even if vertically integrated and/or fully regulated.

CMG is uniquely qualified to be the best partner to achieve the optimal Utility 2.0 plan and roadmap.

For more information on our smart solutions to the challenges outlined in these pages or to ask any questions to our experts, please contact us via the following:

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