Rewiring Utilities for the Power Market of the Future
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Rewiring Utilities for the Power Market of the Future

Thomas Baker, David Gee, Christopher Millican, and Lee Pearson

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Utilities face unprecedented challenges from rapidly changing market demands. They must adapt to technological advances such as rooftop solar, behind-the-meter storage, and other distributed resources, as well as rising customer expectations. This new market is unpredictable, and embracing it requires an overhaul of utilities’ operating and business models.

A Roadmap for a Changing Market
BCG has helped guide several utilities through the beginning of their transformations and has identified the key pillars of change, from modernizing the grid to becoming more consumer-centric.

Stepping into the Future
Deciding what the company will look like in the future is only the first step. Implementing the changes and transforming the company are far more difficult. While much has been written about the utility of the future, change comes only from putting that knowledge into action.
Utilities are under intense disruptive pressure. In the 20th century, successful utilities typically operated as integrated, centralized monoliths catering to a captive customer base that had few alternatives for power. They enjoyed high demand growth and focused on long-term capital investments to expand their networks. But in the past few years, sweeping market changes have upended this traditional model. In the future, utilities will have to contend with a portfolio of decentralized and intermittent energy sources, as well as with stagnant demand, a slew of new technologies, and consumers whose interactions with other industries have accustomed them to a higher level of service and responsiveness. This dizzying array of changes is the result of at least six distinct factors:

- **Growth of Intermittent Renewables.** Renewables account for most of the newly installed generating capacity in the US, thanks to rapid technological improvements, decreasing costs stemming from scale, and favorable government policies. (See Exhibit 1.)

![Exhibit 1 | Renewables Play a Growing Role in US Generating Capacity](image-url)
• **Challenging Economics of Traditional Generation.** Utilities are trapped by the high cost of aging generation assets, which still account for more than half of their capacity. Most coal-fired power plants, for example, are more than 30 years old. Utilities are struggling to cover the costs of these plants amid depressed wholesale power prices and the rising competitive threat from renewables, which have no marginal generation costs. In addition, overall electricity consumption in many countries has fallen because of lower GDP growth and efforts to improve energy efficiency.

• **Integration of Distributed Energy Resources (DER).** The cost of onsite, small-scale power generation has declined dramatically, resulting in significant gains in market share. For example, rooftop residential photovoltaic (PV) solar installations in the US increased from 0.6 gigawatts (GW) in 2013 to 1.8 GW in 2015 and are expected to reach 5.7 GW in 2020. DER presents many challenges for utilities, including the need for tariff reform and the technical demands of integration.

• **Customer Expectations.** Utilities have struggled with customer satisfaction. Customers used to new applications and offerings in everything from banking to ride services now expect similar innovation from electricity providers. In addition, new entrants such as solar installers and providers of smart home services are further raising customer expectations within the power market.

• **Big Data and Analytics.** Big data is poised to transform utilities able to collect, analyze, and interpret the flood of information churned out by devices such as smart meters and other sensors around the grid. By tapping into this abundance of real-time data, utilities can use predictive modeling and insight generation to reduce costs, increase revenues from existing operations, and generate new revenues from innovative services.

• **Regulatory Change.** Regulators are creating, or at least supporting, disruption in the electricity market through the expansion of DER and other new technologies. In some cases, they are radically changing the entire market and oversight structure, as evidenced by such initiatives as New York’s Reforming the Energy Vision program, Hawaii’s 100% renewable portfolio standard target, and a variety of programs from the Grid Modernization Working Group in Massachusetts.

**Preparing for Transformation**

These changes require an overhaul of utilities’ operating and business models even more extensive than the one that came with the deregulation and generation divestitures of the 1990s.

Too many utilities, however, either deny that the threats of a changing market are imminent or address those threats only incrementally. BCG has found that defensive transformations focusing on short-term victories, rather than on the capabilities required for long-term success, destroy the value of the business. Successful companies start their transformations before a significant downturn in performance has occurred. In fact, such proactive transformations generate seven times
the value of defensive transformations. (See Transformation: The Imperative to Change, BCG report, November 2014.) A proactive transformation will take advantage of a utility’s unique assets, exploiting trends rather than merely mitigating their impact on yesterday’s business model.

Before beginning the transformation process, utilities must define their goals and select a business model. Top executives must clearly articulate their vision so that the entire management team understands and agrees with the goals, commits to making the necessary changes, and can plan to engage employees throughout the organization. The business model must articulate customers’ needs and provide a clear revenue model based on the products and services that will meet those needs. Whether the utility chooses to become a grid services provider or to adopt a more conservative, asset-based model in support of future infrastructure needs will help determine the nature of the transformation.

The Five Pillars of Transformation

The transformation that utilities must undertake requires significant effort, planning, and commitment, and utilities need a strategy that flips the odds of success in their favor. While most observers focus on the inherent weaknesses of incumbents, utilities in fact have unique strengths to leverage in the new environment. BCG has helped several utilities around the world develop an approach to embracing and thriving in this rapidly changing marketplace. Regardless of the business model they select, utilities can succeed by developing a strategy based on five pillars. (See Exhibit 2.)

**Exhibit 2 | Building a Utility for the Future**

<table>
<thead>
<tr>
<th>TRANSFORMATION FRAMEWORK</th>
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<tr>
<td>MACRO BUSINESS MODEL/STRATEGY SELECTION</td>
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<td>Grid modernization</td>
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<td>Adaptation to DER</td>
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<td>Flexible generation</td>
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<td>Adjusting market &amp; regulatory models</td>
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Stakeholder engagement

Enablers: processes, capabilities, and organization

Source: BCG analysis.

Note: DER = distributed energy resources.
1. Grid Modernization
Utilities’ aging transmission and distribution infrastructure will require an $880 billion investment over the next two decades, according to the Edison Foundation. To provide the superior service and consistent electricity supply that customers expect, grids must be upgraded to handle new technical capabilities, and utilities must invest in resiliency enhancements in the face of increasing threats to cybersecurity and to physical assets—whether from terrorist attacks or natural disasters.

As DER proliferates, operators must adapt grids to bidirectional power flows. The growing use of behind-the-meter generation, such as rooftop solar, has caused overvoltage and other problems on primary and secondary circuits. Addressing these issues will require investments in a wide variety of technologies, including advanced inverters, grid management and dispatch, and distribution-level energy storage.

Demand response can reduce the stress on generation assets and the need for grid investment by enabling customers to control their power consumption. With smart meters and hourly pricing, utilities can price appropriately during periods of peak demand and improve network operations. This will require investments in advanced metering infrastructure and grid management. Utilities can also use the real-time data collected to improve their reliability and customer service, or they can capitalize on their access to the customer data needed by nonutilities, such as solar installers and developers of smart-home software, to target their own product offerings.

In geographically isolated areas or in areas where most of the generation comes from distributed energy, utilities should consider integrating microgrid technology to avoid stranding existing grid assets. Deploying innovations such as net metering can also help lower utilities’ investment costs in the grid, which is vital to maintaining competitive rates and avoiding a rate return squeeze.

2. Adaptation to DER
DER systems pose significant challenges to utilities’ business models and grid functions, but their growth is undeniable. Costs for rooftop solar have fallen by more than 70% since 2005, and these installations are expected to grow at an annual rate of 25% through 2020 in the US. During the same period, DER will expand to include technologies such as distributed storage, whose cost is expected to decrease by 40% to 50%.

Integrating DER into the grid is inherently difficult because it involves multiple stakeholders and cuts across many generation and distribution functions. Utilities must balance customers’ demand for interconnection options such as battery storage and rooftop solar installations with the economic impact on non-DER customers. They must ensure grid safety and reliability and an equitable tariff policy for all customers, while also addressing the implications of DER for technical integration and the design of grid processes and business models.

Tariff Design. As the use of DER grows, customers will want to participate actively in the grid. This will require tariff structures for DER (such as PV and storage) that reflect the value of the electricity that customers both receive from and provide to the grid. Existing regulatory proceedings address this topic, especially with respect
The technical issues involved in load balancing to match intermittent generation are complex. As renewable energy comes to exceed 30% of total generation, capital needs will increase dramatically so that peaking generation and demand response match the load profile throughout the day.

DER creates unique challenges for utilities when a large number of solar installations or other distributed resources are connected to a specific circuit or feeder. In these situations, investment may be needed to increase feeder capacity, and other measures may be necessary to ensure that the voltage and frequency are kept within acceptable ranges.

Process and Organization Changes. Utilities must address a variety of organizational and procedural issues. For example, in some areas with high concentrations of rooftop PV, there has been an influx of customers applying to manage their usage, such as through demand response or selling power back to the grid, which many utilities have dealt with inconsistently. Standardized procedures are needed to create a clear and fast process for customers.

DER affects executives in diverse functions, from grid operations to customer service. Given the compartmentalized structure of the typical utility, this can inhibit decision making and efforts to integrate DER. Utilities should therefore develop cross-functional teams or even revamp their traditional organizational structure.

3. Customer-Centric Evolution
Utilities of the future will have to develop a greater focus on their customers, products, and services. Those that cling to the status quo face a growing threat to the value of their business. Utilities must move from serving rate payers to delighting customers, reflecting three trends in the marketplace:

- Changing Customer Preferences. In the past, electricity customers were mostly passive, with limited involvement in the energy market and little interest in controlling their energy use. In the future, customers will become much more tech savvy, interacting with the grid through DER and expecting more offerings tailored to their specific needs.

- New Technologies. Technologies such as advanced controls, web-enabled devices, and smart analytics are creating new applications and opportunities to capture value.
• **New Energy Service Providers.** With the growth of DER and other technologies, new entrants have joined the traditional US utility market—SolarCity, Nest, and EnerNOC, among others—offering a variety of innovative tools and services.

A customer-centric utility will look significantly different from the “customer conscious” utility of today. Customers will become clients rather than simply service takers, and utilities will have to position their brands in the marketplace so that they provide the functional and technical benefits demanded by customers. To do that, they must improve customer insight. A better understanding of customers’ needs and preferred channels (including digital) will help utilities refine their value proposition and deliver products and services tailored for each customer.

We have seen utilities experiment with a variety of options for new products and services. For example, many are targeting community solar farms, with a developer or utility building a larger-scale facility and either selling electricity from the solar farm at a differentiated rate or selling ownership interests in the solar farm itself—a kind of “solar condo.” In other cases, utilities are offering rate-based distributed-generation assets, or leases and financing for distributed-generation equipment through bill payments. Utilities might also invest in distributed-storage installations, which will improve power quality and reliability for commercial and industrial customers, and in virtual storage as a service for distributed-generation customers.

Other opportunities exist in energy efficiency and demand management services. In addition to services offered directly to residential and business customers, utilities can use data collected from the grid to offer new value-added services, including the tracking of PV production, to distributed-energy companies.

Our research shows that customers see utilities as the natural provider for services such as community solar, energy use information, electric-vehicle charging stations, and even rooftop solar. To develop an effective customer-centric model, utilities must build the right organization and culture. They must simplify common processes, shift to digital or automated customer service interactions, and expand value-added services to win and retain customers.

4. **Flexible Generation**

Electricity demand is inherently variable and uncertain, and utilities must deliver a load that fluctuates throughout the year and throughout each day. These seasonal and daily variations are largely predictable, and traditional generation assets can be dispatched according to their short-run marginal costs. However, renewables like wind and solar are highly intermittent generation sources, complicating the supply mix.

As renewables come to account for a larger portion of the energy portfolio, vertically integrated utilities need flexible generation with both a faster ramp rate (to ratchet up or down depending on demand) and lower turn-down, or minimum-generation, levels (for times when renewable generation is running at full tilt). Conventional base-load generation sources, such as nuclear and coal, have slow ramp rates and long cycle times, which erode their operational and maintenance efficiency over time. As variable generation from renewables increases, utilities will need to
replace these conventional sources with flexible generation, such as combined-cycle natural gas plants and storage, which will require new types of contracts with independent power producers.

Planning for this transition will be difficult, especially for vertically integrated utilities. In areas where renewable use is expected to be high, utilities should begin early to set a target for generation assets. Then they can calculate the required investment and infrastructure for optimizing the supply side of the network. Hawaiian Electric, for example, took a blank-sheet approach to determine how to reach its target of a 100% renewable portfolio standard. (See the sidebar, “Delivering a More Affordable Clean Energy Future for Hawaii.”) Given the technology's rapid evolution, utilities can no longer plan for a 40-year time frame, and they will have to adopt technology such as battery storage to help compensate for the intermittent nature of renewables.

5. Adjusting Market and Regulatory Models
To make the transformation of utilities commercially viable, not just infrastructure but also regulatory and market models must change. Financial measures such as simple rate-of-return on capital expenditures may not recognize the value created when a utility is offering a variety of new products and services as part of a customer-centric approach.

In many cases, regulators are leading the charge. In New York, for example, the Reforming the Energy Vision program will overhaul the entire electricity system and turn the distribution company into a “common carrier.” Anyone will be able to connect new generation and other kits to the grid, and the distribution company will be responsible for “activating” the market. The distribution company will move away from the traditional cost-of-service model to a performance-based plan, similar to the emerging RIIO system (revenue=incentives+innovation+outputs) in the UK. Many states in the US are pursuing more incremental regulatory reform.

Stakeholder Engagement
Utilities are more integrated into the social fabric of their communities than many other industries, and social and government policy changes bring a greater risk of disruption beyond the industry itself. As they position themselves for the future, utilities must engage a wide variety of stakeholders and invite them to participate in the process. The first step is to develop a comprehensive list of stakeholders for each jurisdiction in which the utility operates. The list should include elected officials such as the governor, as well as state regulators, municipal authorities, and independent power producers. Utilities should also consider new stakeholders, such as solar installers and battery manufacturers. After identifying the most important issues and concerns for each, the utility can develop a heat map to set engagement priorities for each jurisdiction.

Creating Change in the Organization
Successful transformations in any industry require significant changes to business and operating models, as well as new ways of thinking and working. As they rewire
Hawaiian Electric Industries, which provides electricity to 95% of Hawaii’s 1.4 million residents, faced growing disruptive threats in the first decade of this century. Costly, oil-based generation accounted for about 70% of the total generating capacity, contributing to electricity rates that were three times the US mainland average. This and other factors, including generous state and federal tax credits and support for net energy metering, led to the aggressive marketing and rapid adoption of rooftop solar.

With distributed generation at 20 times the national average, Hawaiian Electric, with its small, independent island grids, had to contend with potential grid reliability issues, slow customer interconnections, and increasing concerns about inequality from net metering (as nonsolar customers came to bear a larger share of grid costs). Moreover, Hawaii’s diverse energy stakeholders had differing views on distributed generation and other clean-energy programs and policies. Recognizing these challenges, the Hawaii Public Utilities Commission ordered Hawaiian Electric to reevaluate its strategy and transform its business.

**Crafting the Strategy.** Hawaiian Electric started by articulating a vision to “empower customers and communities with affordable, reliable, clean energy” and “provide innovative energy leadership for Hawaii.” This helped in setting specific goals for achieving Hawaii’s 100% renewable portfolio standard by 2045, tripling distributed solar by 2030, and reducing customer bills while providing more products and services. To deliver on these commitments, senior company officials, starting with chief executive Alan Oshima, supported a company-wide transformation based on the five pillars of change:

- **Grid Modernization.** Hawaiian Electric assessed the implications for transmission and distribution of the proposed generation mix and the expected increase in DER. The company developed a plan for modernizing the grid and is now upgrading its physical infrastructure and pursuing technology that will improve grid functionality—including the use of energy storage, advanced demand response, advanced metering infrastructure, and other smart-grid technologies. The utility’s recent smart-grid application to the Public Utilities Commission reflects the benefits of leveraging advanced metering and other technologies.

- **Adaptation to DER.** Hawaiian Electric created multiple distributed-generation programs that are fair and sustainable for all customers while preserving system reliability. With input from Hawaiian Electric, the Public Utilities Commission developed two new tariffs for DER customers: grid supply and self supply. The utility also accelerated approval of customer applications by streamlining processes and clearing a sizable backlog. It also conducted technical studies, such as inverter testing with the National Renewable Energy Laboratory.
Energy Laboratory, to better understand the local circuit-level and the broader system-level impact of DER penetration. On the basis of these studies, the company has been better able to integrate new distributed-generation systems. Benchmarked and evaluated models to develop the one best suited for Hawaii’s unique characteristics. It focused on shifting from selling kilowatt-hours to becoming an innovator in value-added services.

- **Customer-Centric Evolution.** Hawaiian Electric continues to expand its use of customer research, including community-based renewable energy and initiatives associated with electric vehicles, to gain input on innovative products and services. It is also collaborating with some of its largest customers to deliver customized solutions that create the most value. With decreasing load, retaining the largest customers on the grid is crucial to keeping rates down for all customers and achieving Hawaii’s 100% renewable portfolio standard.

- **Flexible Generation.** Hawaiian Electric designed a generation portfolio through 2045 for each island and built a model that tracks electricity production and demand on an hourly basis, optimizing the resource mix for cost, renewables, and distributed generation while ensuring grid reliability and stability. The plan targeted a generation mix that increased renewables’ share from 18% in 2013 to an unprecedented 100% by 2045 while stabilizing customer bills.

- **Stakeholder Engagement.** Company officials continue to meet with stakeholders on key issues to seek input and understanding for the proposed plans. The utility created a stakeholder map early in the transformation to maintain contact and collect feedback from all parties. Hawaiian Electric worked to be as inclusive as possible during the process, even inviting key stakeholders to internal meetings to develop the results.

- **People and Organization.** A self-assessment of business capabilities revealed gaps that needed to be addressed in meeting future organizational requirements. Hawaiian Electric identified the need for greater customer focus and rigorous analytical skills to meet its goals. It undertook a major cultural initiative to align employees’ behavior with the utility’s vision.

Almost two years later, Hawaiian Electric has made material progress in addressing the technical and organizational challenges of a complicated transformation. Follow the journey at https://www.hawaiian-electric.com/about-us/our-vision.
themselves for the future, utilities must address changes in capabilities, culture, and organizational structure. (See Exhibit 3.)

Capabilities. Companies often underestimate the difficulty of building new capabilities and consequently underinvest in them. A transformation cannot be approached as a one-off event, with the organization returning to business as usual once the transition is complete. Utilities must assess how their current capabilities mesh with their transformation goals.

While transformation strategies vary, the need to strengthen several key capabilities is common across the board. These include an understanding of customer needs, analytical skills to address the data deluge that comes with new technology, and commercial skills to deal with an increasingly competitive market.

Culture. A company’s culture is the set of values and behaviors that collectively define how actions support strategy. To create a high-performance culture, companies must answer four questions: What culture do we need? What culture do we have and why? What aspects of the organizational context should we change to get the behaviors we seek? How do we make the change happen? (See High-Performance Culture: Getting It, Keeping It, BCG Focus, June 2013.) Utilities undergoing a transformation must change employee behavior to match the new strategy, which generally means shifting from a risk-averse, structured, command-and-control environment to one that is more dynamic, flexible, and accepting of calculated risks.

Organizational Structure. The organization’s structure must reflect the future needs of the utility. Traditionally, utilities were organized by functions that had existed for decades. As DER and other services that span these functions become more important to customers, utilities must consider structures that encourage collaboration. Speed and agility are essential if an organization is to respond to marketplace shifts, as are clear reporting lines, appropriate spans of control, and minimal organizational layers.

<table>
<thead>
<tr>
<th>EXHIBIT 3</th>
<th>How Utilities Will Adapt to the Future</th>
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<tr>
<td><strong>TRADITIONAL UTILITY</strong></td>
<td><strong>UTILITY OF THE FUTURE</strong></td>
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<tr>
<td>Infrequent large capital investments</td>
<td>Multiple small investments</td>
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<tr>
<td>Dispatchable</td>
<td>Not dispatchable</td>
</tr>
<tr>
<td>Known impacts on grid operations</td>
<td>Uncertain impact on grid operations</td>
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<tr>
<td>10- to 15-year resource plans, incremental rate of change</td>
<td>Rapid pace of change according to technology, regulations, and customer preference</td>
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<tr>
<td>Rate payers</td>
<td>“Prosumers,” heavy customer contact</td>
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<tr>
<td>Utility balance sheet</td>
<td>Third-party financing needed</td>
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<tr>
<td>100% utility led</td>
<td>Channel partners</td>
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<tr>
<td>Fewer, bundled products across all segments</td>
<td>Multiple products, services, and pricing structures targeting specific segments</td>
</tr>
<tr>
<td>Limited data</td>
<td>Large amounts of real-time data, big data capabilities</td>
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Source: BCG analysis.
The Transformation Management Office

After a utility has identified the key elements of its transformation, it must consider how it will manage the tactical aspects of the change. It must establish the infrastructure needed to execute and oversee the transformation. Even the best transformation will fail unless the right people, processes, and attitudes are in place to support the plan through the transformation and beyond.

Company leaders must be engaged and supportive, because the effort will require significant resources from all of them. To manage and support the transformation, they should create a transformation management office (TMO) to provide project management and other logistical support. The TMO, which should report to the transformation’s leader, typically comprises the following:

- A respected senior executive, who leads and administers the transformation effort
- The transformation teams, which focus on key aspects of the transformation, such as the five pillars described above
- The support teams, which provide backup for the transformation teams in areas such as stakeholder management and culture

Management should require a significant commitment of time from everyone involved, and the TMO should include people who can execute, tackle new problems, keep an open mind, and work across functions. (For more on how to structure a transformation, see A Leader’s Guide to ‘Always-On’ Transformation, BCG Focus, November 2015, and The New CEO’s Guide to Transformation: Turning Ambition into Sustainable Results, BCG Focus, May 2015.)

Utilities face unprecedented demands from customers who expect more, from technology that is increasingly complex and flexible, from big data that is enabling novel business opportunities, and from infrastructure that desperately needs updating. Much has been written about the utility of the future, but change will come only when that knowledge is put into action.

Utilities must decide on the right strategic approach to tackle this new environment. Predicting what the market of the future will look like is one thing, but today’s utilities need a roadmap for getting there. The first steps will be difficult, but the results of a successful transformation will be celebrated by employees, customers, and shareholders alike for decades to come.

NOTE
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