



2016 STRATEGIC DIRECTIONS: ELECTRIC INDUSTRY REPORT

Black & Veatch Insights Group



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A NOTE ABOUT DESIGN

The annual Strategic Directions series captures Black & Veatch's global engineering and construction thought leadership expertise across key elements of the critical human infrastructure market. Just as advising our clients requires mastery of design, strategy development and project execution, so too does selecting a report theme that reflects the dynamics of change across industries.

For 2016, we continue to explore the theme of distinct yet intersecting galaxies, drawing parallels to the ongoing evolution of utility services. These findings, and the conversations they foster among key stakeholder groups, shine light on the influences guiding the future direction of communities around the globe.

From a design perspective, we seek to inspire the exploration of known entities from a new vantage point, taking readers on an informative and engaging journey. As clarity is gained through the acquisition and sharing of knowledge, the vastness of space is a subtle reminder that there is much more to discover.



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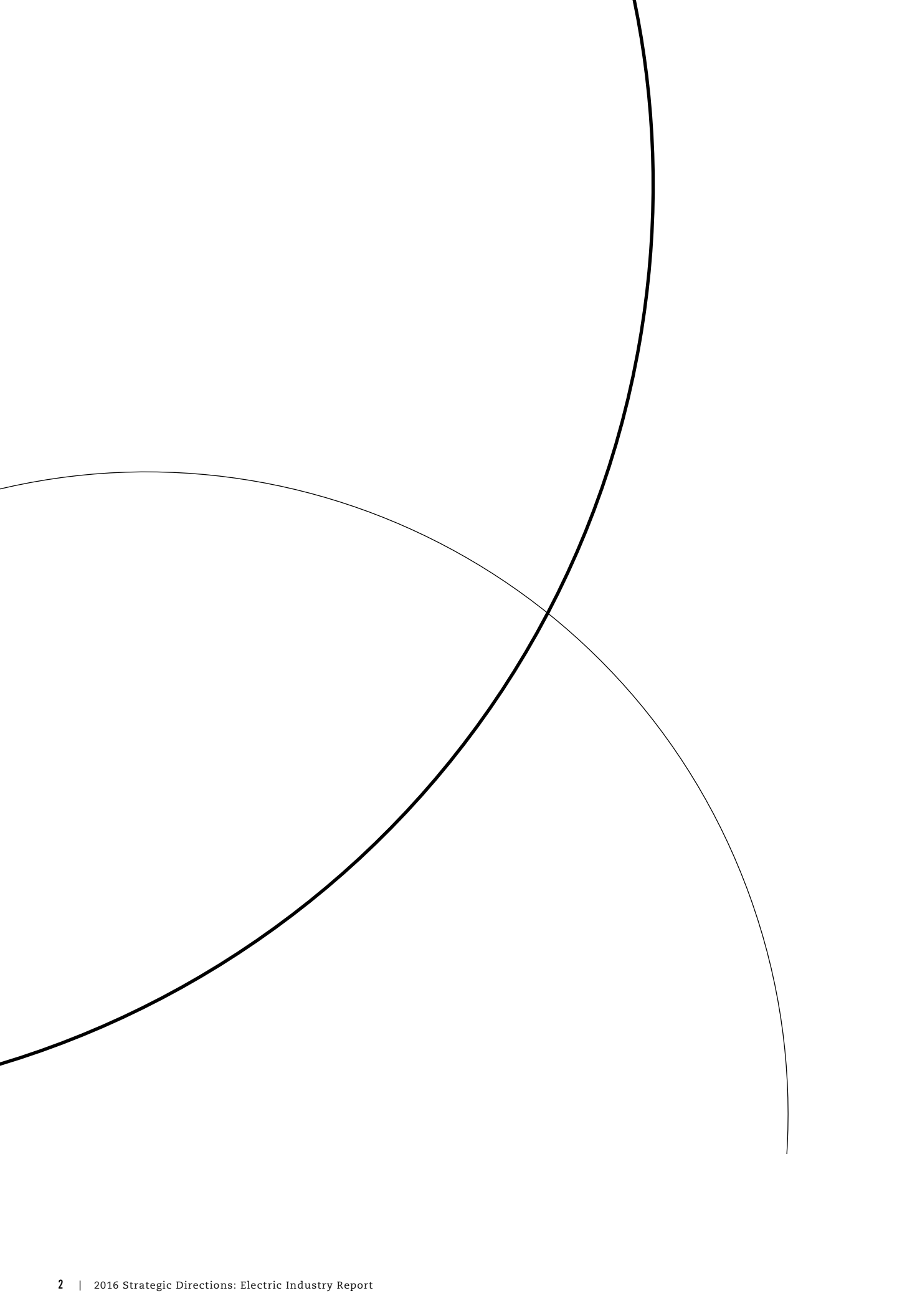
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ABOUT THIS REPORT

The annual Black & Veatch *Strategic Directions: Electric Industry* series of reports represents yearly snapshots of the state of the electric utility industry. In the decade since we first began our stakeholder conversations, we have tracked sentiment and advised the industry throughout a series of fundamental business model transformations. The pace of change has only accelerated. In the past three years alone, we have seen the industry adjust to transformative supply, regulatory, technology and market-shaping conditions. Today, the North American electric industry is boldly and optimistically looking to its origins to better understand its future as the evolution of the central generation model continues.

We are living in exciting times. More than ever before, electric utilities have the opportunity to leverage innovation; renewed interest from customers and regulators; advances in technology and an appetite for smart, connected products and services to solve their most pressing issues around reliability and resilience. At the same time, cyber and physical security challenges, low natural gas prices and aging infrastructure continue to be of concern.

The rise of smart cities and distributed generation offers a glimpse into the next decade for electric providers. No longer seen as disruptions to be overcome, electric utilities are finding new ways to meet challenges head on – and are emerging as innovators in the process. They are demonstrating that integration and creative financing – just two of several tactics being deployed – are part of a larger reliability, resilience and sustainability-focused strategy.

The *2016 Strategic Directions: Electric Industry Report* examines how electric industry services providers are applying lessons from the past to identify and manage emerging challenges and opportunities.

We welcome your questions and comments regarding this report and/or Black & Veatch services. You can reach us at MediaInfo@bv.com.

Sincerely,
ED WALSH | PRESIDENT
Black & Veatch's power business

JOHN CHEVRETTE | PRESIDENT
Black & Veatch Management Consulting

ABOUT THIS REPORT

The Black & Veatch Analysis Team

EXECUTIVE SUMMARY

Ed Walsh is President of Black & Veatch's power business and is responsible for overseeing and implementing strategies, processes and tools to further enhance the company's service offerings and continued growth. He has more than 40 years of global experience and has been with Black & Veatch since 2003. Before his role as President, Walsh was Executive Vice President and Executive Director for the company's energy services projects. Prior to joining Black & Veatch, he served in a variety of executive and senior management positions in businesses and on energy infrastructure projects, including combined cycle combustion turbine, nuclear, hydropower, waste-to-energy and transmission and distribution.

CAPITAL

Jason Abiecunas is Distributed Generation Service Area Leader in Black & Veatch's power business. He is responsible for business development, development of technical solutions/offerings and execution of distributed generation projects. Abiecunas previously served as a consultant and project manager on the development and execution of fossil fueled and renewable energy facilities. His experience includes projects located in the United States, Africa, Asia and the Middle East with technologies including coal; natural gas fueled combined cycle, solar, wind and microgrids with various technologies.

Dominic DiBari is Managing Director in Black & Veatch's power business. He is responsible for connecting capital to development opportunities and providing consulting worldwide to owner/operators, private equity, infrastructure funds, and debt investors in power generation assets. In addition, he oversees business development for engineering and EPC services in power, water, and telecommunications in the NYC metro area.

Kandi Forte is a Director in Black & Veatch Management Consulting and leads asset management, operations excellence, economic and financial analysis, risk management and market analysis studies for energy and water utilities. With more than 20 years of experience in the power and utility industry, her experience has included leading fleet-wide implementation of asset management improvement initiatives, implementation of a decentralized operations excellence organization, performance and reliability improvement initiatives, risk and economic analysis engagements, and project management for several multimillion dollar capital projects and large utility systems.

POWER

Craig Connell is a Senior Vice President at Black & Veatch and is Director for Power Generation Services projects in Asia and EMEA (Europe, Middle East, India and Africa). He has been with Black & Veatch for 37 years, spending most of his career in engineering and project management of power plants in the United States, Malaysia and the Philippines. Connell has also held a management position in the company's Chief Information Office and has served as Director of the Corporate Project Management Office.

Chris Klausner is a Managing Director in Black & Veatch Management Consulting with a power industry focus. He has more than 23 years of experience at Black & Veatch, serving in a variety of roles, including Mechanical Engineer, Consultant and Director. He has led numerous consulting engagements for Black & Veatch covering a wide range of conventional and renewable power generation technologies. Klausner has expertise in merger and acquisition technical advisory services, independent engineering, strategic planning, asset valuation and construction monitoring.

Roger P. Lenertz is an Executive Vice President and Director of Power Generation Services in Black & Veatch's power business. He has more than 34 years of experience at Black & Veatch, serving in a variety of roles, including Director of Major Projects, Project Executive and Project Manager. Lenertz has extensive experience in the power industry on domestic and international projects with various technologies. He has also led the design and implementation of the Business Excellence program in Black & Veatch's business operations.

Robert Mechler serves as Director of Transmission and Distribution Project Development for Power Delivery in Black & Veatch's power business and pursues business development in Texas and throughout the United States. He has been involved with power delivery for the electric utility industry for over 30 years. Mechler has worked for a regional electric utility as well as an independent power producer and unregulated retail provider. He specializes in the planning, engineering, construction and maintenance of power delivery systems. Most recently he has been involved with transmission regulatory policy and unregulated wholesale and retail markets.

Dan Schmidt is Senior Vice President and Director of Black & Veatch's Power Generation Services activities in the Americas. He has more than 35 years of experience at Black & Veatch serving in a variety of roles, including Project Manager and Engineering Manager of various power generation projects. Schmidt has been involved in numerous coal-fired generation projects, as well as natural gas-fired combined and simple cycle projects. He also has experience in modifying existing generating facilities.

Alap Shah is a Vice President and Director of Technologies and Services Areas in Black & Veatch's power business. He has more than 19 years of experience at Black & Veatch serving as Thermal Performance Section Leader and Turbine Technologies Manager. Shah has been working closely with major turbine original equipment manufacturers, such as GE, Siemens and MHPSA, in various turbine technologies assessments and several first-of-a-kind turbine technology launches on Black & Veatch engineering, procurement and construction and services projects. His experience includes projects located in North America, Africa, Asia and the Middle East mainly with technologies related to natural gas fueled combined cycle plants.

Allen Sneath is vice president of marketing and sales director for Black & Veatch's Power Delivery business. He is responsible for directing business development activities, ensuring client satisfaction and helping clients navigate the evolving power transmission market. Sneath has 40 years of experience working with clients across the United States to address their engineering, EPC, project management and other needs in the power and power delivery industries.

POLITICS

Andy Byers is Associate Vice President and Director of Environmental Services in Black & Veatch's power business. He currently serves as the power business Environmental Regulatory and Legislative Policy Advisor and is responsible for tracking developments and advising on risks and opportunities arising from key federal legislative, regulatory and judicial initiatives.

Daniel Chang is the Air Quality Control (AQC) Service Area Leader for Black & Veatch's Power Generation Service business. His expertise is in AQC systems that reduce the emissions of nitrogen oxide (NO_x), sulfur dioxide (SO₂), particulates, mercury and acid gases from the combustion of fossil fuels for power generation. His specialized technical knowledge also includes the regulatory environment associated with air quality compliance in both the U.S. domestic and international markets. Chang is responsible for managing business operations for the AQC service area, supporting business development activities, and monitoring and oversight of ongoing technical studies and detailed design AQC projects with technical, process and management support.

Russell Feingold is a Vice President in Black & Veatch Management Consulting, where he leads the Rate and Regulatory Services group. He has more than 39 years of experience serving electric and gas utilities on a broad range of utility ratemaking and regulatory related projects. Feingold has prepared and presented expert testimony submitted to the Federal Energy Regulatory Commission and the National Energy Board of Canada, as well as several state and provincial regulatory commissions dealing with the cost, pricing and marketing of electric and gas utility services.

Ric O'Connell is responsible for leading Black & Veatch's renewable energy growth in Southeast Asia with a focus on wind and solar energy. With renewable energy increasingly gaining traction in the region, O'Connell assists clients in the development, financing, engineering and construction of renewable energy projects. With 25 years of experience, O'Connell has worked on renewable projects in the United States, Thailand, Australia and China. He has worked on many large-scale projects, such as the 580 megawatt Solar Star project, the largest solar photovoltaic plant in the world. Since 2008, he has been working with policymakers in China to shape its renewable energy policy.

TECHNOLOGY

David Mayers is a Senior Managing Director at Black & Veatch and leads the Security, Risk & Resilience team. He has 26 years of Management Consulting experience, including 12 years in the banking industry and 14 years in the energy industry.

Tracy Monteith is a Director in Black & Veatch Management Consulting. He has spent most of his career in systems engineering, software engineering and project management for space systems and mission-critical systems. Monteith comes to Black & Veatch from the U.S. Army where he served as Commander of the Western Cyber Protection Center. He was also a Senior Space Operations Officer for the Army, where he enabled and provided protections for mission-critical space-based systems.

Donald Parr serves as Associate Vice President in Black & Veatch Management Consulting. In this role, he focuses on helping energy and water utilities manage complex system integration efforts. The majority of his 23 years of experience has been with direct involvement on the implementation of new customer information systems, enterprise asset management and enterprise resource planning solutions – from customer relationship management through billing and collections to work management, financials and human resources.

Paul Stith is a Solution Lead for Black & Veatch's Smart Integrated Infrastructure service line, specializing in sustainable transportation infrastructure, energy storage and their convergence within smart cities. He has experience working with government agencies, key stakeholders, utilities, and established and emerging technology partners. Stith works to plan and deploy grid-interactive distributed energy resources and programs that create wins for the environment and sustainable business models.

CLOSING COMMENTARY

John Chevrette is President of Black & Veatch Management Consulting and works closely with clients to address key challenges affecting today's electric, water and gas utilities. Chevrette has more than 20 years of industry consulting experience and has worked with domestic and international clients in the electric utility, energy technology, gas pipeline, telecommunications and water industries.

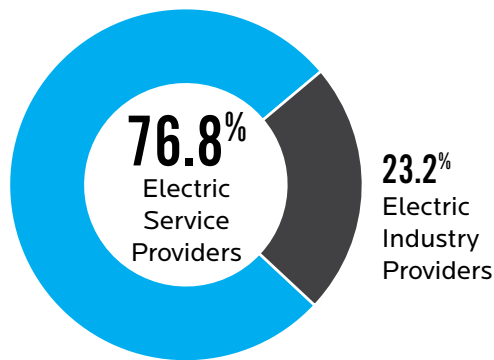
ABOUT THIS REPORT

2016 Report Background

The Black & Veatch *2016 Strategic Directions: Electric Industry Report* is a compilation of data and analysis from an industrywide survey. This year's online survey was conducted from 24 May through 9 June 2016 and reflects the input of 672 qualified utility, municipal, commercial and community stakeholders. The report also includes perspectives from leaders in key Black & Veatch markets abroad.

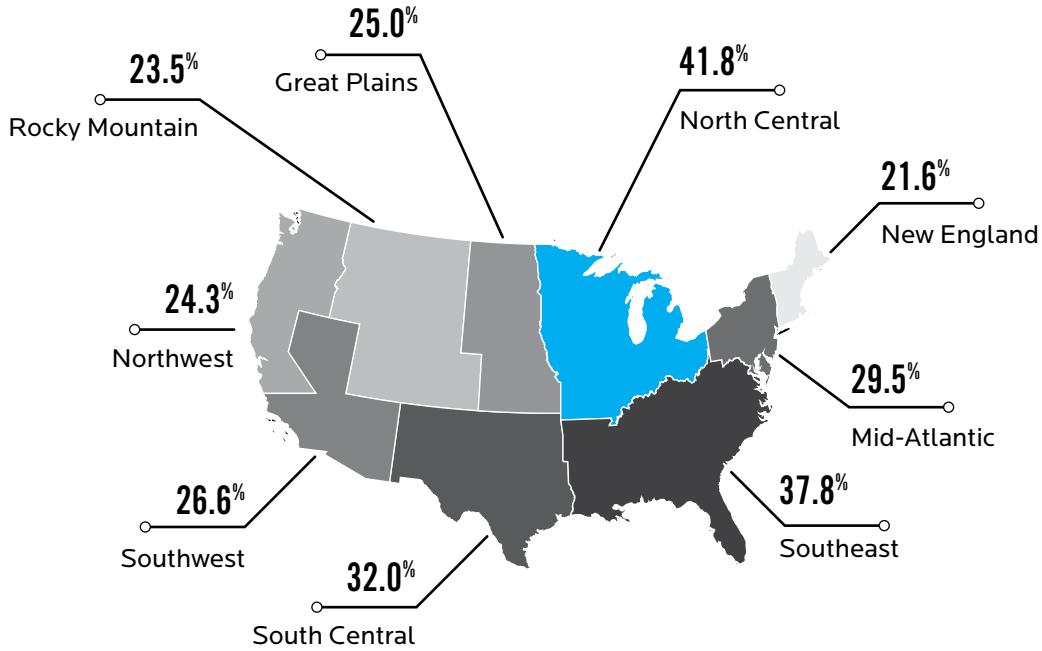
The following figures provide additional detail on the respondents in this year's online survey, which is primarily comprised of U.S. electric industry participants. The results of the 672 survey responses have a precision of at least +/- 3.8 percent at the 95 percent confidence level.

Industry Type



Source: Black & Veatch

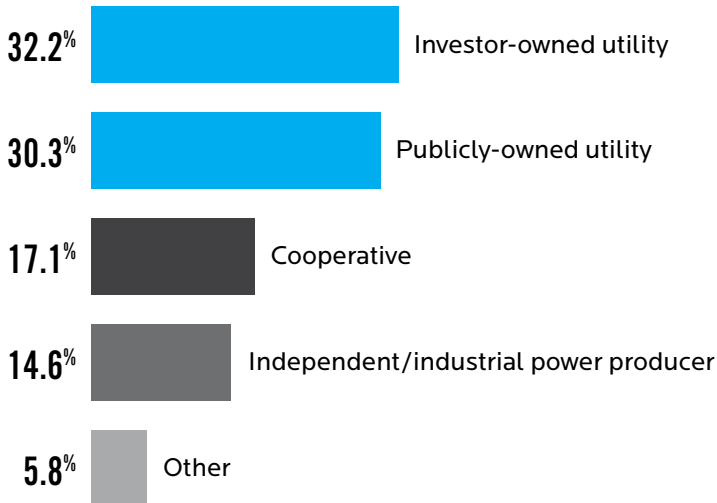
Primary Business Region



13.1% Other U.S. Locations	8.9% Mexico
19.2% Canada	11.5% Other Countries

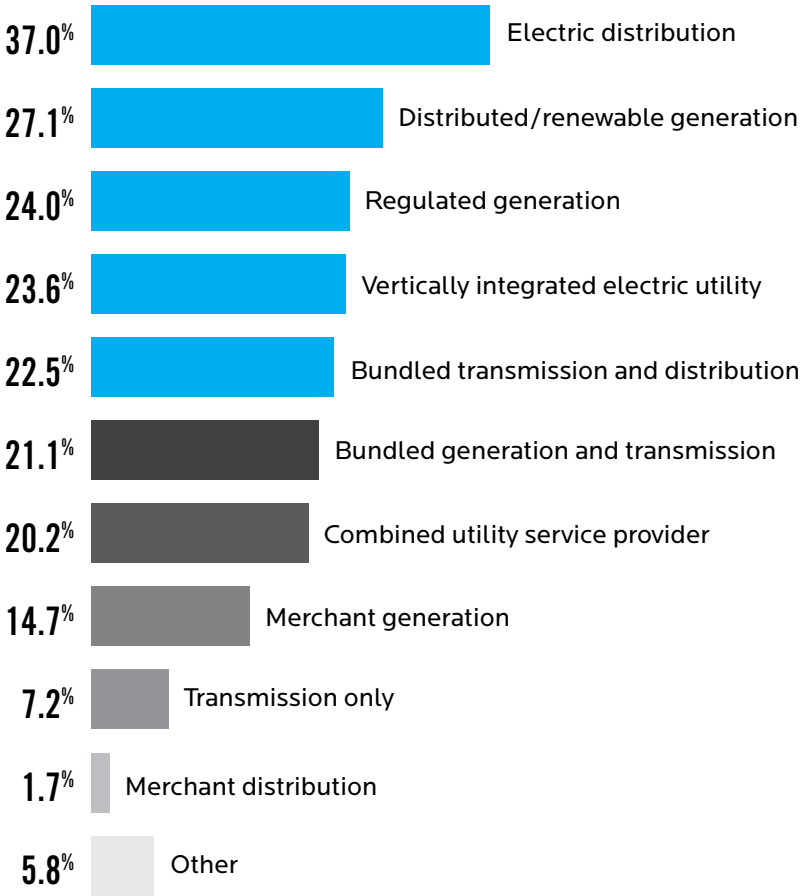
Source: Black & Veatch

Electric Services Provider Type



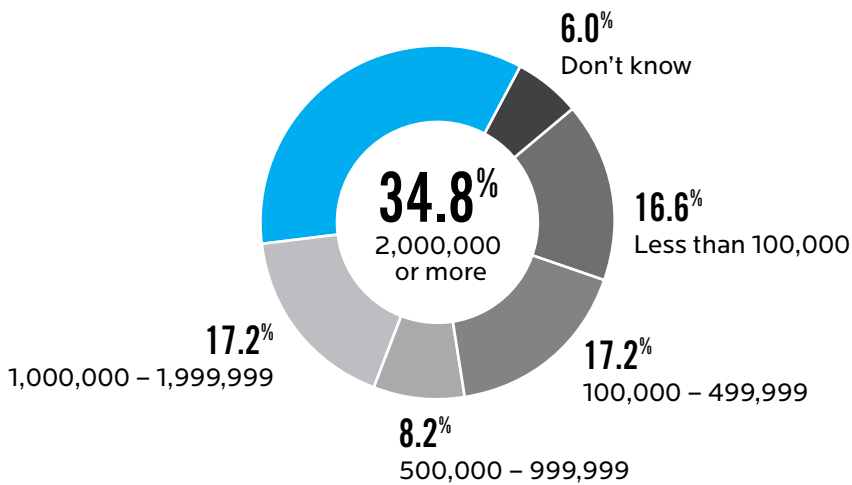
Source: Black & Veatch

Electric Services Provided

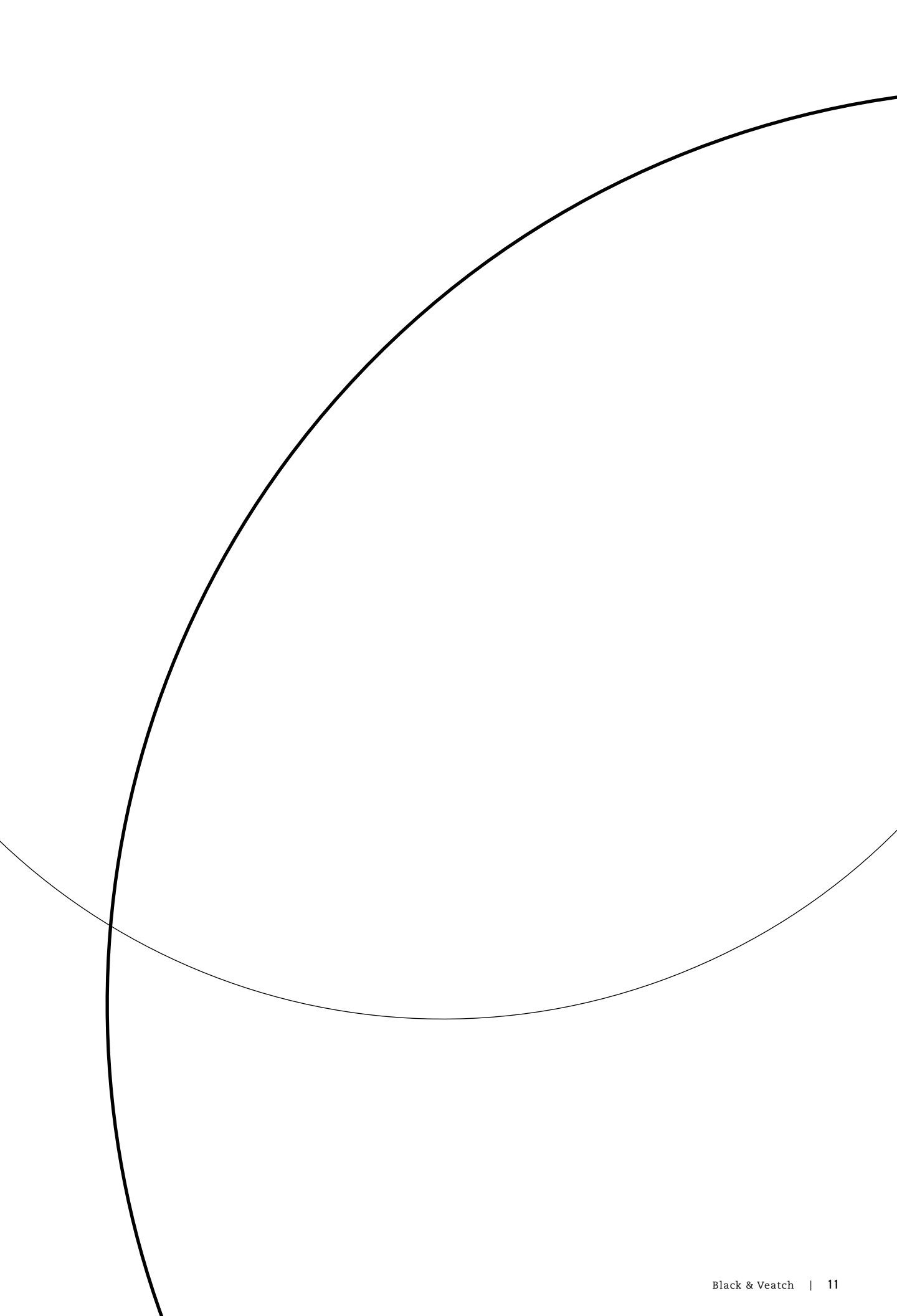


Source: Black & Veatch

Population Served



Source: Black & Veatch



EXECUTIVE SUMMARY

For Utilities, Technology Binds Risk and Reward

By Ed Walsh

We can no longer talk about renewable energy's slow march on power generation and distribution. Utility leaders across the United States and the world recognize that solar, wind, microgrids and distributed generation are prominent in the new discussion around resource efficiency, and customers are compelling their infrastructure providers toward sustainability.

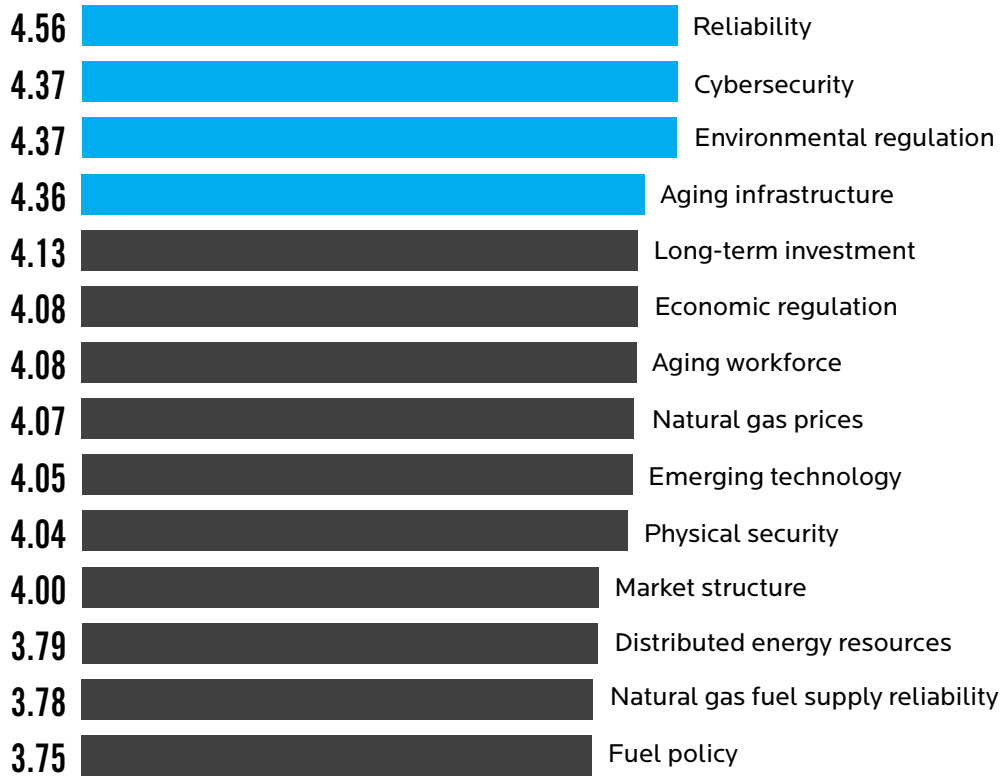
Yet a fundamental question raised by this trend – the question of reliability – persists throughout the industry and is found across the nearly 700 responses we received for the 2016 *Strategic Directions: Electric Industry Report*. Utilities conscious of the rise of new forms of energy and power generation are meeting the challenge in exciting ways, suggesting a natural evolution from legacy generation to a new era of balanced power portfolios that showcase new technology. The low price of natural gas, which has been positioned alongside renewables as a cleaner and relatively inexpensive generation source, and large, advanced technology combined cycle projects are certainly bridging these two eras and helping to assuage reliability and intermittency concerns associated with renewables.

But many providers are taking sometimes halting steps toward distributed generation, expressing uncertainty about whether these changes can meet the expectations of an always-on, always-connected society that demands 100 percent uptime. Reliability, as it has in recent years, tops the list of industry concerns, followed by cybersecurity, environmental regulation, aging infrastructure and the management of long-term investments (Figure 1).

Utilities conscious of the rise of new forms of energy and power generation are meeting the challenge in exciting ways, suggesting a natural evolution from legacy generation to a new era of balanced power portfolios that showcase new technology.

Figure 1

Please rate the importance of each of the following issues to the electric industry using a 5-point scale, where a rating of 5 means “Very Important” and a rating of 1 means “Not Important at All.” (Please select one choice per row.)



Source: Black & Veatch

But it's the arrival of environmentally conscious microturbines, fuel cells, photovoltaics, wind turbines, improved energy storage and other advanced power technologies – all pushing distributed generation toward parity with traditional utility generation – that is arguably generating the most attention. As these technologies enhance in place of raise reliability, the question most utilities have is how they can accommodate distributed generation and become active agents in growing distributed generation for long-term growth and benefit. Costs associated with utilities upgrading their distribution systems to accommodate distributed generation are a major barrier, as are concerns that ratemaking and regulatory issues may not always allow utilities to accommodate rising distributed generation and sustain their baseload commitments to the grid. Many utilities haven't yet fully bought into the economics of distributed energy projects (Table 1).

Table 1

What is your opinion of investments in distributed energy projects relative to your organization?
(Select top two choices.)

Perceptions of Investments in Distributed Energy Projects	By Utility Type			
	Publicly-Owned Utility	Independent/Industrial Power Producer	Investor-Owned Utility	Cooperative
A demonstration or test project	48.9%	9.1%	38.6%	27.6%
A lower risk investment than central station generation or transmission projects	24.4%	27.3%	22.8%	17.2%
A risky investment with questionable economics	17.8%	24.2%	24.6%	27.6%
A significant part of our investment in generation going forward	22.2%	30.3%	14.0%	3.4%
Not part of our investment plans	15.6%	24.2%	10.5%	27.6%
Don't know	0.0%	9.1%	10.5%	17.2%

Source: Black & Veatch

Our report captures those aspirations as well as the anxieties unlocked by the disruptive nature of distributed generation and other trends, such as how renewable energy’s increasing profile will affect business models and utility investments in transmission and distribution; how microgrids are a growing part of the power discussion as a resilience play; and how the rise of technology in generation raises questions about our approach to security – both digital and physical.

We also review how significant numbers of respondents say their coal-fired generation assets are headed to retirement, coal power appears to have a lasting role due to its cost competitiveness, reliability and the significant capital deployed to develop assets, many of which are in the early portion of their design lifespan. The role of nuclear in clean energy production, meanwhile, has been complicated by the anticipated retirements of nuclear facilities in California, Illinois and Nebraska amid suggestions that inexpensive natural gas will make it hard for nuclear to compete. We note, however, that two new facilities under way in Georgia and the recent announcement of power production at Tennessee Valley Authority’s Watts Bar plant suggest nuclear will play a role in the near term. This report also examines the Environmental Protection Agency’s (EPA’s) Clean Power

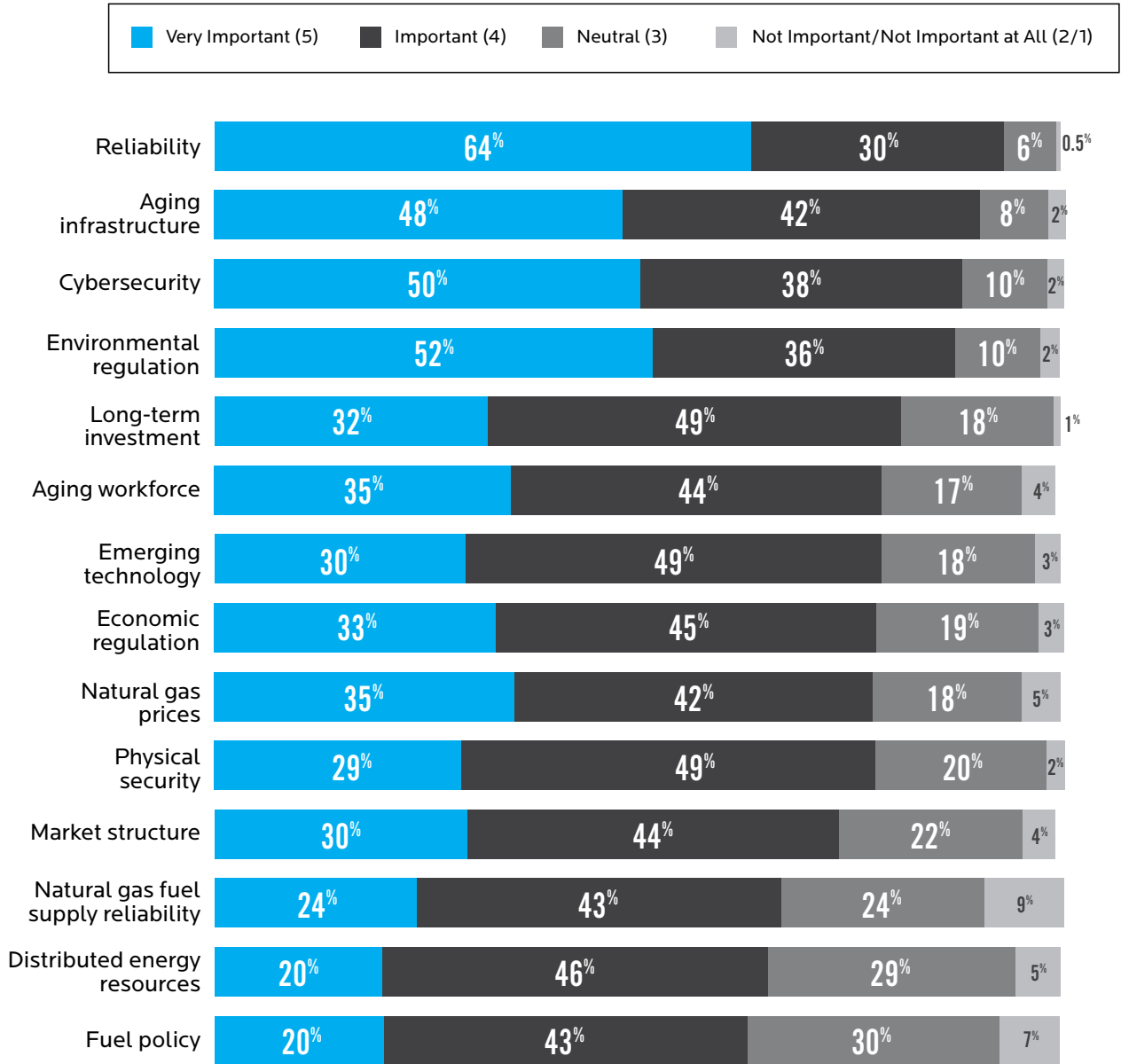
Plan, which remains in limbo after the U.S. Supreme Court stayed the rules amid numerous legal challenges by states.

Here are some of the key issues addressed in-depth in this year’s report:

Cybersecurity – The infrastructure that distributes power across the country was deployed before the advent of modern cyber threats. Now, the role of technology – particularly when it comes to data analytics making our systems more efficient and reliable – simultaneously creates the potential for security vulnerabilities while promising step changes in grid performance, reliability and intelligence. Cybersecurity ranks just behind reliability and aging infrastructure as the most important industry issues (Figure 2). Some of the strategies we are seeing to address cybersecurity include physical hardening at facilities, work to segregate risky networks and risk reduction through the construction of strong vendor service-level agreements. Recent data and physical breaches coupled with the government deadlines and the specter of security audits are prompting providers to act.

Figure 2

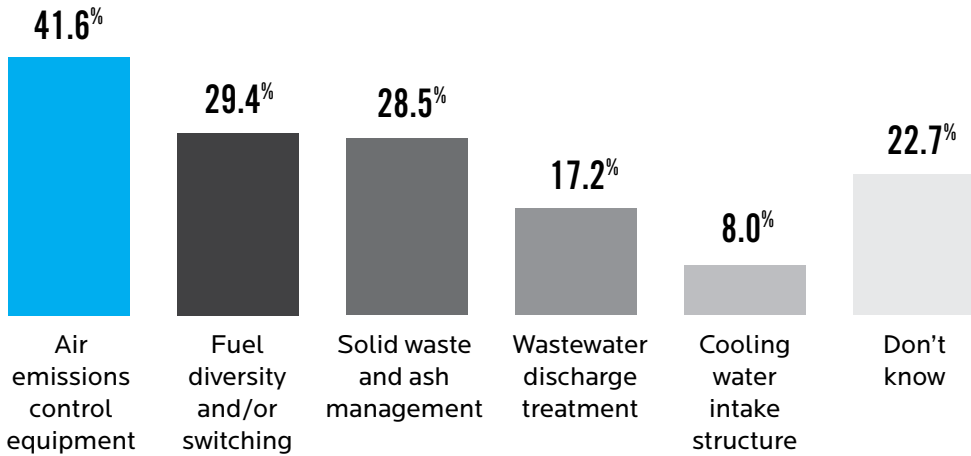
Please rate the importance of each of the following issues to the electric industry using a 5-point scale, where a rating of 5 means “Very Important” and a rating of 1 means “Not Important at All.”
(Please select one choice per row.)



Source: Black & Veatch

Figure 3

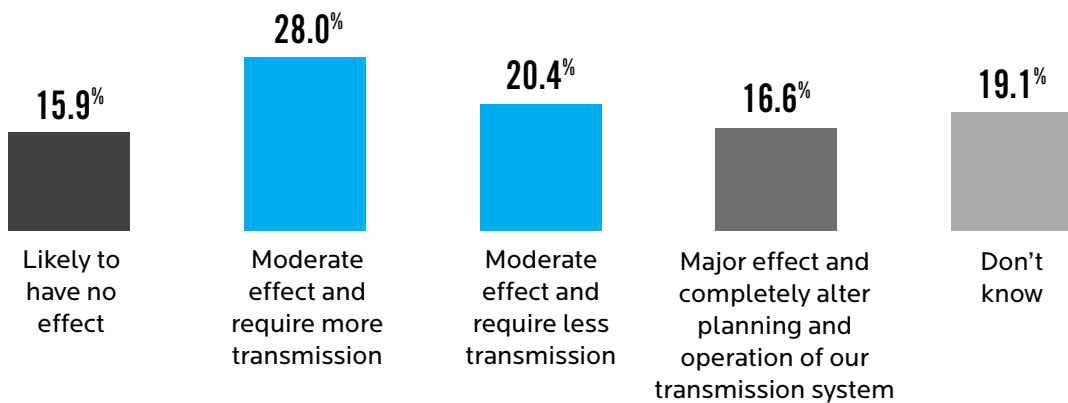
[Electric Services Providers] Which of the following environmental requirements will your organization invest in most over the next five years? (Select top two choices.)



Source: Black & Veatch

Figure 4

[Electric Services Providers] Distributed generation and microgrids are relatively newer concepts. How does your company view these concepts as affecting your transmission system in the future? (Select one choice.)



Source: Black & Veatch

Figure 5

What is your level of interest in the following as a potential revenue stream for EVs? Please rate each on a 5-point scale, where a rating of "5" means "Very Interested" and a rating of 1 means "Not Interested at All." (Select one choice per row.)



Source: Black & Veatch

Air quality control – Mandates in the EPA’s Clean Power Plan and the United Nations’ Climate Change Agreement are prompting new moves by service providers to reduce greenhouse gas emissions. Meeting these stringent limits will likely result in utilities aggressively managing their existing fleets and developing new power generation sources, which will rely greatly on air emissions control equipment. That equipment represents a significant share of the industry’s anticipated environmental investments over the next five years, our survey found (Figure 3).

Microgrids – Microgrids are becoming a powerful tool for utilities and energy consumers across a spectrum from grid-scale nontransmission alternatives to smarter energy systems for industrial, commercial, water and wastewater treatment, and campus facilities. They are gaining traction as a resilience hedge against natural disasters or transcendent weather events. Experimentation and demonstration projects are now focused on microgrid technology as an evolution of smart grid principles to provide more resilient, efficient, more local and more economic solutions to deliver electric service to communities. Vertically integrated utilities and transmission utilities are grappling with business models, regulatory structures and technical criteria while seeking to understand the real value these projects bring to their systems (Figure 4).

Electric vehicles – Electric vehicles (EVs) are an untapped source of revenue for utilities, and they are showing significant interest in potential EV-related revenue streams. Though estimates vary, there is wide agreement that electric charging will account for growing shares of American vehicles in the coming years, especially as production costs drop and battery storage technology improves. More importantly for the larger grid, we expect improvements in EV battery storage to drive overall energy storage gains and propel reliability upward. Utilities understand this, and it explains why a large number of them see opportunity in the transmission and other infrastructure necessary to support a larger EV fleet (Figure 5).

Customer billing – Customer billing and operations are quickly becoming differentiators for electric utilities, and modern customer information systems (CISs) give utilities a platform to strengthen business performance and to improve customer engagement. Such systems will be key to measuring customer conservation habits and will be important considering that new grid technologies and distributed energy resources are only as good as their CIS’s ability to enable the advanced billing features needed to connect those advancements with rate designs.

MEETING THE MOMENT

Taken individually, these and other issues explored in the report are complex and require complex solutions. But their interconnectedness is unmistakable. Technologies that make our systems more efficient, sustainable and reliable also carry stark risks of financial viability, intermittency and disintermediation. Fortunately, ours is an industry well-versed in adaptation and innovation.

The last several iterations of this report have captured the pulse of an industry in the midst of a fundamental business model transformation. Recent years have seen utilities begin to adjust to transformative supply, regulatory, technology and market-driven challenges. This year is no different, but we are as excited as ever about the ways utility leadership will meet the challenge.

CAPITAL

Resilience, Customer Demand Drive Adoption of Distributed Generation

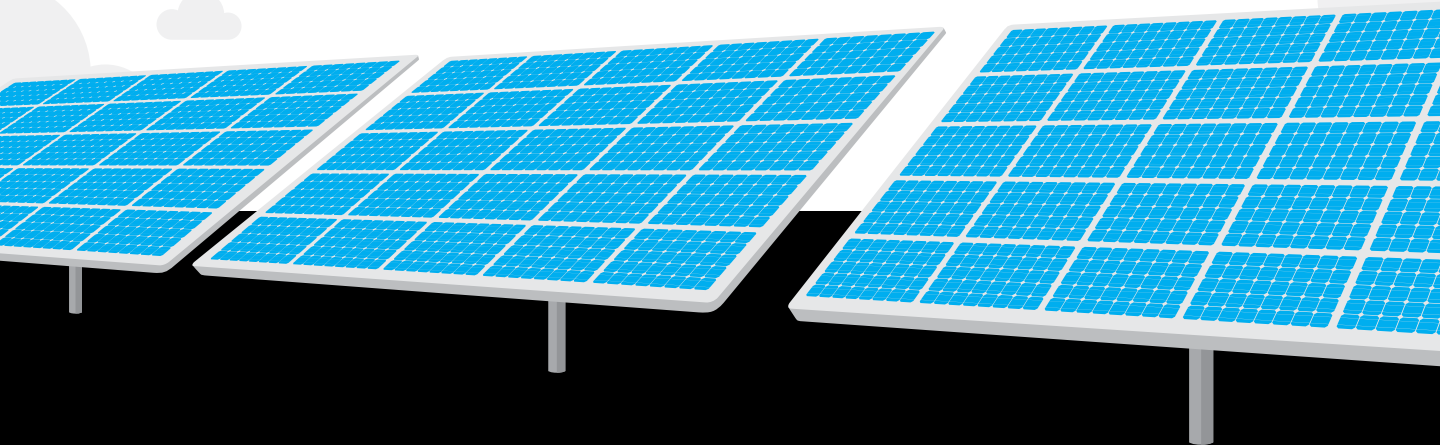
By Jason Abiecunas
and Dominic DiBari

Distributed generation and distributed energy resources may collectively make up the single biggest accelerator of change within the power generation industry. Their emergence is affecting many points along the stakeholder chain at the residential and enterprise levels – from customer engagement and the spending of capital to bold business opportunities aimed at taking advantage of wider adoption of distributed generation and renewables, such as solar, wind, reciprocating engines, combined heat and power, fuel cells and microturbines.

Increased application of distributed generation comes as customers show increasing interest in controlling their energy use by pursuing cleaner energy options, cutting their electric bills or shoring up their own perceived deficiencies in the reliability of the grid, such as during storms or natural disasters. This growing interest appears to be driving utility leaders toward orienting their infrastructure development to accommodate distributed generation, and this work is afoot on both sides of the meter.

CONFRONTING THE FUTURE NOW

Now is the Time to Think About Distributed Generation's Role for Your Utility



WHAT DO YOUR CUSTOMERS WANT?



Reduce their carbon footprint



Lower costs



Control over their energy



Reliability & resilience

SO, WHAT'S HOLDING UTILITIES BACK?

1

Industry uncertainty

2

Regulation & rate recovery

3

Cost & financing

55%

of respondents are

EXPLORING DG AS A VIABLE BUSINESS OPPORTUNITY

HOW CAN UTILITIES MEET CUSTOMER EXPECTATIONS?



Expanding transmission and distribution



Embracing new technologies



Partnering with customers and communities

Hidden in the growing enthusiasm, however, are some cautionary themes worth watching in the near term.

At the Edison Electric Institute's annual convention earlier this year, Edison International President and CEO Ted Craver said the utility has increased infrastructure spending to reflect California's heightened emphasis on distributed generation and renewable power generation. Craver said nearly all of the utility's capital budget was focused on transmission and distribution, with heavy focus on the system's ability to take on more distributed energy.

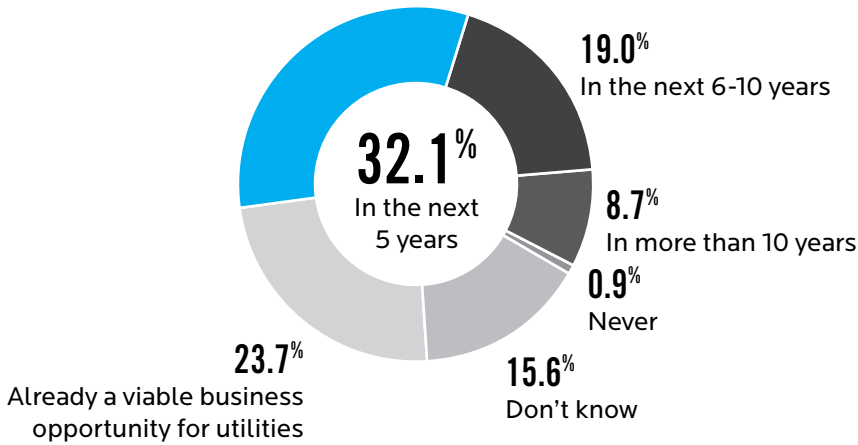
Such shifts are reflected in the responses to this year's *2016 Strategic Directions: Electric Industry Report*, which found that more than half of respondents believe distributed generation is either a current viable business opportunity or will be within the next five years (Figure 6). Distributed generation is no longer on the fringes, and its position in the mainstream of the power industry will solidify over the next five years. A key indicator may be the following conclusion from the survey: The larger the utility, the more on board it is with respect to distributed generation as a viable business opportunity. This interest will only hasten change in the industry. As large utilities roll out distributed generation programs, the industry will achieve scale and cost will continue to drop.

Hidden in the growing enthusiasm, however, are some cautionary themes worth watching in the near term.

The first factor is industry uncertainty. Just over one-third of survey respondents indicated they have already developed, own and/or operate distributed generation projects or assets. But reluctance abounds, with about a quarter of respondents saying they have no current plans but may enter the space eventually, while 17 percent envision pursuing distributed generation in the next five years (Figure 7).

Figure 6

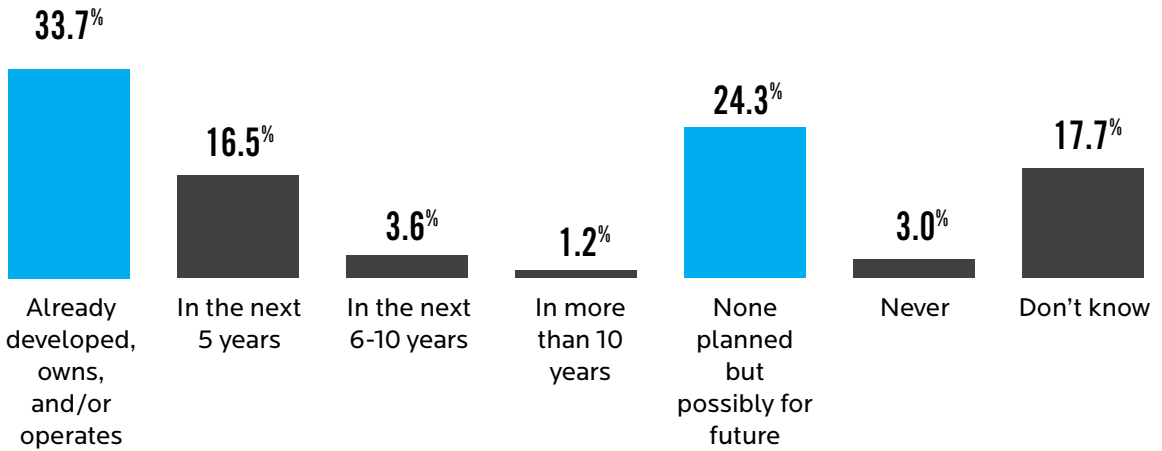
When will distributed generation and microgrids become a viable business opportunity for electric utilities? (Select one choice.)



Source: Black & Veatch

Figure 7

[Electric Services Providers] When does your company plan to develop, own and/or operate distributed generation resources, including microgrids? (Select one choice.)



Source: Black & Veatch

Customer-owned distributed generation changes the economics for vertically integrated utilities, whose rates are generally built around demand and energy charges to cover the cost of generation and the transmission and distribution network.

Some of this reluctance may be attributed to how the industry is grappling with business models and regulatory structure that is not conducive to utilities owning distributed generation. Several states are starting to grapple with the big questions of distributed generation ownership, grid integration and the economics of changing priorities in utility investment and rate recovery models. Significant costs are associated with utilities upgrading their distribution systems to accommodate distributed generation, and recoveries of past and current investments in the system remain an issue that utilities are working through. The transmission and distribution systems are the platform that enables utility-connected distributed generation.

Customer-owned distributed generation changes the economics for vertically integrated utilities, whose rates are generally built around demand and energy charges to cover the cost of generation and the transmission and distribution network. This issue is leading utilities to both evaluate rationalization of rate structures to reflect the fixed cost of the network and consider business models that involve utility ownership of distributed generation assets.

While current regulatory regimes are a barrier to widespread adoption of distributed generation, contractual and procedural requirements for interconnection also appear to be a widespread and significant barrier, especially for small projects. Other obstacles include procedures for approval of interconnection, application and interconnection fees, insurance and operational requirements. Utilities that have standard procedures and designate a point of

contact for distributed generation projects considerably simplify and reduce the cost of the interconnection process both for themselves and for the distributed generation promoters.

Another major factor is financing. Some form of public-private partnership appears to be the business model preferred by the industry. 55 percent of survey respondents indicated this, highlighting the narrative of distributed generation, and microgrids in particular, as a community resource. This partnership model makes sense, because cities often don't have the capital to deploy such systems on their own, but could afford them by pooling resources, perhaps with private investors or utilities eager to match equity with public needs (Figure 8).

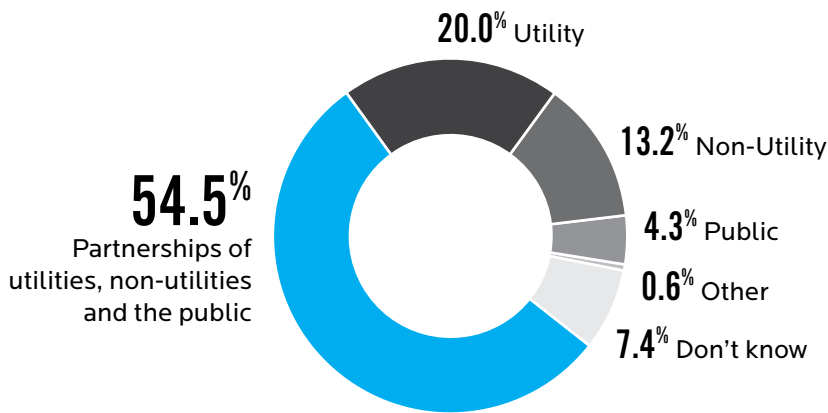
Such arrangements can lead to longer project development cycles because there are more stakeholders to get on board. Anecdotally, Black & Veatch is seeing very long project development cycles for microgrids throughout the United States. Whereas traditional utility projects have involved more limited stakeholder engagement or opportunity for influencing the project structure, location or scope, recent and ongoing microgrid projects under development have included broad coalitions of city leadership, communities, technology partners, utilities and investors. Town hall-style meetings conducted for several projects have elicited high attendance and keen interest from the public. The general public is more informed about and interested in energy policy and the future of the electric system, so it appears that electric consumers will be one of the driving forces for change.

The industry is positioning for bigger programs, or at least demonstration projects that can and will lead to larger customer and grid-scale programs. The industry has recognized that with smaller projects the key to driving cost down and improving economics is to achieve scale in deployment. There is a willingness to invest and figure out the technology and how it applies to the utility system (Figure 9).

As the energy industry evolves and further decentralizes, the planning for – and resulting installation of – distributed generation assets will be more important than ever. Whether it is for energy autonomy, sustainability, resilience or rural electrification, wider distributed generation penetration reflects how leading utilities are confronting the future, now.

Figure 8

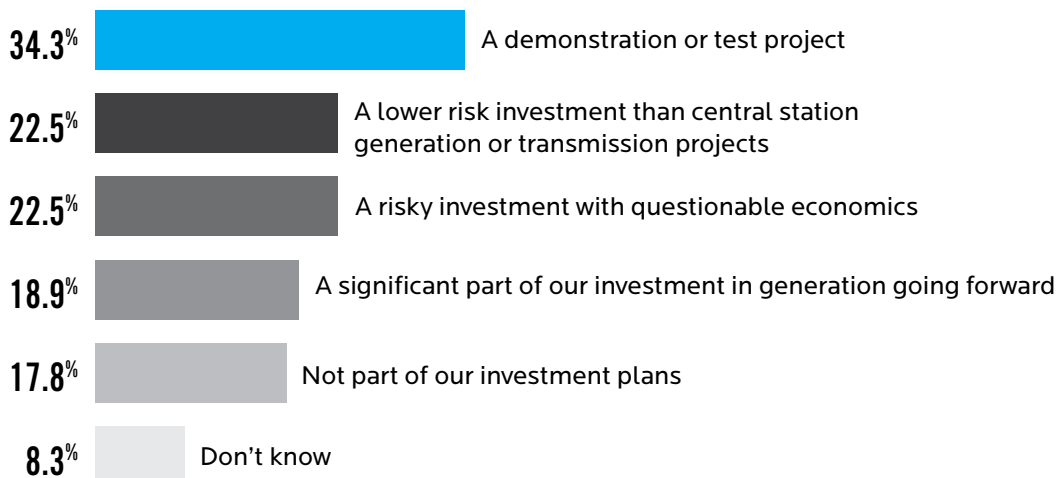
Who do you think should be the dominant owner/operator of microgrids in the future? (Select one choice.)



Source: Black & Veatch

Figure 9

What is your opinion of investments in distributed energy projects relative to your organization? (Select top two choices.)



Source: Black & Veatch

CAPITAL

Asset Management and Investing in the Future of Electricity

By Kandi Forte

Electric utilities are charged with preparing their infrastructure to accommodate new demands on the grid. At the same time, asset management has increasingly been leveraged to help utilities with the long-term decision-making associated with the regulations and the changing energy market. Other issues, such as aging infrastructure, continue to drive asset management programs. What has changed is the focus from a systemic to a programmatic view of asset management.

The last decade of the *Strategic Directions: Electric Industry Report* series has tracked the industry's move from a sole focus on reliability-centered maintenance to predictive analytics and preventive maintenance. Today, electric utilities are recognizing that as infrastructure ages, even with a maintenance-based program, the probability of failure is going to increase. New asset management conversations focus on understanding the impact of risk and regulation and leveraging planning ahead of long-term investment decisions.

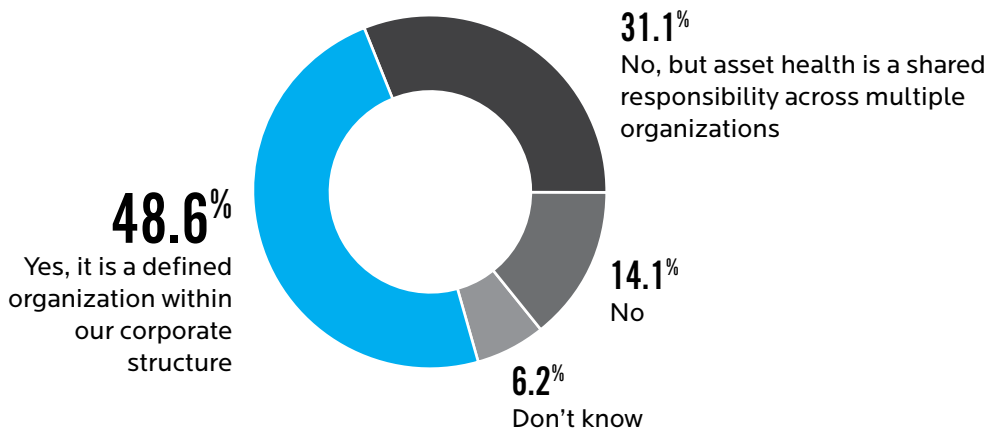
TOWARD A CENTRALIZED ASSET MANAGEMENT ORGANIZATION

This shift from long-term maintenance to long-term investment planning is sparking an identical change in the way electric utilities view asset management’s place within the utility. Asset management is becoming a more centralized function with touchstones throughout the organization. Nearly half of respondents have defined asset management as an organization or department within their corporate structure (Figure 10).

Structuring a centralized asset management function means defining roles and responsibilities as opposed to individual titles and names, focusing on program management and establishing good data and reliability measures for assets. Larger utilities are leading the charge with dedicated staff and capital to cover the cost of a central organization; whereas, smaller organizations find challenges in justifying the investment (Table 2). Results can be achieved; smaller organizations can still benefit by prioritizing program management and asset data.

Figure 10

[Electric Service Providers] Does your company currently have an organization or department that is responsible for asset health and/or reliability? (Select one choice.)



Source: Black & Veatch

Table 2

[Electric Services Providers] Is your company planning on making major investments in any asset management tools or processes over the next three years? (Select one choice.)

Planned Investments in Asset Management Tools or Processes	By Population Served		
	Less than 500,000	500,000 - 1,999,999	2,000,000 or more
Yes	32.1%	38.1%	35.0%
No	50.9%	28.6%	21.7%
Don't know	17.0%	33.3%	43.3%

Source: Black & Veatch

Some larger, more proactive utilities are not waiting for regulators. They tend to be drivers of change and approach conversations with regulators as opportunities to present ideas to manage issues in a cooperative way.

REGULATIONS DRIVE ASSET MANAGEMENT PROGRAMS

Regulatory requirements and cost recovery are also driving the asset management program transformation. Black & Veatch is working with utilities to establish programs that make the case for system and reliability improvements where the mechanism for recovery lies outside of the traditional rate case.

The industry has come out of the downturn of the economy, and some markets and utilities have recovered more quickly. Other utilities realize that even in regions where there is a lag in customers and load, equipment is aging and modernization of the grid needs to be supported. Those markets, in particular, are starting to recognize a need for infrastructure investment mechanisms; otherwise, reliability will become an issue.

Some larger, more proactive utilities are not waiting for regulators. They tend to be drivers of change and approach conversations with regulators as opportunities to present ideas to manage issues in a cooperative way. Having good regulatory relations should be a goal of all regulated utilities, establishing good practice asset management programs as a commitment to customers rather than a requirement.

The benefits are clear: proactive utilities are developing a better and more favorable position with their regulators simply by being more proactive about assets and reliability.

SUCCESSFUL PROGRAMS START WITH PLANNING

Survey respondents ranked planning as most important to the health and reliability of assets (Figure 11). Applying asset management best practices sets the stage for more comprehensive and well-planned investment strategies, further securing the health and longevity of assets and the electric utility organizations that rely on them to provide services.

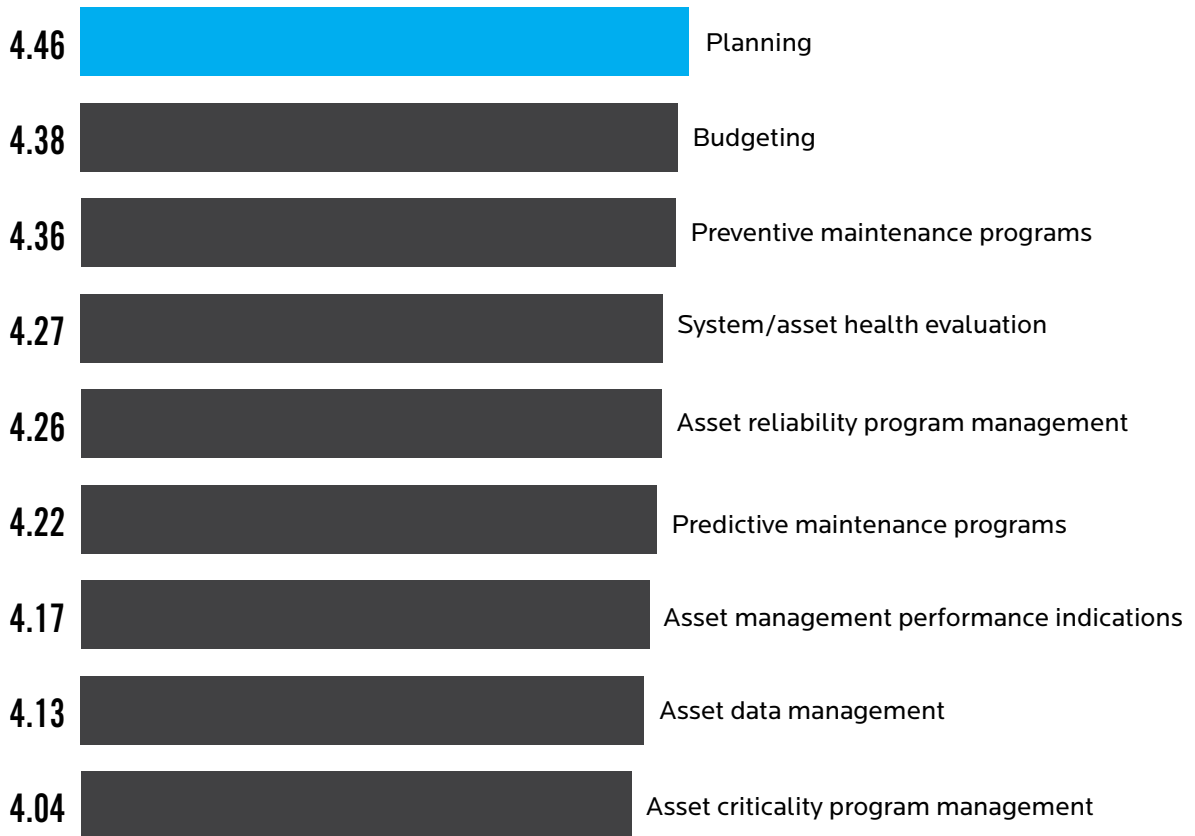
Understanding the overall risk of each asset according to each asset's criticality and likelihood of failure enables smarter investment and planning decisions. Through a

balance of risk-based planning and cost-benefit analysis, capital and maintenance planning are optimized to support overall strategic objectives.

Recently Black & Veatch supported a major Midwest utility with asset risk model analysis and capital prioritization for its transmission and distribution assets. The resulting capital improvement plan prioritized more than \$1 billion dollars in capital expenditures over a seven-year forecast and accounted for a 32 percent reduction in risk to the portfolio.

Figure 11

Please rate the importance of each of the following issues to the health and reliability of your assets using a 5-point scale, where a rating of 5 means "Very Important" and a rating of 1 means "Not Important at All." (Please select one choice per row.)



Source: Black & Veatch

POWER

Uncertainty is the Only Certainty in Coal's Future

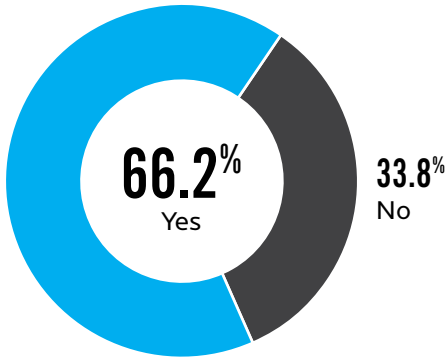
By Roger P. Lenertz, Chris Klausner and Dan Schmidt

Coal hasn't been generating many positive media headlines recently. Major coal producers have announced bankruptcies and laid off workers. Railroad shipments of coal are down 30 percent or more from year-ago levels and continue to fall. This year, for the first time, natural gas is expected to outrank coal as a fuel resource for electric generation on an annual basis. Yet, despite this negative scenario, coal remains an important part of generation across North America, especially in the Midwest and South, and nearly two-thirds of survey respondents still have active coal facilities counted among their assets (Figure 12).

For a power generation owner contemplating the future of coal there are three basic strategies: (1) hold on and continue generating coal-fired electricity for as long as possible, (2) retire the coal assets or (3) repurpose the coal asset by switching to gas-fired, biomass or dual-firing capabilities (Figure 13).

Figure 12

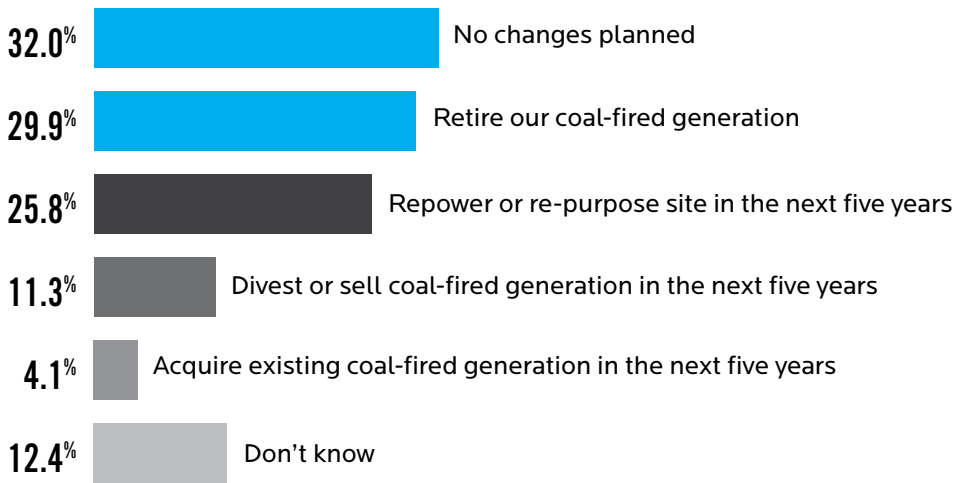
[Electric Services Providers] Does your organization currently have coal-fired generation assets as part of your generation fleet? (Select one choice.)



Source: Black & Veatch

Figure 13

Which of the following strategies is your organization considering related to coal-fired generation? (Select all that apply.)



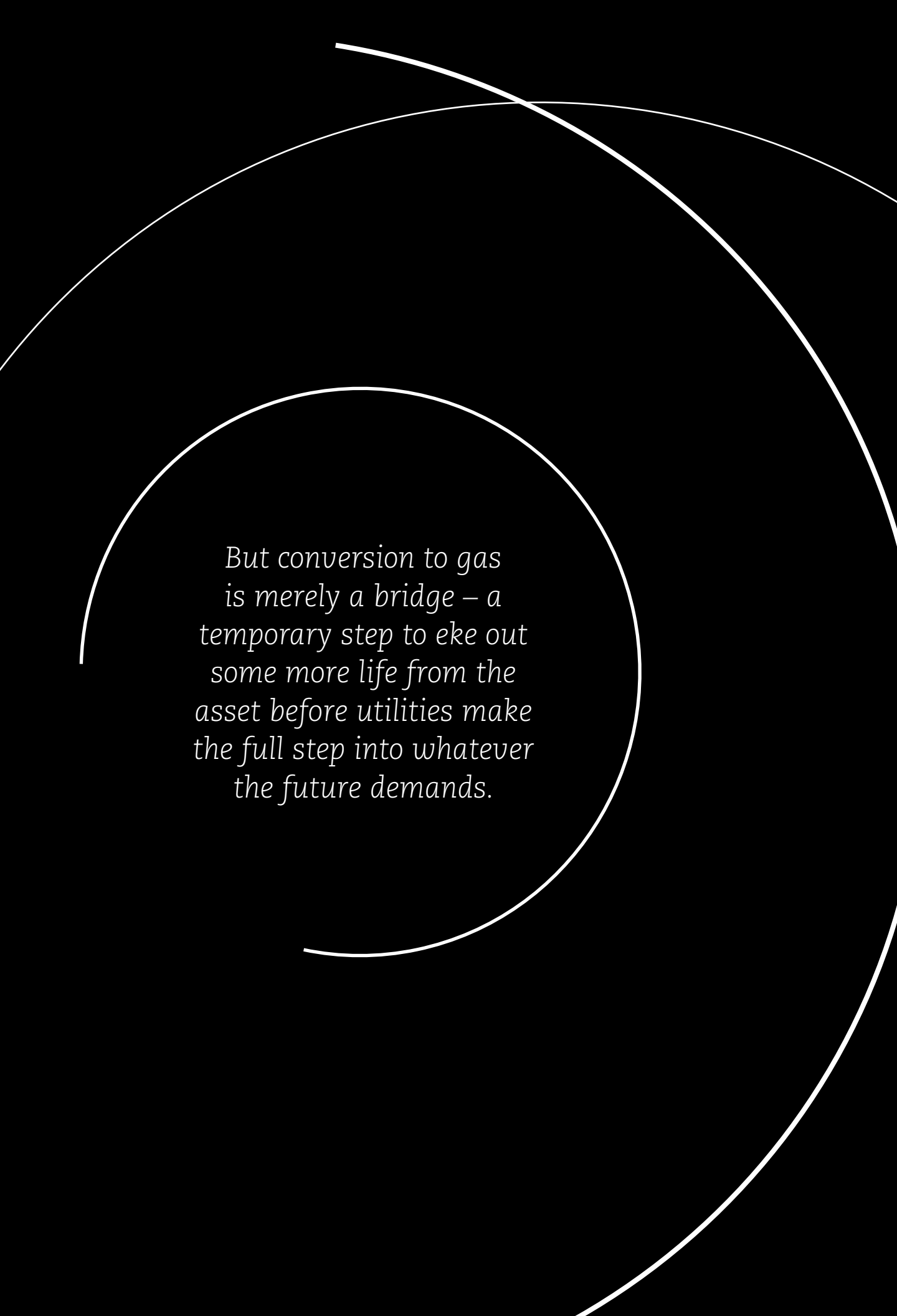
Source: Black & Veatch

Responders who have no changes planned for their coal facilities likely feel as if they need to continue with this investment they've already made and squeeze some more value from it. Many power generators have already retired older, less efficient plants in their fleet. Owners have generally invested heavily in the remaining coal plants (usually to meet air quality regulations), and they will hang on to those remaining plants for as long as they can – legally or politically speaking. Some utilities are finding usefulness by cycling these plants up and down to meet demand, although this is admittedly hard on the equipment, which is not designed to run in this manner.

The option of repurposing a plant is popular, at least as a study. Black & Veatch has conducted more than 50 studies over recent years for clients that are entertaining the idea of switching fuel sources. However, while more than a quarter of respondents say repowering is in their plans, our experience shows that very few are actually ready to make that decision now.

Fuel switching a coal facility to gas is not the most efficient move from a power production perspective, but it does extend an owner's opportunity to continue using that asset for a period. If owners choose to convert to gas, they may have to derate the unit. For example, a 300 megawatt (MW) unit might have to be derated to 280 MW because of a loss of thermal efficiency.

But conversion to gas is merely a bridge – a temporary step to eke out some more life from the asset before utilities make the full step into whatever the future demands. Repowering may give utilities another five to seven years to see how initiatives such as the Clean Power Plan will work out (will it be upheld in court?). Conversion then becomes a short-term, smaller investment that buys time to gain clarity for the future.



*But conversion to gas
is merely a bridge – a
temporary step to eke out
some more life from the
asset before utilities make
the full step into whatever
the future demands.*

UNCERTAINTY STILL A DRIVER

The driver in the coal market is uncertainty. The Environmental Protection Agency (EPA) puts out proposals and rulings, but they are contested in the courts, and it takes years to move them through the legal system. The Supreme Court stays the decision, and that only prolongs the uncertainty. Add in the fact that U.S. elections are occurring in the fall.

Even the respondents who say they plan to retire coal are “kicking the can” a considerable distance down the road (Figure 14). About two-thirds say retirements are six to 10 or even more years away. Again, this response is likely a reflection of many owners having already retired smaller plants and wanting to get the most – or even the full life cycle – out of the remaining fleet.

The country’s migration to more renewables introduces new demands on generation response across the board and changes power flow requirements in the existing transmission system.

RELIABILITY STILL A CONCERN

Can anything stop the momentum toward decreasing or removing coal entirely from the U.S. power mix? Many would say the answer is “no.” But, at the same time, the country has yet to experience a widespread, prolonged issue with reliability, which is listed as the top concern for electric utilities (Figure 1). The country’s previous coal generation backbone has provided high reliability in the past. As coal and nuclear power disappear from the baseload realm and only gas and renewables remain, many utilities see this as a worrisome scenario (Figure 15).

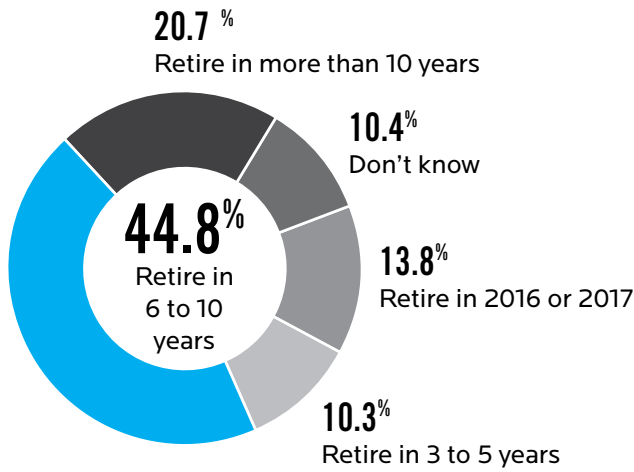
Reliability is not limited to the generation resource – it also encompasses the huge transmission network that spans the continent and the interactive control of the generation portfolio. Many of these lines are aging or are at maximum capacity. The country’s migration to more renewables introduces new demands on generation response across the board and changes power flow requirements in the existing transmission system. Utilities recognize the need for transmission system upgrades; however, the existing market systems may not allow them to equitably fund such changes. Nevertheless, there is remarkable activity in the transmission upgrading market.

Utilities will quickly respond to any threats toward reliability and, in fact, have already started moving in that direction. Fast-ramping natural gas facilities can help power generators respond to reliability issues or the built-in intermittency of renewables. Battery storage is another option that is gaining momentum and, again, complements renewable resources.

Lastly, some large customers, such as office and industrial complexes, universities and military bases, are showing considerable interest in microgrids as a means of hardening their assets, controlling prices and implementing resilience. Utilities are actively investigating how they can participate in these new market mechanisms.

Figure 14

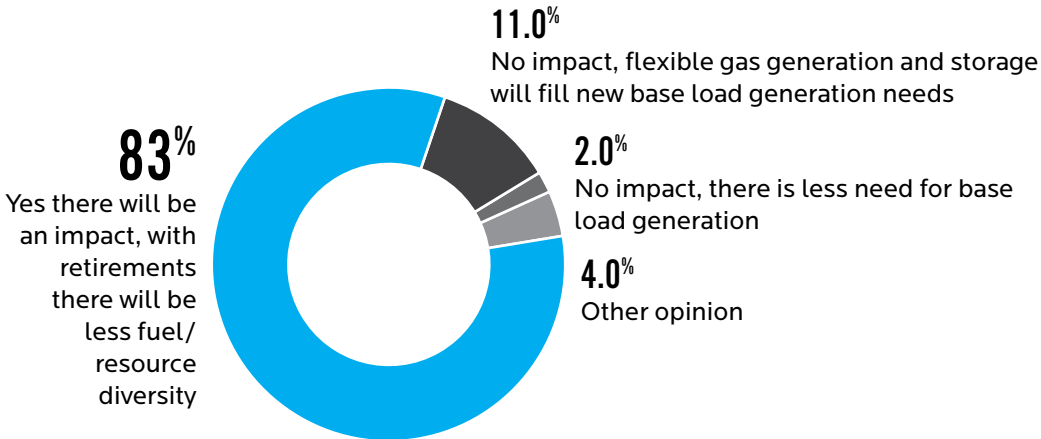
How soon does your organization plan to retire your coal-fired generation? (Select one choice.)



Source: Black & Veatch

Figure 15

Do you think early retirements of traditional large baseload coal and nuclear facilities pose any risks to system reliability? (Select one choice.)



Source: Black & Veatch

POWER

Microgrids Should Be a Key Element in Power Grid Modernization

By Jason Abiecunas

Modernization of the U.S. power grid will not only require replacement of old components with new ones, it will also need to account for larger amounts of renewable energy and distributed generation while enhancing electric reliability and resilience for residential, business and industrial customers. The industry is rethinking how to build the generation and distribution network to more cost-effectively deliver reliable electric service.

Microgrids are a promising part of the grid modernization solution. A new generation of low-carbon microgrids is emerging and shifting the way energy is produced, distributed and consumed. The concept of locally generated and consumed energy is evolving how we think about and plan for utility systems in densely populated cities, where resilience is increasingly valued in the face of powerful storms and other events that can bring down the power grid.

Modernization is a special challenge because as many cities and municipalities are starting to make commitments to reduce greenhouse gas emissions, they must also provide reliable utilities and resilient essential services during emergencies or natural disasters. Residents and businesses stand to benefit by incorporating distributed low-carbon microgrid projects in smart city initiatives and, even more significantly, embedding them at the core of holistic strategic infrastructure and urban revitalization plans.

The idea of deploying local, renewable energy-driven microgrids is gaining momentum across the United States. A total of 124 microgrids with a combined capacity of 1,169 megawatts (MW) were up and running across the nation as of July 2015, according to Pew Research, which also predicted that microgrid capacity will grow to exceed 2,850 MW by 2020, an increase of almost 145 percent. Market revenue is expected to soar as well, rising nearly 270 percent to total over \$3.5 billion.

Part of this recent surge is caused by particular risks, such as recent extreme weather events that have caused extended grid outages across the Northeast. These high profile events have served as catalysts for federal, state and local governments to take action. Microgrids have emerged as a powerful tool in building a more resilient and sustainable power grid.

Resilient and low-carbon systems require multiple technologies to deliver on requirements. A system based only on solar and wind generation would be low-carbon but would not deliver resilient or reliable service, because these are both intermittent resources dependent on the sun and wind. To be resilient, dispatchable resources such as energy storage and fossil fueled generation sources are required as part of the system. Seamless integration of multiple generation sources and loads is then at the heart of what makes a system a microgrid.

A platform for remotely operating and maintaining multiple distributed generation resources and microgrids is also critical because these resources are typically designed to be “operator-free.” Modern data analytics platforms analyze operations, performance and equipment health data in real time and perform predictive analytics to optimize performance and predict maintenance requirements. These platforms can identify wasted energy and enhance efficiency and resiliency through coordination of generation and demand of smart devices deployed on the system – all while constantly monitoring and evaluating market costs and environmental performance.

Cities and communities are increasingly looking at smart city initiatives with the objective of building more sustainable, connected and resilient cities. Several large and small cities are now developing programs with components as varied as Wi-Fi kiosks, electric vehicle charging, microgrids, smart street lighting and smart traffic management systems. Microgrids are a key part of these initiatives, delivering locally generated renewable energy and resilient generation to keep critical community facilities online when the grid goes down and improving economics of power supply to the community. As shown in the results of this year’s survey, utilities and cities are moving toward public-private partnerships to fund these initiatives. Many communities are capital constrained, and this model enables them to take advantage of smart city programs and microgrids.

To gain a greater understanding of the overall performance and potential value of microgrids, Black & Veatch constructed a hybrid low-carbon microgrid that powers a significant portion of the company’s world headquarters in Overland Park, Kansas. This system is composed of 50 kilowatts (kW) of solar photovoltaic generation, two 65 kW natural gas-fired microturbines with the ability to capture and use waste heat (combined heat and power), a 100 kW/100 kilowatt-hour (kWh) lithium-ion battery energy storage system, electric vehicle charging stations and a geothermal well field that helps maintain comfortable temperatures year-round. The system is also integrated with the building management system to enable transitions from grid-connected to island operation by matching generation with the building load.

Microgrids can enable energy companies and city and municipal leaders to meet the pressing, interrelated challenges of modernizing our aging power grid infrastructure, as well as the pressures of ongoing urbanization and the escalating threats and costs of climate change.

Seamless integration of multiple generation sources and loads is then at the heart of what makes a system a microgrid.

POWER

Flexible Models Play Key Role in Grid Reliability

By Allen Sneath and
Robert Mechler

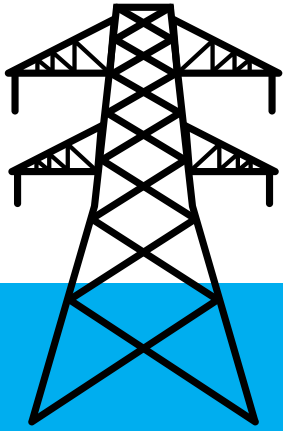
The ability to seamlessly transmit and distribute electric power from an increasingly complex array of generation resources is essential to creating a more flexible, resilient electric grid. Yet questions remain as to how this essential, yet often overlooked, component of the power network can adapt to keep pace with emerging technologies and changing customer demands.

Similar to the wave of innovation taking place on the generation and smart grid side, the July 2011 issuance of Federal Energy Regulatory Commission (FERC) Order 1000 has paved the way for a transformation of the traditional transmission market. FERC Order 1000 requires transmission planning at the regional level to “consider and evaluate possible transmission alternatives and produce a regional transmission plan.” In addition, it requires that the cost of projects “chosen to meet regional transmission needs to be allocated fairly to beneficiaries.”

Getting from

POINT A to POINT B

Overcoming the *push* and *pull* of building *additional* transmission



THE INDUSTRY'S GOAL is
COMPLETE RELIABILITY.

WHY AREN'T WE
there yet?

POWER GENERATION
isn't the challenge...



...the hard part is getting
THE POWER TO THE PEOPLE.

WHAT MAKES
POWER DELIVERY
SO COMPLEX?



Environmental
PERMITS



ROUTING
and SITING
ISSUES



PUBLIC
perceptions



THE POWER
INDUSTRY NEEDS
TO DO

a better job of explaining
COSTS and COMPLEXITY of RELIABILITY.



Table 3

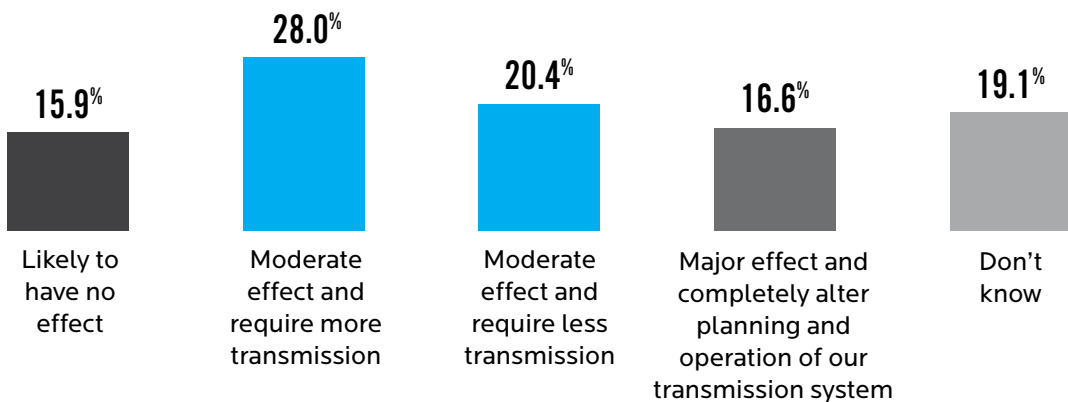
FERC Order 1000 has provided new challenges and opportunities for utilities. How does your company view competitive transmission? (Select one choice.)

View of Competitive Transmission	Bundled Gen. and Trans.	Bundled Trans. and Dist.	Combined Utility Services Provider	Electric Dist.	Merchant Gen.	Regulated Gen.	Dist./ Renewable Gen.	Vertically Integrated Electric Utility
It is a passing fad, and we will not have any involvement	5.9%	6.3%	9.7%	10.9%	0.0%	5.6%	2.9%	0.0%
It is here to stay, but we will not engage in this area	23.5%	31.3%	35.5%	32.6%	64.7%	38.9%	35.3%	35.7%
It is here to stay, and we will compete in our native territory	47.1%	28.1%	45.2%	41.3%	17.6%	33.3%	41.2%	46.4%
It is here to stay, and we will compete in other areas as well as our native territory	23.5%	34.4%	9.7%	15.2%	17.6%	22.2%	20.6%	17.9%

Source: Black & Veatch

Figure 16

How does your company view these concepts as affecting your transmission system in the future? (Select one choice.)



Source: Black & Veatch

In effect, Order 1000 requires more interregional coordination to resolve power flow across long standing seams in the electric grid. FERC continues to review the progress of Order 1000 through technical conferences and efforts to explore the need for additional reforms. These conditions (subsequently contested in court cases) lifted the final barriers to creating potential opportunities for open competition in the transmission space, previously dominated by incumbent electricity suppliers.

With much of the litigation settled, it appears that the industry has come to terms with the fact that competitive transmission is here to stay (Table 3). Overall, 60 percent of industry respondents indicate they will compete in the transmission space, with higher levels among bundled generation and transmission companies (71 percent) and bundled transmission and distribution providers (63 percent).

Yet, despite the goal of FERC Order 1000, only 20 percent of respondents indicated an interest or willingness to extend their operations or compete for projects beyond their service territory. Given the high costs and complexity in executing transmission projects, organizational scale can play a major factor in pursuing projects that extend beyond existing service territory. Other market participants, such as municipal utilities or co-ops, may not have charters that support operations outside of their service territory, further limiting competition.

With renewables, microgrids and distributed energy resources (DER) garnering numerous headlines, the role of a flexible power delivery model becomes increasingly important to maintaining grid reliability. Rooftop solar, a rapidly expanding DER, creates interesting challenges for distribution networks because traditional load patterns can shift dramatically depending on time of day and weather conditions.

For operators, as increasingly large volumes of power generation originate behind the meter, questions arise as to how they manage their system (Figure 16). Twenty percent of respondents indicated that if they lose load, they'll require fewer transmission assets. Conversely, 28

percent stated that as distributed resources grow, more transmission assets are needed, likely to support grid function when these resources are offline.

Looking more closely, there are parallels across the response categories. Broadly, 64 percent of respondents think distributed generation won't have much impact on their system, while only 17 percent view the evolving generation market as a huge change for their business. We note that this latter group could likely be viewing the challenges presented by the often-cited California Independent System Operator (CAISO) duck curve.

For these respondents, it could indicate a system that is struggling to recover from the loss of DER at sundown. Many system operators own traditional generation assets that were not designed to be particularly nimble. As large volumes of solar assets cease production, significant amounts of backup generation must be ready to produce power. High-speed ramp-up capabilities become an increasingly valuable proposition to maintain grid stability.

With increasingly stringent renewable portfolio standards or federal regulatory actions reducing the viability of certain fossil fuel-driven assets, competitively priced storage has to be an increasingly larger component of the transmission and distribution system. Moving power from these assets to the areas where it is most needed will be a critical component of supporting achievement of or compliance with these mandates.

To that point, executing transmission projects is difficult. While renewable assets generate power and are supported by broad-reaching advocacy, transmission is the critical piece few seem to care about until it is routed through their community.

Figure 17 reflects the challenges that face transmission projects, with both environmental permitting concerns and routing/siting issues receiving similar rankings within this report's margin for error.

As an industry with more than 100 years of experience and innovation behind it, our environmental challenges can often be solved through advances in science and engineering. On the other hand, routing and siting issues are often more of a political or personal challenge. Too frequently, the benefits of transmission projects run headlong into "Not in My Back Yard" (NIMBY) issues or other challenges outside the control of project developers. For this reason, critical large-scale projects are the ones that can engender the greatest public response and opposition; whereas, smaller projects can be quickly acted upon.

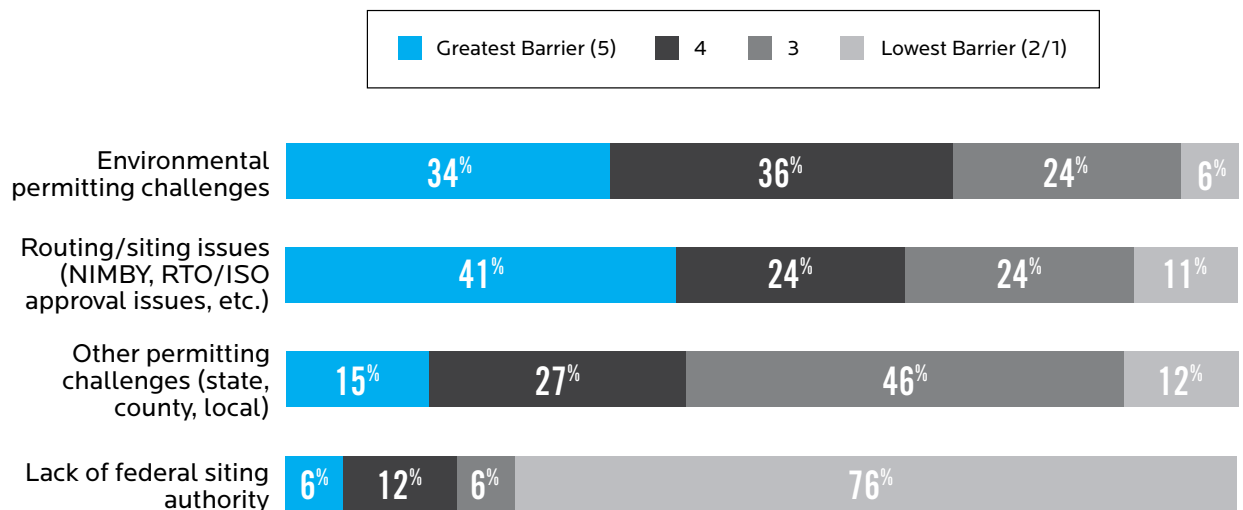
To overcome this push and pull, the power industry must do a better job of explaining the costs of reliability.

Similar to the issues facing the water utility sector, there is a fundamental lack of understanding about how complex the delivery of power (or water) is to homes, businesses and communities. For example, the \$7 billion Texas Competitive Renewable Energy Zone (CREZ), approved as a public good to support the integration of 18.5 gigawatts (GW) of wind power by building a 3,600-mile high voltage transmission network, will have a cost to all ERCOT (Electric Reliability Council of Texas) ratepayers for decades to come. Other less ambitious projects can still require massive capital expenditures.

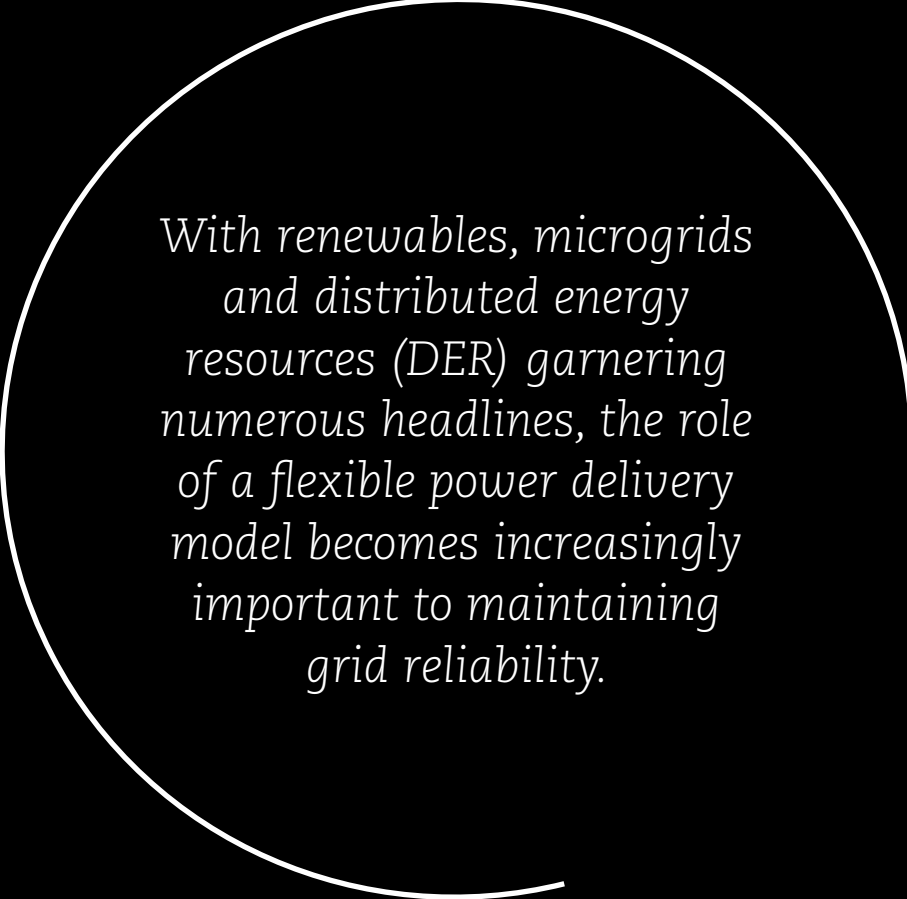
Balancing these competing interests (as now, more than ever, people want and expect reliable power) makes power delivery an increasingly complex element of the electricity market. Seemingly simple solutions to potential NIMBY or environmental issues, such as burying lines or expanding existing transmission line capacity, can introduce insurmountable cost or resilience factors. Working with regulators and the public will be essential to building the reliable transmission grid of the future.

Figure 17

Which of the following represent the greatest barrier to building additional transmission?



Source: Black & Veatch



*With renewables, microgrids
and distributed energy
resources (DER) garnering
numerous headlines, the role
of a flexible power delivery
model becomes increasingly
important to maintaining
grid reliability.*

POWER

Natural Gas is New King of Power Generation in the United States

By Alap Shah

According to the U.S. Department of Energy (DOE), 2016 will be the year we crown a new king of power generation in the United States.

For the first time, annual generation from natural gas is expected to surpass generation produced with coal.

The historic transition is tied to the following:

- Ample natural gas availability at an affordable price.
- Flexibility of the gas-based plant to substantially complement renewable generation.
- Highly efficient combined cycle technologies available in the market, making this type of generation environmentally friendly and easier to permit.
- Less capital-intensive, faster implementation and reduced operations and maintenance.

Yet, questions abound. Potential investors in the power business often ask how long will this sweet spot for natural gas-based power generation continue? What threats are there to derail the upward trend of natural gas-based power generation? Are we in an oversupply situation, which can make future investment in natural gas-based power generation less attractive?

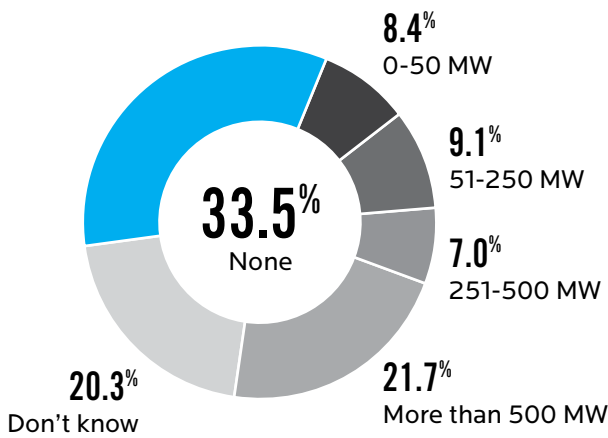
Combined cycle is becoming the technology of choice for future investment in gas-based power generation.

In North America, the market has been driven by large utility purchases and the shift from coal to gas. We expect a little decline in the short term and then expect to rebound in the midterm. The global market is different from the U.S. market. We see that gas turbine sales in the United States are going to cool down some, but on a global basis, the gas turbine market is going to be strong. We see significant development activities in Africa, South America and Indonesia with respect to liquefied natural gas. Planned natural gas-based power generation investment in the next five years is higher for bigger markets served compared to smaller utilities (Figure 18).

Combined cycle is becoming the technology of choice for future investment in gas-based power generation. This is not surprising considering the recent technological advancement in the efficiency and flexibility of combined cycle plants (Figure 19).

Figure 18

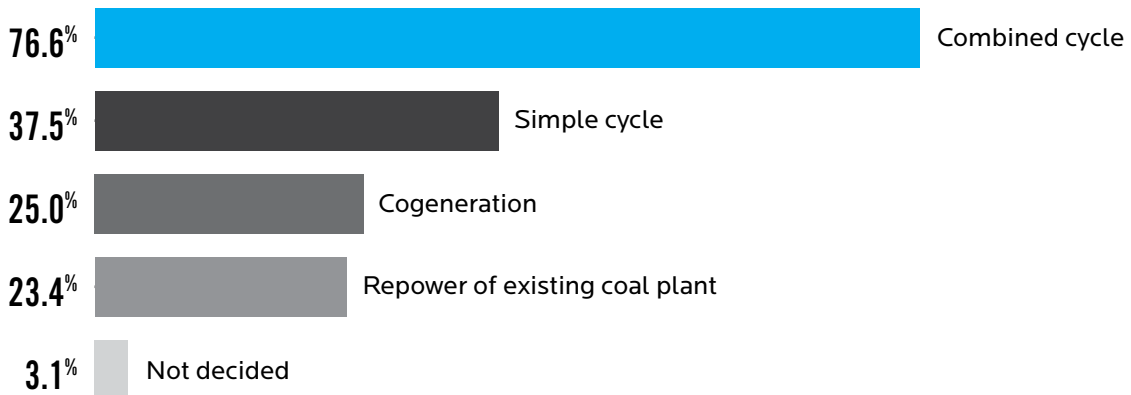
How many megawatts (MW) of natural gas-fired power generation are you planning to add in the next five years? (Select one choice.)



Source: Black & Veatch

Figure 19

What types of configurations are being considered for your natural gas-fired power generation additions? (Select all that apply.)



Source: Black & Veatch

Table 4

What are your expectations for what the PJM auction clearing price will be in 2017? (Select one choice.)

Expectation for the PJM Auction Clearing Price in 2017	By Organization Type	
	Electric Services Providers	Electric Industry Providers
Within +/-20% of the 2016 clearing price	22.6%	39.4%
Less than 20% of the 2016 clearing price	7.1%	14.8%
More than 20% higher than the 2016 clearing price	4.8%	3.2%
Don't know	65.5%	42.6%

Source: Black & Veatch

In the United States, it appears that there is a slowdown in natural gas-based power project developments compared to the last two to three years. As seen in the PJM (Pennsylvania-New Jersey-Maryland Interconnection) auction clearing price trend from the 2016 to 2017 auctions, the balance has moved toward more supply than demand. Approximately 40 percent of the respondents (Electric Industry Providers) believe that the 2017 clearing price is going to be within +/- 20 percent of the 2016 clearing price (Table 4).

For the first time, capacity factors in 2015 for gas-fired power plants exceeded capacity factors for coal-fired plants, according to the DOE. Combined cycle plants in the United States are running at 56 percent capacity, on average, which is significantly higher than previous years. Some of these combined cycle plants were running 80 percent of the time in 2015 (Figure 21).

The gas turbine-based plants that were installed in the early 2000s are due for major overhauls. This timing is a great opportunity for gas turbine upgrades. The goals of these technology upgrades are mainly efficiency, reliability and flexibility improvements to enhance

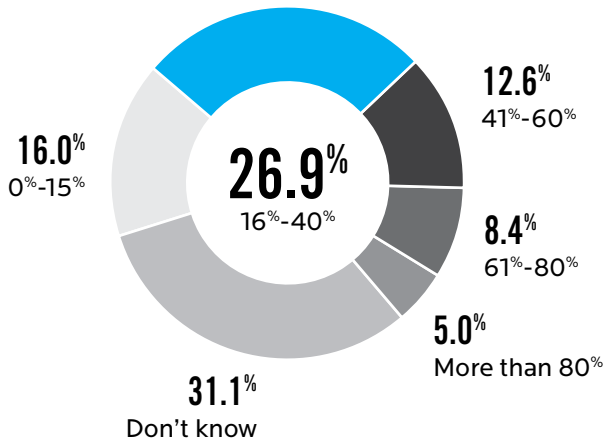
responsiveness to grid demand. Gas turbine original equipment manufacturers have made investments so that advanced gas turbine designs are having a positive impact on operating plants. The advancements in component designs and durability are being implemented back into the operating fleet.

Significant advancements have been made to improve the operational flexibility of those plants in terms of low load turndown, emissions compliance, and power and efficiency optimizers, all of which contribute toward higher capacity factors. These higher capacity factors justify investment in the existing gas-based plant upgrades, which is a trend that will continue for some time, in our opinion (Figure 22).

Historically, the natural gas market was renowned for its volatility. In the past, it was not unusual to see prices spike from \$3 per thousand cubic feet (mcf) to \$13 per mcf in a fairly short period. In recent years, however, gas prices have remained consistently low, and with expectations that price will remain low in the near term, Black & Veatch expects natural gas to be an essential player in a balanced power generation portfolio.

Figure 21

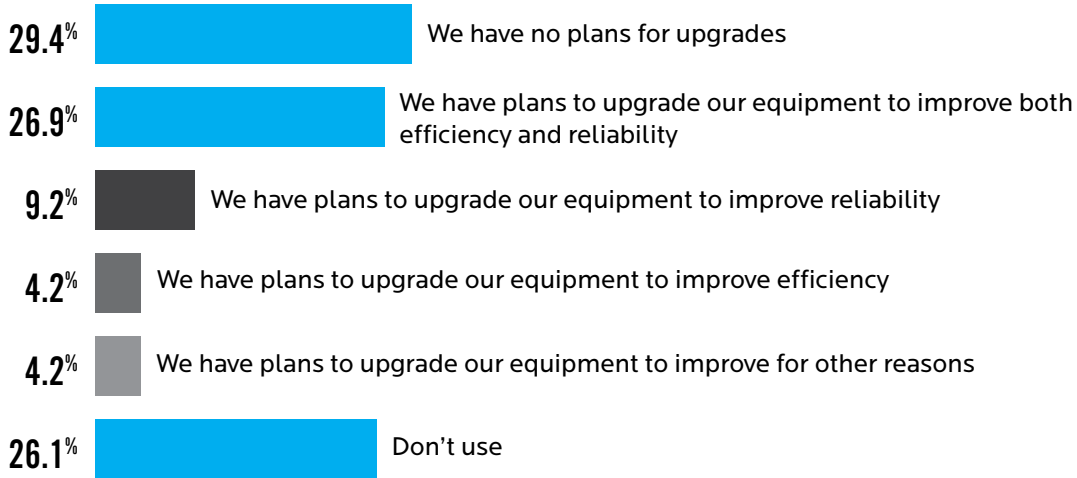
What was the average capacity factor of your natural gas-fired power generation fleet in 2015? (Select one choice.)



Source: Black & Veatch

Figure 22

Does your organization have plans to upgrade your existing natural gas-fired power plant equipment (such as gas turbines) for any of the following reasons? (Select best choice that applies to your organization.)



Source: Black & Veatch



GLOBAL PERSPECTIVE

*Learning to Live
with Coal*

By Craig Connell



The use of coal is declining in much of the Western world. As a fuel that generates power with much higher levels of greenhouse gas emissions than alternatives such as gas, nuclear and renewables, coal is subject to concerns over global warming and climate change.

The United States and Europe have such stringent regulation of the levels of emissions of gases associated with coal, such as carbon monoxide, sulfur dioxide and nitrogen oxide (NOx), that many coal-fired power plants have faced early closure.

In fast-growing economies devoid of significant oil and gas reserves, but in possession of large coal reserves, coal represents the quickest and cheapest way of building substantial electricity generating capacity and is quite often the most attractive way of being able to keep up with rapidly growing demand. Today, countries such as South Africa, India and Indonesia rely on coal to enable the continued growth of their economies.

In South Africa, coal is the major indigenous energy resource, and it is responsible for almost 90 percent of South Africa's electricity generation. Coal is so abundant that it is also converted and provides between 20 percent and 30 percent of the country's liquid fuels.

While the South African government does plan to reduce the country's reliance on coal to just 48 percent of the energy mix by 2030, 9.6 gigawatts (GW) of new capacity is currently under construction by the state utility, Eskom, with an additional 4 GW of capacity being sought from independent power producers.

A successful electrification program means the majority of South Africans now have access to electricity, but generating capacity only keeping up with demand has become a significant barrier to economic growth.

The chief answer to supply constraints in the short term will be the construction of the world's fourth and fifth largest power plants at Medupi (4,674 megawatts [MW]) and Kusile (4,800 MW) – both coal-fired power plants.

It is a similar story in Indonesia, which currently has the lowest per capita utilization of power among Southeast Asian nations, despite being a \$1 trillion economy.

Like South Africa, Indonesia has an abundant natural coal resource that is currently responsible for just over half of all the country's electricity generation.

Indonesia's gross domestic product growth rate is approximately 6 percent. To maintain this growth, the power growth requirement is about 8 to 9 percent. Adding this to the existing requirement of connecting 12,000 villages that currently have no electricity supply to the grid translates to about 7,000 MW per year or 35,000 MW in five years.

In India, coal accounts for 75 percent of energy needs, but despite being the world's fifth largest electricity generating nation, up to 400 million people are still without reliable energy.

Industrial demand is also growing, and despite India making significant investment in renewable electricity, the need for coal-fired electricity is still estimated to triple by 2030.



MANAGING EMISSIONS

It would be unrealistic for countries such as India, Indonesia and South Africa to marginalize coal in the same way some Western nations have. As a result, steps are being taken to minimize the environmental impacts of coal-fired power stations.

South Africa's Kusile and Medupi plants both utilize pulverized coal and supercritical boiler technology to improve efficiency and thus reduce emissions.

Kusile, which is being developed by Eskom with engineering and construction management support from Black & Veatch, is also the first coal-fired plant in Africa fitted with flue gas desulfurization (FGD) air quality control technology, while Medupi, and many other existing coal-fired plants, will be retrofitted with the technology.

In Indonesia, the government is encouraging the use of supercritical and ultra-supercritical steam boilers in all new coal plants. Many of Indonesia's new plants also rely on financing from international bodies, such as the World Bank, that impose their own emissions requirements as part of any financing agreement.

India, meanwhile, has recently introduced stringent emissions standards, for both new and existing power plants, that cover particulate matter, NO_x, sulfur dioxide and mercury.

The subcontinent's utilities and developers are now immersed in the process of exploring technologies, such as FGD, selective catalytic reduction and low NO_x burners that will help them meet government regulations. These regulations are currently expected to come into force over the next five to seven years.



SAVING WATER

In both India and South Africa, another critical environmental consideration is water usage. A scarce resource in both countries, water is used in large quantities in coal-fired power plants.

The Indian government is in the early stages of introducing regulations requiring coal plants in the vicinity of wastewater treatment plants to use only recycled water.

In addition, the Indian government is looking at requiring the use of hybrid or air cooling systems.

The supercritical and ultra-supercritical plants that are now being built achieve greater efficiency by operating at high temperatures and pressures. This creates an ever-greater need for effective cooling of the steam as it leaves the turbines, to minimize back pressure exerted on them.

Typically, water is used for cooling, but the process can be achieved using air, or a combination of air and water, through the use of large fans that cool the steam as it leaves the condenser.

Air cooling is common in dry areas of the United States, and is likely to increase in popularity in emerging markets. South Africa is a water scarce country that started using air cooling in the late 1980s.

POLITICS

Clean Power Plan Expectations and Outlook

By Andy Byers

Global concerns over climate change culminated in an unprecedented international agreement in December 2015. The Paris Accord set the stage for nations to commit to reducing emissions of heat trapping pollutants beginning in 2020. Here in the United States, the Clean Power Plan (CPP), finalized in the fall of 2015, similarly aims to set the stage for large-scale carbon dioxide emissions reductions from existing power plants beginning in 2022.

The CPP is a U.S. Environmental Protection Agency (EPA) rule that established standards of performance that would limit carbon dioxide emissions from existing power plants. Under the final rule, states would develop and implement plans to ensure compliance with the proposed standards. Currently, the rule is suspended while legal challenges are being addressed by the U.S. Court of Appeals for the D.C. Circuit and, subsequently, the United States Supreme Court. While many states have suspended their planning efforts, utilities are continuing to prepare for the potential outcomes of the litigation and possibilities for future carbon regulatory regimes.

As they consider the potential outcomes, utilities remain keenly aware of the CPP's impending compliance timelines set to begin as soon as 2022, with the final goals to be achieved by 2030.

Meanwhile, current market forces, such as the price of natural gas and flat electricity demand, make it especially prudent for electric utilities to consider positioning themselves for potential future carbon regulation in their resource planning scenarios. Retirements, fuel switching, adding more renewable energy and even distributed generation are being given careful consideration by many in the industry.

One unintended consequence of the court's suspension of the CPP is that numerous states are continuing to deliberate how they could craft their own programs to reduce power plant emissions within their own jurisdictions. This presents a risk that even if the CPP is invalidated in the courts, a patchwork of individual state programs may still emerge. To many utilities, this would present even greater challenges than a nationwide approach, especially one that could enable a larger trading market for the electric utility industry to more equitably distribute and share the costs of compliance.

The specter of carbon regulations presents potential implications for future development of the entire electricity supply system. Emissions reduction requirements are driving the need for additional pipelines to deliver gas to power plants, as well as additional transmission lines to deliver electricity from remote renewable energy farms to load centers. Meanwhile, other climate change-induced challenges, such as extreme weather events, are necessitating incorporation of more infrastructure resilience through engineering and design improvements.

Black & Veatch encourages utilities to view these climate change conversations as an opportunity to proactively assess and plan for strategic transformation to a sustainable business future.

Meanwhile, current market forces, such as the price of natural gas and flat electricity demand, make it especially prudent for electric utilities to consider positioning themselves for potential future carbon regulation in their resource planning scenarios.

POLITICS

Are Performance-Based Incentives the Key to a Modernized Grid?

By Russell Feingold

Government incentives have played a germinal role in spurring research, development and, eventually, adoption of technological innovations throughout U.S. history, and that's certainly the case when it comes to utility grid modernization. Finding ways to decouple power utility revenues from consumers' electricity consumption and provide meaningful incentives to promote desirable actions on the part of utilities lies at the heart of the matter.

Traditionally, utilities and their shareholders are compensated on the basis of the amount of infrastructure they build and maintain, as increases in rate base lead to higher earnings. Utilities, therefore, don't have a financial incentive to facilitate the adoption of technologies such as distributed energy resources (DER) that can often reduce the need for infrastructure.

As a result, regulators will need to pay more attention to optimizing the condition and performance of the existing utility transmission and distribution system to ensure utilities can fund the new technologies required for a transition to the grid of the future. A complicating matter is that the sizable investment in modernizing the electric grid comes at a time when growth in electricity demand, and therefore, growth in utility revenues, has slowed.




PERFORMANCE METRICS

PROVIDE NEW OPPORTUNITIES

There is a growing recognition that the earnings of a utility must be closely aligned to increased consumer value. The grid investments being made by utilities should be supportive of DER investments by third parties that increase the economic efficiency of a fully integrated utility grid.

With the large investments by utilities in grid modernization, regulators are recognizing the need for new approaches that provide financial incentives to the utility. Some states, such as Connecticut, Illinois and Maryland, have established performance-based reliability requirements to spur accelerated upgrades to the grid. These requirements incorporate both incentives for meeting minimum reliability standards and penalties for falling short.

In New York, the state regulator is undertaking a major initiative with the Reforming the Energy Vision and proceeding to create new earnings opportunities for utilities. These opportunities will be a combination of outcome-based performance incentives and revenues earned directly from the facilitation of consumer-driven markets. These earnings opportunities will address a number of critical areas, including system efficiency, energy efficiency, customer engagement, interconnection and affordability.



There is a growing recognition that the earnings of a utility must be closely aligned to increased consumer value.

CONTROLLING COSTS WITH PERFORMANCE-BASED REGULATION PLANS

More broadly, some regulators are considering the adoption of performance-based regulation to replace the traditional cost of service regulation. Under this model, the utility's revenues would not be based on the total costs of providing service. Performance-based regulation provides a utility with a stronger incentive to control costs, and the resulting prices charged to its customers, than under traditional cost of service regulation.

Performance-based regulation mechanisms fundamentally change the rate-setting process from a singular focus on cost recovery to one focused on financial and operational incentives. As such, the utility has a strong motivation to control costs because it can retain some level of financial benefits associated with improving the efficiency of its operations, and because it has a reduced ability to pass on cost increases typically allowed under cost of service regulation.

Very simply, performance-based regulation plans focus utility management on the outcomes of the business rather than on investments and energy throughput. A well-conceived performance-based regulation plan provides a means to encourage higher levels of cost performance, without unduly jeopardizing service, by providing utility management with an opportunity for enhanced rewards for assuming some additional degree of risk.

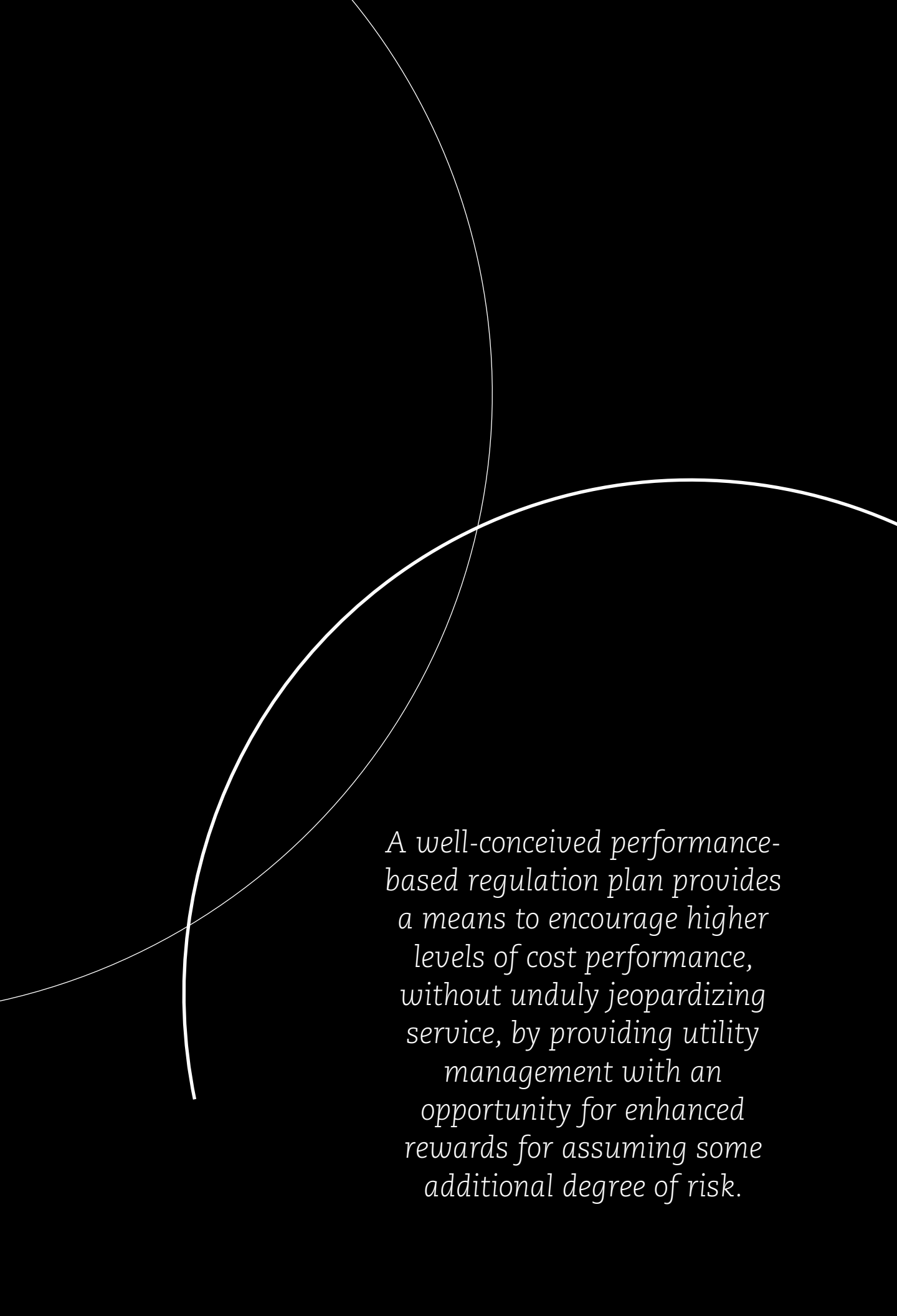
If properly structured, the incentives contained in the performance-based regulation plan should motivate the utility to increase its efforts and to change its behavior to embrace the added managerial and operational flexibility afforded under performance-based regulation, to the ultimate benefit of both its customers and shareholders.

OUTCOME MEASUREMENTS BECOME THE STANDARD

Under these mechanisms, the outcomes achieved by utilities will be the standard by which their performance will be judged. As long as the outcomes are structured to meet the needs of the energy marketplace, utility management should be given greater latitude to decide upon the right levels of investment and specific business activities to best align the interests of its shareholders and customers.

Performance-based regulation plans have been adopted in Canada, the U.K., New Zealand and Australia. With the transformational activities occurring today in the electric utility industry, there is a strong belief that performance-based regulation will be revisited in the United States over the next few years.

The significant investments in smart grid will motivate regulators to measure the achievement of the desired benefits through performance metrics and will have clear financial implications for the utility industry.

The image features two large, thin white arcs that overlap on a solid black background. One arc is positioned higher and further to the left, while the other is lower and further to the right, creating a lens-like intersection in the center. The text is located in the lower right quadrant of the image, within the black space.

A well-conceived performance-based regulation plan provides a means to encourage higher levels of cost performance, without unduly jeopardizing service, by providing utility management with an opportunity for enhanced rewards for assuming some additional degree of risk.

POLITICS

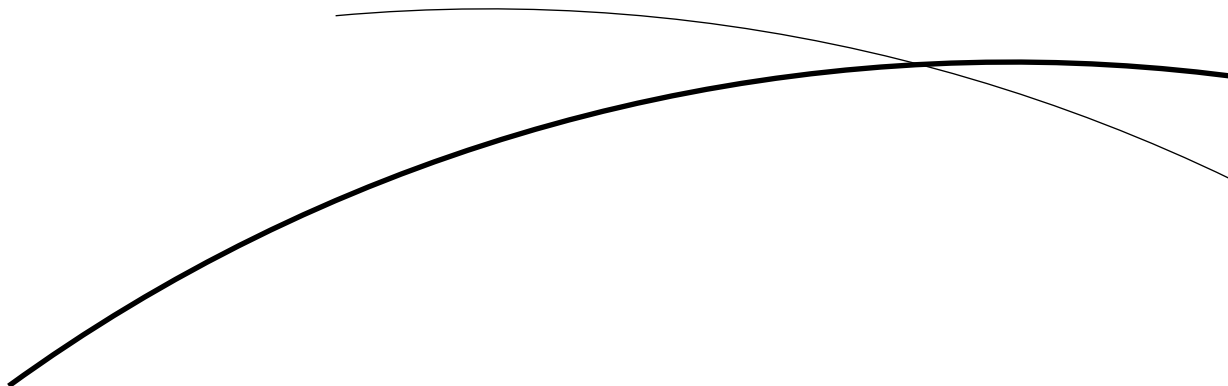
Air Quality Controls

By Daniel Chang

With fossil fuels to remain in the energy mix for power generation globally, environmental regulations play a large role in controlling their impact on air quality. Mandates in the Clean Power Plan and related regulatory actions motivated by the United Nations (U.N.) Climate Change Agreement are requiring electric service providers to reduce their carbon footprint. Additionally, other criteria pollutants are also regulated by national environment protection institutions and also are safeguarded by international consensus for air pollution impacts for power generation project funding. How utilities manage their existing fleets and develop new power generation sources will be heavily dependent on meeting these stringent emissions limits.

To meet standards, utilities will need to invest in environmental requirements such as air emissions control and monitoring equipment, diversification of their electric generation profile and demand-side efficiency programs.

The Environmental Protection Agency (EPA) Clean Power Plan aims to reduce carbon dioxide (CO₂) emissions from existing coal and combined cycle power plants in the United States. States will be required to develop and implement programs to lower carbon intensity or overall emissions from these regulated sources within their jurisdiction by 2022. While most states' actions have been suspended pending the outcome of ongoing litigation, utilities must still determine the best course of action over the long term to meet potential future requirements.



THE COST OF COMPLIANCE

Taking impending regulations into account, utilities are already planning to invest in certain environmental features. For existing power generation, a significant amount of that investment will be allocated to air emissions control equipment in the near term, as is indicated by this year's survey responses (Figure 23).

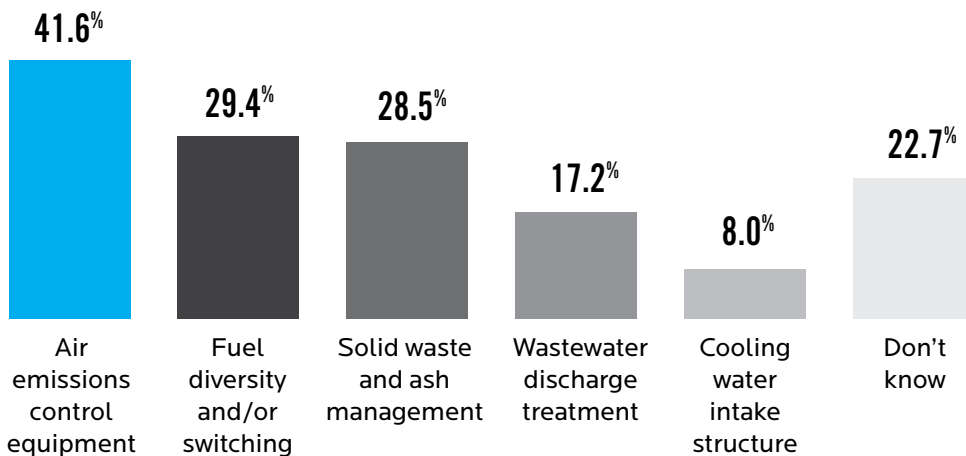
For existing coal-based power plants, recently finalized environmental regulations are forcing decisions to either switch fuels or upgrade their ash and wastewater management systems in order to continue operations.

In sync with looming compliance deadlines, priorities in investment planning directly reflect these more recently finalized mandates.

Environmental investments can considerably impact a utility's operational costs. Investor-owned utilities are increasingly looking to invest in fuel diversity. With the current low price of natural gas, combined with the Clean Power Plan mandates to reduce carbon intensity, many utilities are looking to protect shareholders while taking advantage of this currently lower cost energy source.

Figure 23

[Electric Service Providers] Which of the following environmental requirements will your organization invest in most over the next five years? (Select top two choices.)



Source: Black & Veatch

Environmental regulation will continue to drive how utilities choose to invest in carbon footprint reduction. How they choose to prepare to meet these standards could potentially impact their bottom line.

PREPARING FOR NEW REQUIREMENTS

How can utilities best prepare for regulations if deadlines are still unclear? More than half of electric service providers surveyed anticipate that the timeline for additional requirements stemming from the U.N. Climate Change Agreement will be imposed on operations within the next nine years (Figure 24), which coincides with the initial compliance deadlines set forth in the Clean Power Plan in the United States.

Several electric providers are already investing in efficiency improvements, including integrating renewable energy sources and innovative technologies that will aid in complying with new requirements. Integrating a diverse power generation mix will be integral for electric service providers. Introducing renewable energy sources will help lower carbon emissions and promote reliable and resilient systems. Carbon taxation is also still seen as an effective motivator, and its effects can be alleviated by incorporating noncombustion energy.

Innovations such as carbon dioxide capture and sequestration (CCS) technology can also reduce emissions by capturing, compressing and then storing the CO₂ in underground formations. CCS has been demonstrated to be technically viable, but the costs of capture, transport and sequestration remain high. The use of compressed CO₂ for enhanced oil recovery can partially offset these costs.

CAPITALIZING ON ENVIRONMENTAL MARKET EFFICIENCY

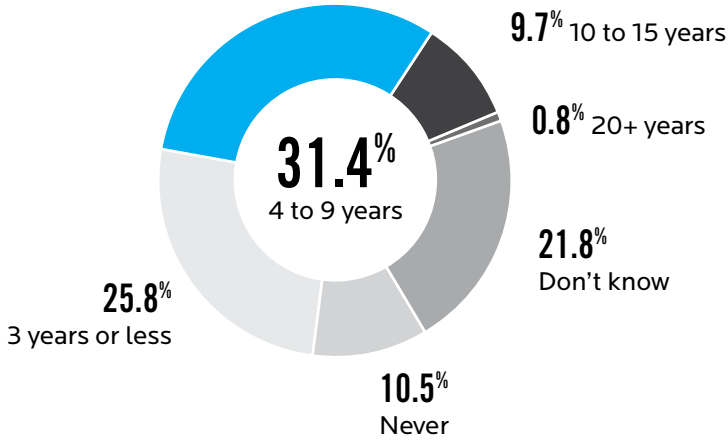
Environmental regulation will continue to drive how utilities choose to invest in carbon footprint reduction. How they choose to prepare to meet these standards could potentially impact their bottom line. As previously mentioned, the cost of compliance is not cheap; however, trading programs can provide opportunities for utilities to spread the costs of compliance among generation sources across states or regions to achieve Clean Power Plan reduction goals at a lower overall cost.

Nearly a third of survey respondents identified a mass-based cap and trade program as the most equitable implementation option for reducing greenhouse gases (Figure 25). In a mass-based cap and trade program, electricity providers that can more efficiently and economically reduce emissions from their overall portfolio can sell allowances to providers with higher marginal reduction costs. This allows both parties to maintain compliance while achieving the overall reduction goals. It is generally believed that the larger the allowance trading market a utility can participate in, the lower its overall costs of compliance will become.

How utilities plan to meet requirements could impact their success down the road. While compliance can require upfront investment, those that take advantage of air quality control opportunities can benefit in the long run.

Figure 24

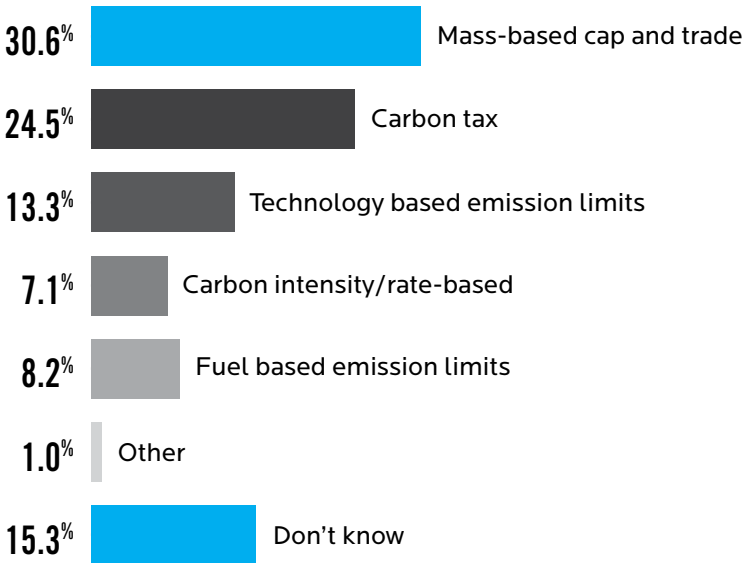
[Electric Service Providers] How soon do you expect significant additional requirements will be imposed on your operations as a result of the United Nations Paris Climate Change Agreement? (Select one choice.)



Source: Black & Veatch

Figure 25

[U.S. Electric Service Providers] Assuming a greenhouse gas reduction program or regulation is implemented in the United States, what type of national program limits would be most equitable and efficient for the power sector? (Select one choice.)



Source: Black & Veatch

GLOBAL PERSPECTIVE

*Will An Expanding Role for China's
Independent Power Producers Alter
the Global Renewables Landscape?*

By Ric O'Connell



Over the past few years, both renewable generation and renewable equipment manufacturing have surged in China. Now, a combination of government initiatives, macroeconomic shifts and market forces could drive Chinese renewable energy independent power producers (IPPs) onto the world market at a much larger scale than before. This shift could mean increased competition for established IPPs, but could also provide new opportunities for cooperation in international sustainable development.

REMARKABLE GROWTH IN THE CHINESE RENEWABLE INDUSTRY OVER THE LAST DECADE SETS THE STAGE

In 2006, Germany was the world's wind power leader, with an installed capacity of approximately 20 gigawatts (GW). By comparison, China's installed wind capacity at that time was just 2.6 GW. But by 2015, while Germany's installed wind power had more than doubled to nearly 45 GW, China's had grown to 145 GW, a 56-fold increase, according to The Global Wind Energy Council's 2015 report.

By many accounts, the rapid growth of the Chinese wind industry can be traced to a 2005 renewable energy law that required grid operators to purchase a percentage of their electricity from renewable energy providers. A feed-in tariff for wind energy was set by the National Development and Reform Commission, a regulatory department of the State Council. The cost of purchasing renewable energy was distributed among consumers. As the renewable source with the lowest cost per kilowatt-hour at the time, wind power benefited.

Compared to wind, solar generation in China was slower to take off. Even as the nation became a global leader in the production of solar panels, a relatively high per-kilowatt-hour cost kept solar from penetrating the domestic Chinese market for a number of years. As late as 2010, Chinese solar capacity was only 0.3 GW; however, even as domestic solar power generation lagged behind wind, solar equipment manufacturing for the global market surged.

Years of robust economic growth encouraged many Chinese companies, both private and state-owned, to incorporate capital investment as part of their growth strategies. Given the transitional nature of the economy, many of these nascent capital investment efforts focused on promising industries and led to what has been termed the "Wave Phenomena" and overinvestment in sectors such as solar manufacturing. The result was a collapsing price of solar panels. As the price of panels fell, the government responded by passing a feed-in tariff for solar power generation, in part as a way to support the industry and absorb excess manufacturing capacity. By 2015, China had an installed domestic solar generation capacity of 45.5 GW.



A SLOWING ECONOMY CAUSES CHINA'S ENGINEERING SECTOR TO LOOK OUTWARD

The solar equipment industry, however, was not the only manufacturing sector in China that had surplus capacity. As of 2016, many analysts were reporting a significant slowdown in the broader Chinese economy, with excess industrial production, from sectors including iron and steel manufacturing to downstream industries such as equipment and machinery manufacturing, bearing at least part of the blame.

In response, China has been looking at macroeconomic policies and initiatives abroad. The recent creation of the Asian Infrastructure Investment Bank (a Chinese-led international institution that aims at financing infrastructure throughout Asia) and the Silk Road Infrastructure Fund (a state-owned investment fund) underlines the idea that China continues to look beyond its borders to tackle domestic capacity issues.



The recent creation of the Asian Infrastructure Investment Bank (a Chinese-led international institution that aims at financing infrastructure throughout Asia) and the Silk Road Infrastructure Fund (a state-owned investment fund) underlines the idea that China continues to look beyond its borders to tackle domestic capacity issues.

However, this trend is not new. Since becoming a member of the World Trade Organization in 2001 and with the onset of globalization in general, China (and its infrastructure development companies) has been exerting influence overseas on energy and other infrastructure projects. Many new Chinese international contracting companies have emerged to the extent that, in terms of revenue, 62 of the top 250 international contractors were Chinese, according to Engineering News-Record.

The power generation sector, in particular, has been active overseas and was boosted on the back of the 2008 financial crisis when the Chinese government channeled the largest portion of its ¥ 4 trillion RMB stimulus package (37.5 percent) to the Transport and Power Infrastructure sector. Chinese companies, both contractors and equipment manufacturers, have aggressively targeted international coal-fired power generation projects overseas. In recent years, they have played significant roles in many projects around the world, particularly throughout Asia and Africa.

Official government communication at the end of 2014 sent a signal to Chinese lenders to ramp up financing for Chinese companies that are “going global,” noting it would help “make more use of excess production capacity.” According to recent estimates, international investments make up almost one-fifth of China Development Bank’s loans.

China's commitment to invest both private and state funds into international infrastructure projects, engineering and sustainable development, coupled with a slowing domestic market for such projects in China, suggests that Chinese renewable IPPs could soon be expanding globally as well.

NEW POSSIBILITIES FOR INDEPENDENT POWER PRODUCERS AND RENEWABLE GENERATION

In late 2015, The Times of Africa reported on the rapid growth of independent power production in Africa. While the focus of the article was on the opportunities in the market for the South African renewables sector, it also pointed out that China has pledged \$60 billion for development on the continent.

China's commitment to invest both private and state funds into international infrastructure projects, engineering and sustainable development, coupled with a slowing domestic market for such projects in China, suggests that Chinese renewable IPPs could soon be expanding globally as well.

Such growth will likely come not from large, state-owned enterprises, but from more nimble, publicly traded global companies. For example, Goldwind Americas, the American arm of the Chinese wind turbine manufacturer, recently acquired the 160 megawatt Rattlesnake Wind project in Texas from RES Americas. In the last few years, Goldwind has acquired or developed wind projects in six continents.

Canadian Solar provides another example. Although technically a Canadian company, Canadian Solar produces the bulk of its solar panels in China and has customers around the world. The company is building utility-scale solar power plants in a number of countries, including India, Japan, the United States, Brazil and the U.K.

CHALLENGES AND OPPORTUNITIES

If Chinese renewable energy IPP growth does take off globally, it could provide a competitive challenge for many established or traditional IPPs but could also provide real opportunities for cooperation between nations to meet the global climate challenge.

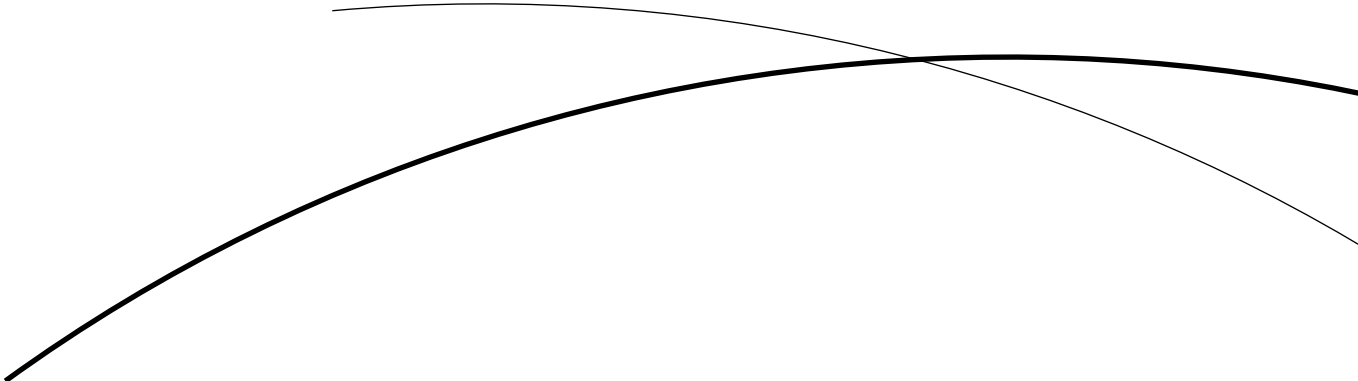
In December 2015, 191 countries and entities negotiating at the U.N. COP21 (Conference of the Parties) climate change conference in Paris reached a landmark agreement calling for global reduction in greenhouse gas emissions. At the same time, 2015 marked the end of the first period of the U.N. millennium development goals, an initiative that aimed to eradicate extreme poverty through sustainable development in the poorest parts of the world. Its successor, sustainable development goals, adopted in September 2015, explicitly linked climate change to the initiative and called for access to renewable energy as one of its 17 sustainable development goals.

China's renewable energy IPPs could play a crucial role in helping the world make progress on both of these important initiatives. Just as low-cost Chinese solar panel production has helped spur a solar boom in the United States and elsewhere, greater competition from IPPs could push the costs of utility-scale projects down, making renewable energy even more viable in both the developed and developing world.

However, this potential expansion is not without risk. A new wave of Chinese engineering, procurement and construction (EPC) contractors could pose risks to international developers and project owners in the future. In the past, a number of international power generation projects struggled as inexperienced contractors won contracts based on low-cost bids and unrealistically aggressive schedules leading to cost overruns, delays and long-term maintenance challenges. Procuring Chinese power equipment has called for tight quality and supply chain control as well as an understanding of how to resolve different Chinese and international engineering codes and standards.

Such risks could be mitigated by the fact that the new breed of Chinese IPPs are public, internationally traded companies with an explicitly international focus and thus may have nimbler business models and approaches than earlier state-owned players. These new approaches could present new opportunities for a blend of international EPC contractors, owner's engineers and equipment manufacturers.

No matter which players are engaged in the international renewable IPP market, utilities and their partners will need to continue working together on best practices for successfully integrating renewable IPPs and distributed generation into the grid. As the COP21 conference highlighted, the need to develop robust and sound renewable energy policies has never been more urgent.



TECHNOLOGY

Electric Vehicles – No Time Like the Present

By Paul Stith

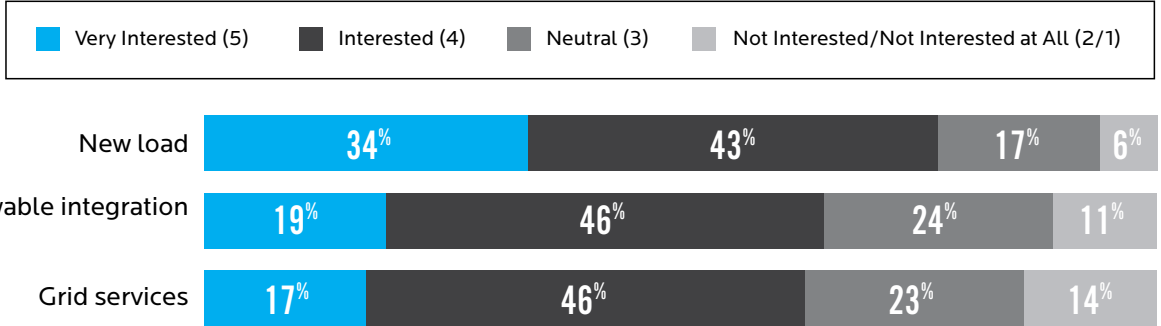
Although generating less than 1 percent of global auto sales, electric vehicles (EVs) passed a historic milestone in 2015 as the 1 millionth EV rolled off a dealer lot. In less than a decade, multibillion dollar investments in EV design and manufacturing capacity, coupled with rising consumer demand, have taken once dubious concept cars and made them growing fixtures of global roadways. Concurrently, significant progress in key markets that leverage EVs lowers the total cost of ownership and operations, including transit, freight, and corporate and public fleets. In addition, while growth in the EV market will likely transform the transportation sector in the future, its growth is increasingly tied to the dynamism of the power networks that will support their use.

For electric utilities, much of the excitement regarding EVs involves their potential as a source of new demand load. More than 75 percent of respondents identified themselves as “very interested” or “interested” in EVs as new revenue streams while traditional industrywide demand remains flat (Figure 26).

Even though the market remains in its nascent stages, the potential for rapid and occasionally concentrated growth will require preparations across operational and business groups. Figure 27 shows the vastly differing experiences of utility service providers ranging from those with fewer than 100 EVs (34 percent) to a small number of respondents with more than 10,000 EVs on their network (4 percent).

Figure 26

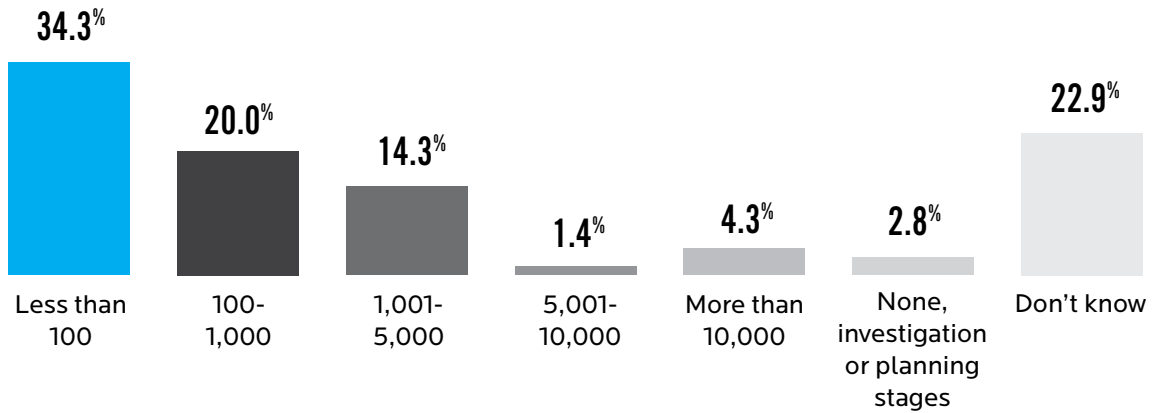
What is your level of interest in the following as a potential revenue stream for EVs? Please rate each on a 5-point scale, where a rating of “5” means “Very Interested” and a rating of 1 means “Not Interested At All.” (Select one choice per row.)



Source: Black & Veatch

Figure 27

How many EVs do you have currently in your system? (Select one choice.)

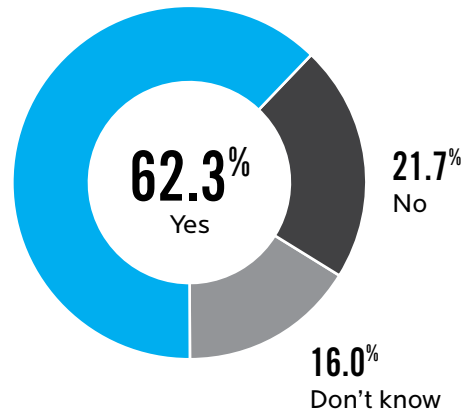


Source: Black & Veatch

Given the potential disruptive effects of EVs on existing infrastructure, particularly neighborhood-level transformers, it will be important for electric utilities to increase customer engagement surrounding adoption. Of concern, nearly one-quarter of respondents indicated they had no idea of the number of EVs in their system. Although owners do not have a requirement to notify utilities that they have purchased an EV, solutions to ensure adequate maintenance and investment scale with adoption are important. Greater coordination among agencies, such as state departments of motor vehicles; and EV rates can play an important role in helping electric utilities identify the rate of load growth of EVs in their system.

Despite limited representation within the world's largest car markets, Norway, with 22 percent of all auto sales already plug-in vehicles and a 100 percent target on the horizon, shows what can be achieved in a relatively short time frame. Electric utilities must examine how they can play a role in supporting the necessary investments in EV infrastructure to support rising consumer interest in the expanding portfolio of EVs from manufacturers such as Tesla, Nissan, Ford, BMW, General Motors and Volvo. To this effect, nearly two-thirds indicate a need to examine tariffs and the state/local regulatory structures to allow them to support growth in EVs (Figure 28).

Figure 28
Is your organization examining/studying the regulatory environment surrounding EV infrastructure? (Select one choice.)



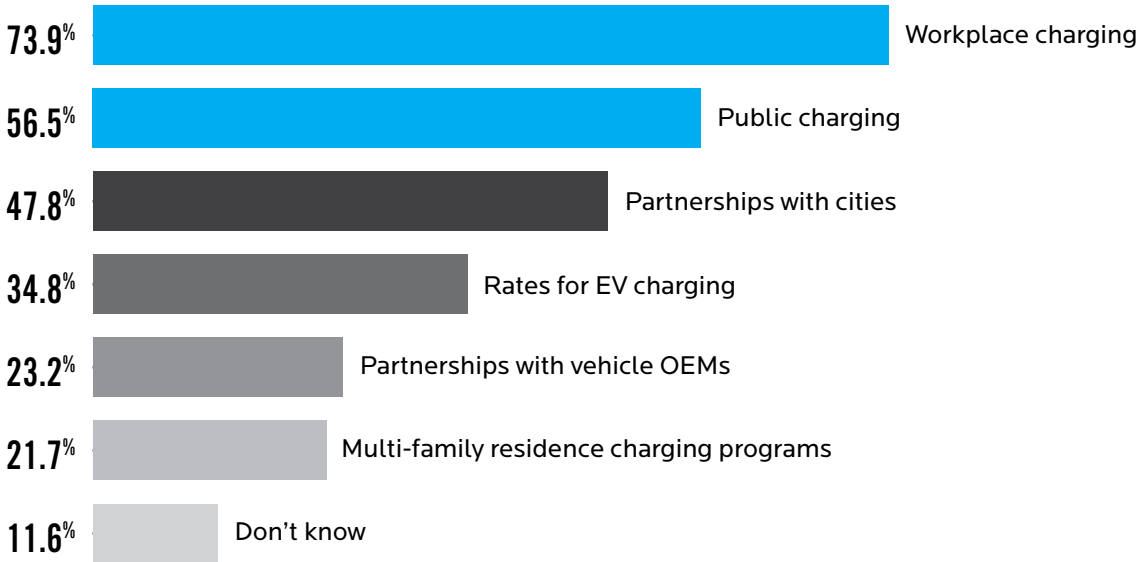
Source: Black & Veatch

In many instances, electricity costs are dominated by demand fees designed to recover the cost of delivery. This is especially true for high power direct current (DC) fast-charging stations often metered independent of other loads that are critical to broader EV adoption. To support cost recovery yet encourage infrastructure development, tariffs can be developed to spread high demand fees across kilowatt-hours delivered and may be tailored to evolving market conditions. Such structures will remove barriers to early market infrastructure deployment and will lead toward new load growth over time.

Similarly, the fee structures can be adjusted to encourage owners to charge during the best time for the utility. Nearly 75 percent of respondents indicated support for workplace charging initiatives, with more than half (57 percent) supporting public charging (Figure 29). Support for workplace charging typically means that utilities are working with their large commercial accounts and are ready and seeking to strengthen their relationships with these customers.

Figure 29

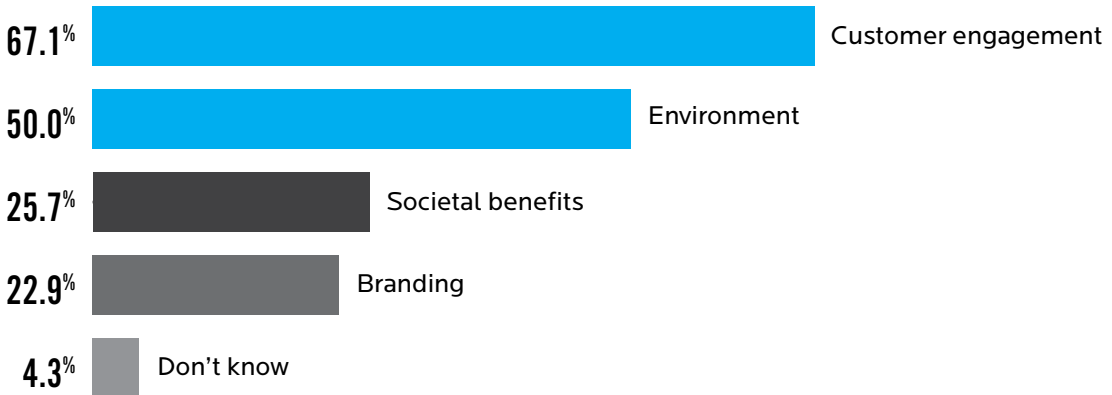
Does your organization support the adoption of any of the following EV programs or technologies?
(Select all that apply.)



Source: Black & Veatch

Figure 30

Beyond grid/energy value, what does your organization see as the greatest benefits of encouraging EV adoption?
(Select top two choices.)



Source: Black & Veatch

In California, for example, with large volumes of solar resources available during the daylight hours, workplace charging is a compelling option for utilities. Other states may encourage evening charging as demand loads drop while baseload capacity remains. Efforts to explore these options in anticipation of widespread EV adoption are encouraged because altering regulatory constructs typically can take extended periods of time.

For an industry often thought of as trailing the retail or financial sectors in terms of customer experience programs, it is important to note that two-thirds of respondents indicated that encouraging EVs represents a great way to interact with and communicate with their customers (Figure 30).

Not only do EVs give utilities a way to get in front of their customers, they can also be viewed as a strong market enabler, supporting the growing ecosystem of market participants via support for charging infrastructure investment while enhancing their brand. In addition, 50 percent of utilities indicated that EVs have environmental impacts and that support for the technology mirrors changing customer expectations for their service providers. As an ancillary opportunity, the ability to demonstrate societal benefits such as reduced greenhouse gas emissions, real regional economic and health benefits through reduced fuel imports, and pollution reduction can be used to support investments that can be included in the rate base.

A few years ago, there was significant concern across the industry about the potential for EVs to accelerate transformer burnout, making support difficult. However, the combination of gradual adoption and both regulatory and public support for investments in a more reliable, flexible grid/charging network has created a scenario in which electric utilities are prepared to play a major role in facilitating broader adoption. Because, without a doubt, the combination of vehicle technology, market forces and changing cultural standards is creating a perfect storm that will propel EVs forward.



Without a doubt, the combination of vehicle technology, market forces and changing cultural standards is creating a perfect storm that will propel EVs forward.



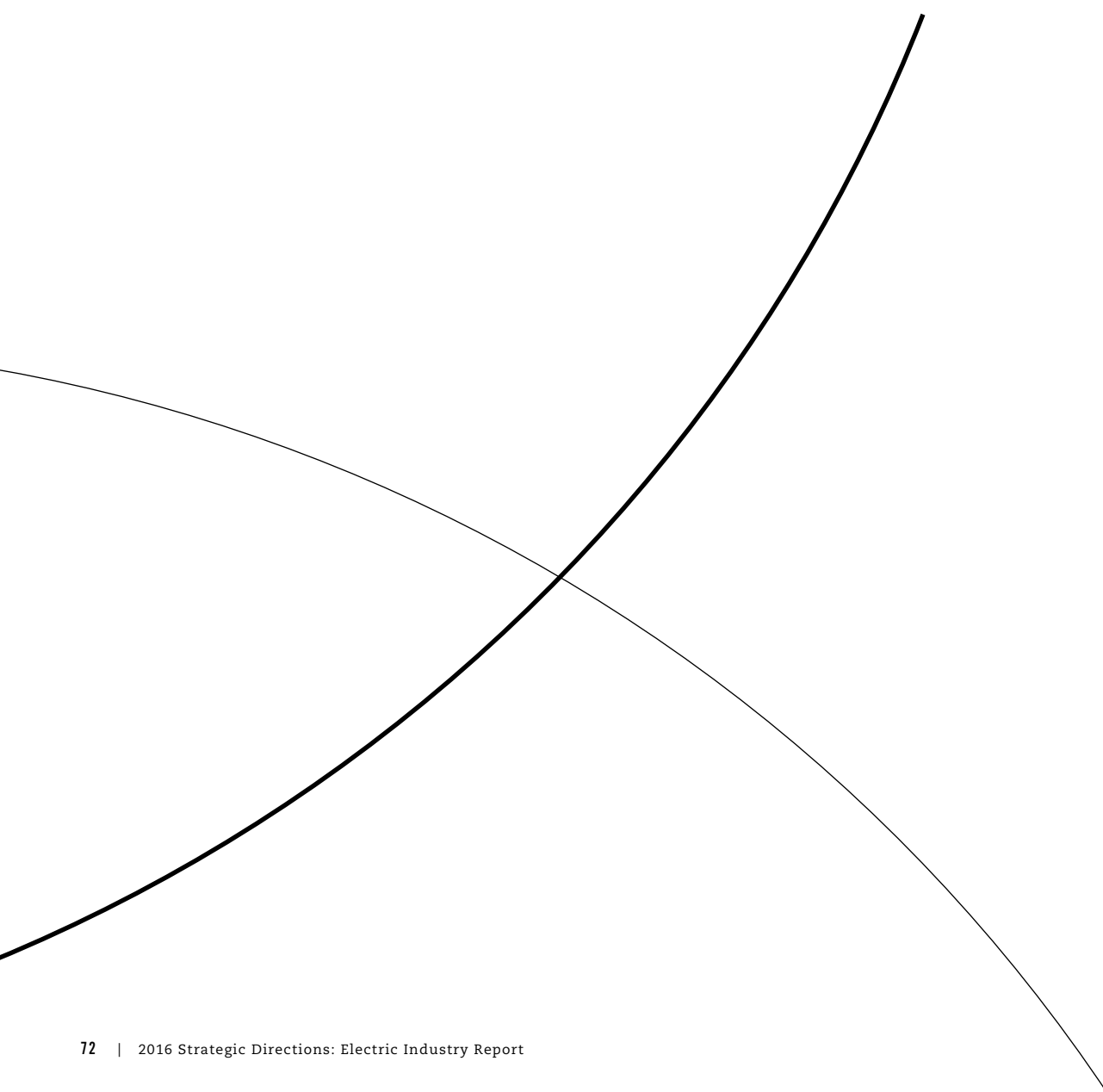
TECHNOLOGY

Modern Customer Information Systems Benefit Customers and Utilities

By Donald Parr

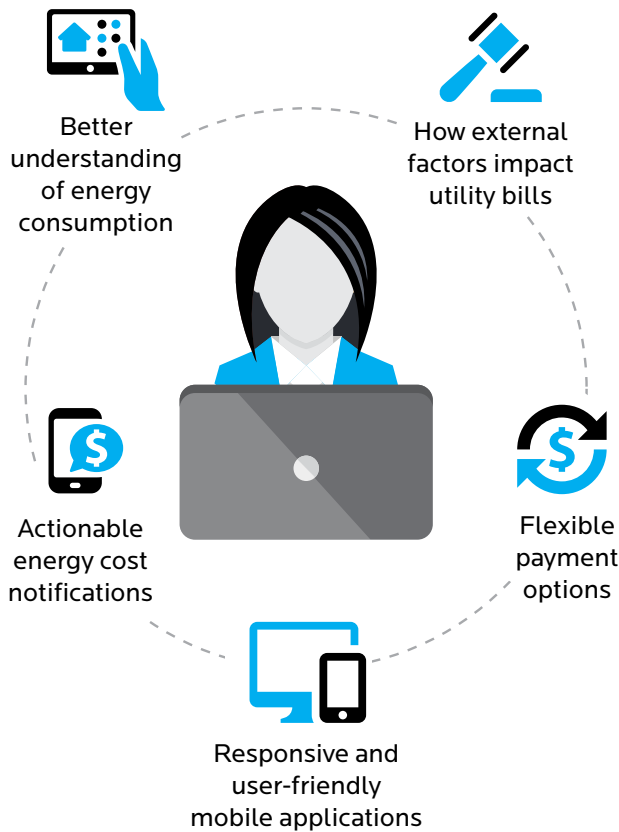
Cloud-based technologies have transformed customer billing and operations for electric service providers. No matter their size, utilities are expected to utilize the latest customer-facing technology to increase engagement. Additionally, utilities can increase operational efficiency and customer support by moving to more advanced systems.

Advanced metering infrastructure (AMI) makes these new technology investments easier to implement and can be significantly more cost-effective and less time-intensive than an entirely new customer information system (CIS) upgrade.



YOUR SUCCESS AS A UTILITY DEPENDS ON CUSTOMER COMMUNICATION

*The Key Benefits of a Modern
Customer Information System (CIS)*



***Investments today
in modernizing your CIS
will pay off tomorrow.***

Source: Black & Veatch | bv.com/reports

CUSTOMER DEMAND DRIVING TECHNOLOGY INVESTMENTS

The end of the 20th century brought the fear of a Y2K glitch in front of any business with online systems. In electric utilities, the chance that an outdated payment and operational system would crash on 1 January 2000 drove countless CIS replacements. At present, several of those systems have long been outdated and electric providers are now investing in new technologies.

A modern CIS can provide a number of benefits to both the customer and to the utility. Easier access to billing information provides insight on the exact services being provided and their consequent pricing. Detailed usage information, especially with the increased use of smart grid technology and distributed energy resources (DERs), can motivate customers to conserve energy, choose a more appropriate rate plan or enroll in incentive energy efficiency programs. Increased online communication also leads to a rise in paperless billing, which decreases overhead costs to both customers and utilities and benefits both from quick online payment methods.

Customers expect their electric service providers to not only provide reliable energy but also empower them to make informed decisions in energy usage. To meet customer demand, utilities are adapting to new mobile applications, revamping customer self-service portals, implementing new CIS technology and overhauling call center technology. Cloud-based solutions make applying new technologies more manageable for even smaller utilities that typically lack dedicated resources to manage technology infrastructure.

LEVERAGING AMI CAPABILITIES

AMI can benefit utilities and customers alike. AMI systems enable the collection and analysis of energy usage data to better serve customers. With increased interest in smart grid technology, demand management and energy conservation, nearly half of electric providers surveyed are planning to invest in leveraging these capabilities (Figure 31).

Almost as many respondents are also planning to enhance digital customer engagement. Beyond basic self-service, digital engagement can boost customer satisfaction by providing an information portal in case of outages. Users can track resolutions online as well as request service orders.

Incorporating DER provisioning, though scoring the least in planned investments, could signify different concepts for each utility. Some electric providers may still be in the nascent stages of devising their DER strategy and are reluctant to invest significantly until their AMI is fully operational.

UPGRADING MOBILE APPLICATIONS TO BENEFIT CUSTOMERS AND OPERATIONS

The benefits a modern CIS provides customers are tangible, but electric providers can also enhance operational efficiency with new technology. Energy usage data not only help customers make better consumption decisions but also help providers manage energy production. Paper orders for service technicians have moved to mobile applications. Instead of depending on paper requests and transit and communication from the utility base to customer homes, information can be transferred through mobile devices, streamlining the response process.

AMI facilitation of remote meter access has additional operational advantages. Utilities can obtain meter readings in real time or perform remote service disconnects without having to send a technician out into the field. These advantages are likely the justification for an increased investment in upgrading or deploying mobile applications (Figure 32).

CONFIGURING TECHNOLOGY TO BENEFIT CUSTOMERS AND UTILITIES

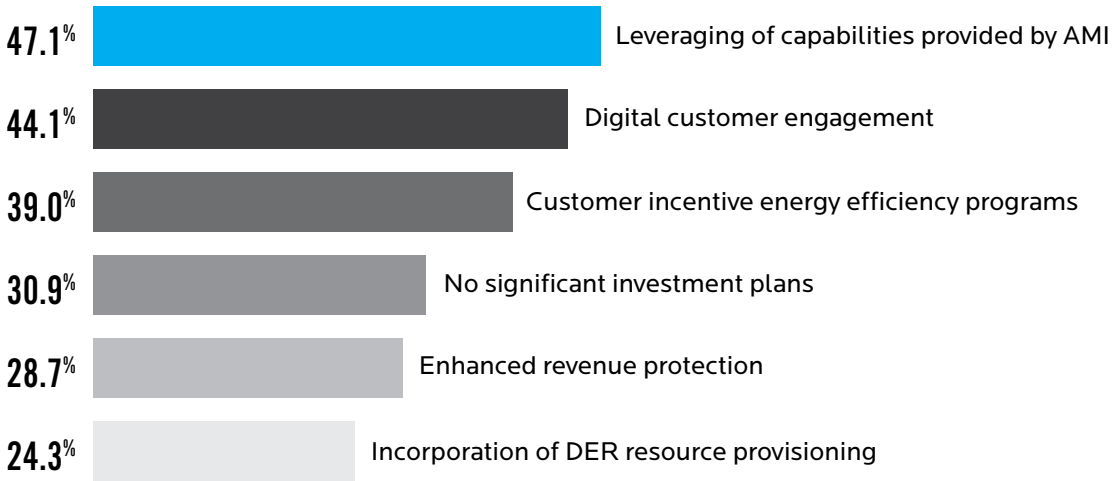
As new technologies continue to evolve and enhance the electric utility customer experience, it can be difficult to prioritize which investments are wisest to make. Implementing a new CIS from the ground up is costly, likely averaging in a \$35 to \$45 per customer rate. The process is also time-consuming and can take upwards of 18 to 24 months.

Identifying the CIS configuration that will best serve a customer base, as well as the utility, is an important first step in upgrading customer billing technology. Utilities will probably see differing priorities based on geographic location that could modify these needs. For example, electric providers in U.S. states such as Hawaii or California may see more demand from their customer base for DER options for reliability assurance or environmental interests.

How electric providers manage the balance between customer demand and operational efficiency will be integral for successful technology adaptation. Electric companies should evaluate long-term goals and choose a technology strategy that best fits their specific customer satisfaction and operational goals.

Figure 31

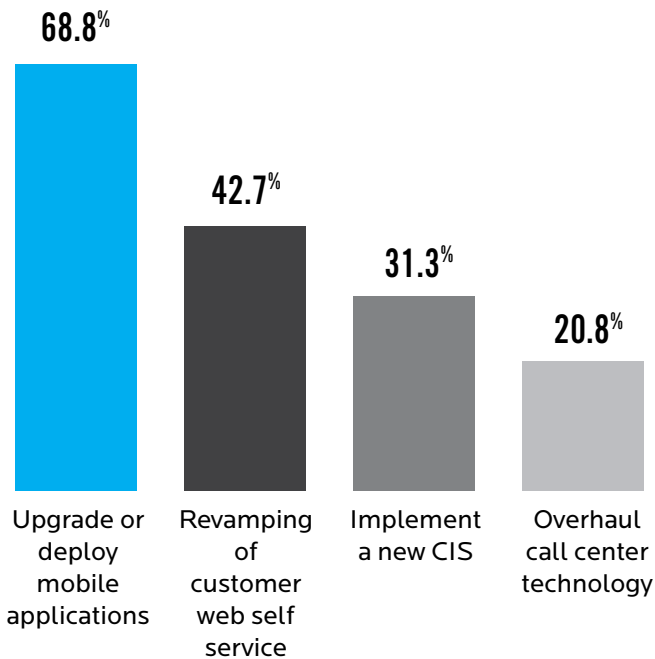
[Electric Service Providers] Does your organization plan on making changes to your CIS system to support the following? (Select all that apply.)



Source: Black & Veatch

Figure 32

Which of the following is your organization planning to change in the next year? (Select all that apply.)



Source: Black & Veatch

TECHNOLOGY

Energy Storage Begins to Move Beyond Early Markets

By Paul Stith

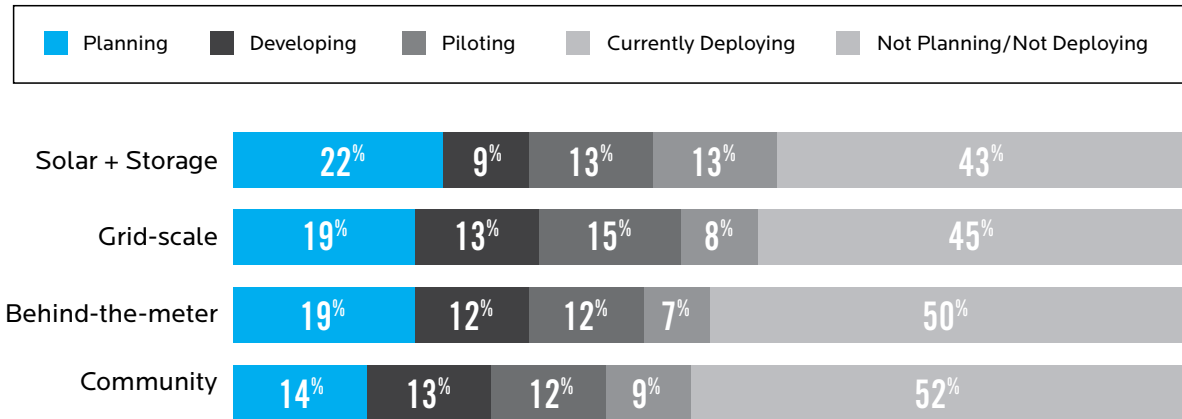
Utilities are starting to get on board with energy storage programs, whether they are grid-scale, behind-the-meter, solar and storage, or community. Generally, about half of survey respondents said they are planning, developing, piloting or already deploying storage programs – certainly a solid number for a still-emerging technology (Figure 33).

Despite that positive number, the other half said they had no plans to deploy any type of energy storage program. This demonstrates the education that needs to occur surrounding this technology, since we believe any utility can benefit in a growing number of ways from energy storage. It is not just for the large utilities or just for certain geographic locations.

While storage can be positioned in multiple places on the grid and is in certain applications very location-specific, in general, the closer it is located to the grid edge, the more value streams it can address. When positioned behind the meter, customer applications, such as peak reduction, time-of-use shifting or demand response programs, are readily accessible. Today's software, coupled with fast-acting energy storage systems, optimizes capacity around customer tariffs and offset demand fees in the most valuable ways for their particular situation. As the regulatory landscape progresses, the same assets can be used in utility programs or participate in independent system operator markets. This opens up new economic windows for storage.

Figure 33

[Electric Service Providers] Is your organization currently planning, developing, piloting or deploying any energy storage programs? Please indicate your organization's current state of deployment for the following programs by selecting the appropriate response choice.



Source: Black & Veatch

ENERGY STORAGE COUPLED WITH SOLAR

Battery storage systems – both behind-the-meter and utility-scale – paired with solar are becoming more common as grid realities such as high solar penetration and economics of storage advance. For instance, Hawaii has experienced a very strong solar adoption – so strong that the utility had to develop new approaches to interconnection. Going forward, consumers and businesses must have the software and technical ability to automatically cut off exports to the grid under the control of the utility. Storage can be activated as a means to preserve energy for self-consumption, giving another strong incentive to install storage.

Net metering considerations are also part of solar debate in markets such as Arizona and Nevada. Continued adoption of solar in markets with less favorable net metering compensation may encourage accelerated adoption of storage and, ultimately, leaving the grid.

AGGREGATE STORAGE POOLS

Another interesting development in the battery arena is the creation of aggregated pools in California of distributed energy resources (DER), including energy storage. These pools have been approved by the Federal Energy Regulatory Commission for demand response programs to respond as if they were a virtual power provider. This allows providers to offer energy storage packages of services by combining fleets of battery storage units from diverse locations. In effect, the move allows battery owners to play both sides of the game – both behind the meter and beyond the meter. This development signals that momentum is building for grid-aggregated, behind-the-meter assets to serve grid-scale requirements. The key to this movement – beyond regulatory changes – is that software vendors are actively creating new products to make these “stacked benefit” transactions seamless and transparent.

Incentives are playing a major role in the development of battery storage. Industry players are taking advantage of these where available, thereby enabling early market storage projects to reach break-even sooner. Black & Veatch has been very active in helping utilities and project developers leverage these incentive programs.

The momentum is certainly strong, and many new players are entering the market to etch their place in the new energy picture by pursuing promising new opportunities.

RAPID CHANGES IN THE MARKETPLACE

As the market evolves, and as more third-party companies become service providers, the regulatory environment must also reflect the change to enable the most benefits. Utilities will need to develop a new level of comfort around all of these changes. Based on responses from survey participants, that may be difficult. More than one-third to one-half selected “extremely challenging” or “very challenging” for the question of how difficult it will be to connect storage to the grid as it relates to siting, technology integration, interconnection or the physical location (Figure 34).

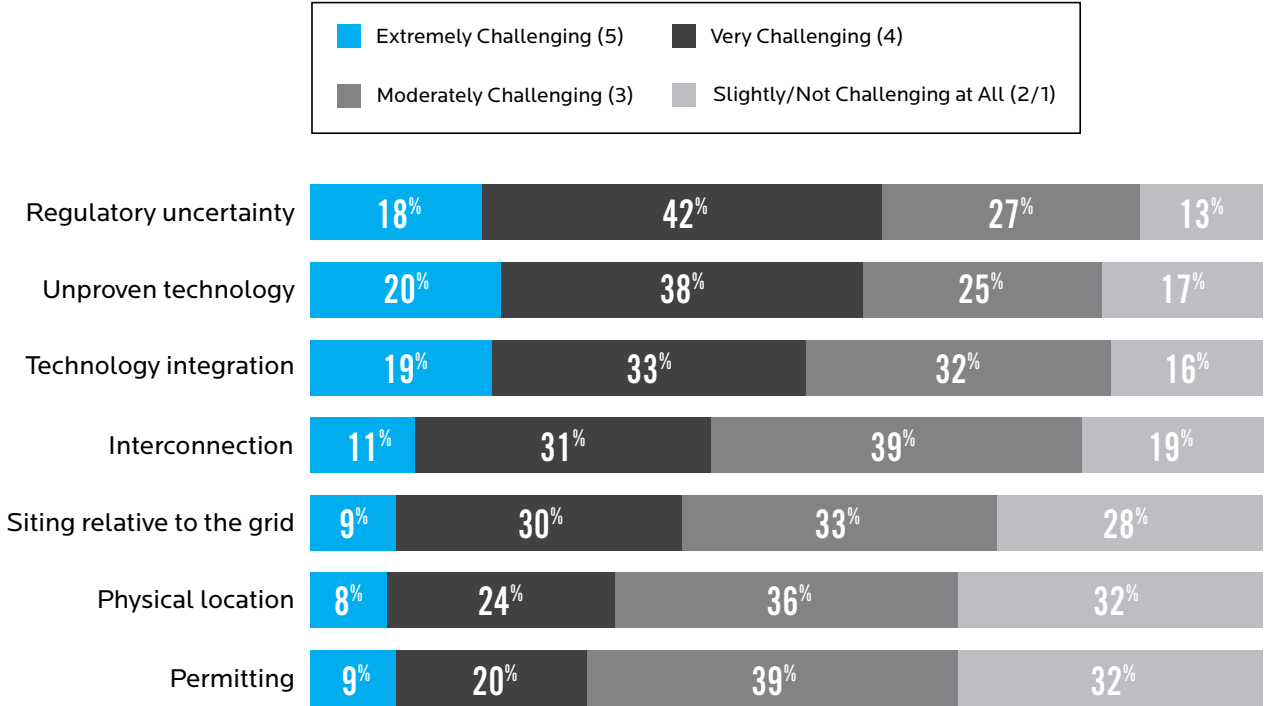
In some states, there is a major disincentive to share assets; yet with customer-side assets, if they are shared, this could allow utilities to get the benefits of assets for less expense. Despite this cost-savings potential, not owning assets might not be in the best interest of shareholders. Depending on the business model in use, utilities make money on their capital spend because of the guaranteed fixed rate of return. In effect, less spending equals less return.

Changing the equation, however, allows many new options. Utility-controlled battery schemes that reside on consumers’ real estate are a new idea. These schemes provide emergency backup for the consumer (or prosumer), as well as an ability to produce, store and optimize use of energy. Utilities benefit from the storage assets and control what is coming on to the grid, and many outside players are allowed to finance, participate and compete in the energy and battery storage markets.

Navigating these changes in the marketplace will pose just one more challenge that utilities must overcome. The momentum is certainly strong, and many new players are entering the market to etch their place in the new energy picture by pursuing promising new opportunities. Some utilities are reacting by forming their own energy service companies to compete outside of their regulated market territories. This changing landscape certainly requires new thinking.

Figure 34

What have been the greatest challenges associated with connecting storage to the grid? Please rate each item on a 5-point scale, where a rating of 5 means it is “Extremely Challenging” and rating of 1 means it is “Not Challenging At All.” (Select once choice per row.)



Source: Black & Veatch

TECHNOLOGY

Securing Power

By David Mayers and
Tracy Monteith

The risks to utilities from cyber and physical attacks have never been more top of mind. Recent breaches have shown the negative impact that can come from a highly publicized incident. Damage is done to customer trust, brand and overall reputation. The threat environment, coupled with the impending North American Electric Reliability Corporation (NERC) Critical Infrastructure Protection deadline –and the audits that are likely to result – is impacting how utilities address security risks.

ASSESSING THE CURRENT RISK ENVIRONMENT

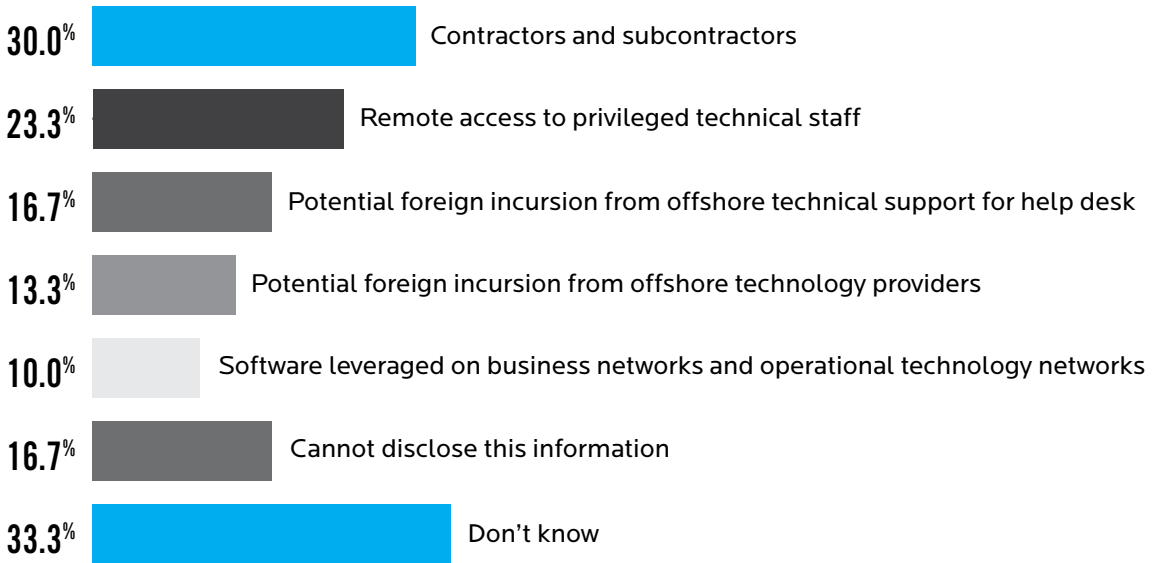
Survey respondents rank cybersecurity second only to reliability among the most important industry issues (see this report's executive summary). Compliance deadlines aside, security is only growing more important as electric utilities continue the march toward smart infrastructure and cities. Increased connectivity comes with increased vulnerability.

Here, electric utilities have much to learn from other industries such as banking, where concerns about the security of consumer data and regulatory compliance catalyzed changes in the industry's approach to and management of cybersecurity challenges.

For electric utilities, as with banking institutions, protecting sensitive customer data is paramount. In order to do so, utilities must identify and mitigate risks to the exposure of that information. High profile data breaches have proven and highlighted that significant risk can be found within the supply chain and other points where utilities may not have full control of security. Survey responses reflect this awareness, identifying contractors and subcontractors and remote access to privileged technical staff as among the top two security vulnerabilities (Figure 35).

Figure 35

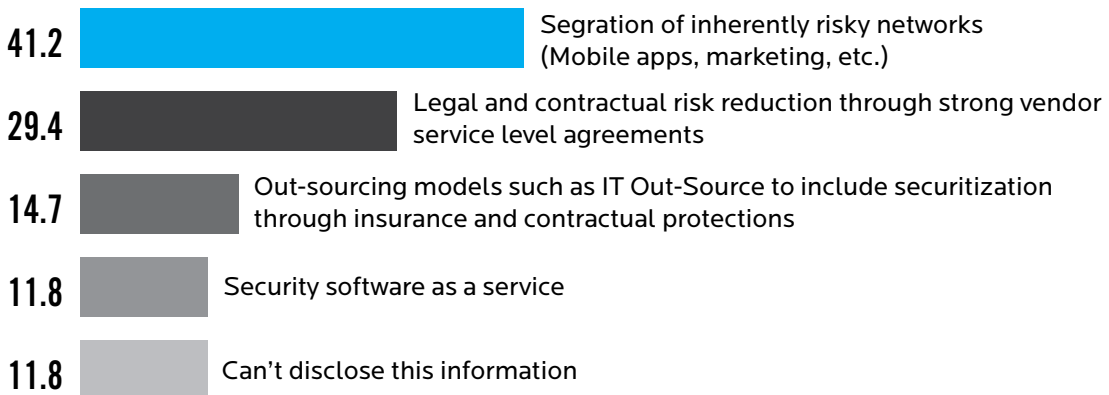
[Electric Service Providers] Does your system have any gaps that are vulnerable to the following threats? (Select all that apply.)



Source: Black & Veatch

Figure 36

[Electric Service Providers] Is your company considering any of the following approaches to security? (Select all that apply.)



Source: Black & Veatch

Recognizing these vulnerabilities, some electric utility executives have moved to segregating inherently risky networks and looking at risk reduction through strong vendor service-level agreements (Figure 36). Segregating networks creates stronger barriers between business information technology (IT) systems and infrastructure

operating systems, preventing a breach in online systems from disabling physical operations. A strong vendor service-level agreement can also provide an added layer of security by requiring vendors to conform to particular cybersecurity requirements on their networks as well as limit their access to the utilities' IT systems.

Modern cyber threats turn the table on traditional protection methods that generally restricted physical access to systems and secure areas.

REGULATIONS DRIVING CYBERSECURITY POLICIES AND PROCEDURES

Also similar to the banking industry, while most electric utilities appear to be aware of the current threat environment, it is clear that their risk-mitigating actions have been driven by regulations. Banking institutions and utilities alike have adjusted their cyber practices to primarily comply with regulatory mandates.

However, employees, not just systems, create risk across the enterprise. Because of this, implementing an organization-wide culture of risk is also a vital but often overlooked part of cybersecurity. Electric utilities that view risk management as a series of tactics or simply adapting practices mandated by regulations must move to a more holistic view.

One barrier to this culture change is that the industry has historically viewed security as an IT or engineering and operations problem. To truly prepare and manage risk, security has to apply to every part of the organization and be looked at in the context of an overall risk evaluation. A comprehensive approach can bolster cybersecurity beyond regulation compliance.

PHYSICAL SECURITY OF GROWING CONCERN

Industry conversations frequently turn to the intersection of cyber and physical security challenges for electric utility organizations. The infrastructure that distributes power across the country was developed and deployed before the advent of modern cyber threats. For example, generation and substation equipment is often more than a generation old. Power distribution systems were developed primarily for safety, redundancy and functionality. Security requirements were few and far between. Security considerations were overlooked for

the interest of cost savings. During development and deployment, developers often lacked the imagination that unknown future adversaries could or even would use advanced techniques to infiltrate or disrupt power. Not considering security during design and deployment has left far-reaching gaps to the overall systems security.

Modern cyber threats turn the table on traditional protection methods that generally restricted physical access to systems and secure areas. Adversaries can now gain access to systems through fairly common and innocent activities and human error such as installing new equipment, clicking the unprotected email link or not disabling default passwords. Attackers will prey on human weaknesses to get deep into critical systems. Generally the presence, accesses and intent of adversaries in systems is unknown until it is too late. The wrong time to discover system vulnerabilities is during a cyberattack that can affect the availability of power to millions of customers.

DEVELOPING A HOLISTIC VIEW OF SECURITY

Survey respondents echo Black & Veatch's experience with client concerns; electric utilities have a desire to understand their business/corporate-level risks and subsequent cyber and physical security threats (Figure 37). What varies is the level of investment by each utility.

Larger utilities often have the capital to go beyond requirements, while smaller utilities can benefit from investing outside of what is required instead of making the minimal investment required for compliance. As security is moving outside of just an IT or operations role, more providers may choose to devote more resources in the future.

Performing or obtaining a proactive security risk assessment can be a practical low investment option. Going beyond just “checking the box” for regulation compliance can comprehensively better protect systems as smart devices increase. Evaluating current policies, procedures and processes can play an integral role in discovering which security areas are being targeted.

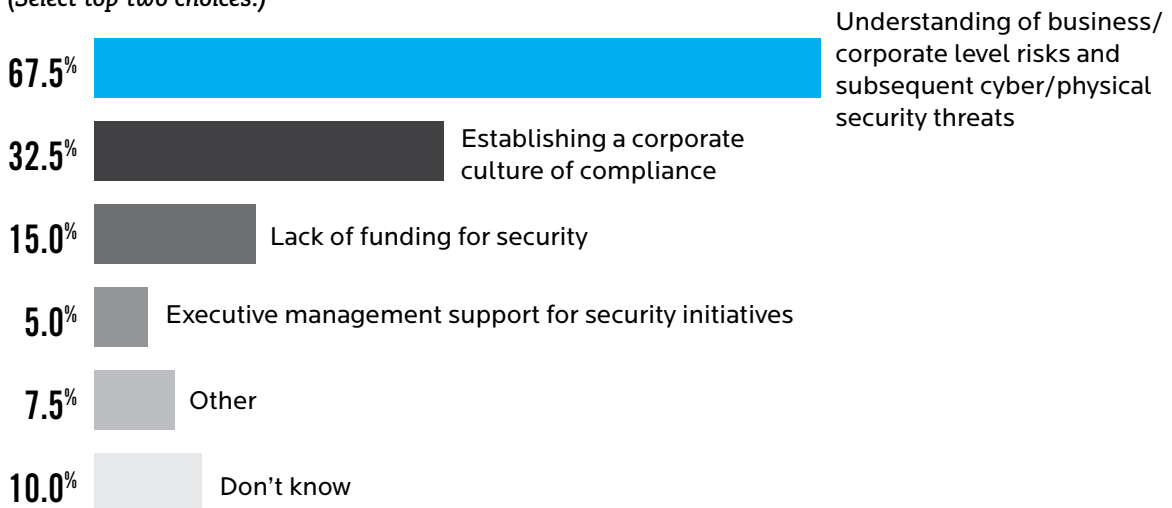
This comprehensive analysis should serve as the foundation for best addressing current and future threats. Once identified, they can be mitigated through proper awareness training, policies and other tactics that impact the enterprise from top to bottom.

Risk mitigation starts with a comprehensive security program that goes beyond restricting physical access to systems. Security must become a part of an organization’s culture and should be considered for every part of an organization. A comprehensive governance program will exceed basic compliance and provide true protection to systems and organizational processes. A mature governance and compliance program should include the following:

- The integration of people, policies, processes and technologies.
- A risk assessment program that tracks and mitigates vulnerabilities.
- Diligence and persistent event monitoring.
- A well-documented system architecture that is access-restricted to only need-to-know professionals.
- A robust systems security program that includes malware protection and blocks unused ports and services.
- Restricted systems and physical access to only vetted, trusted and well-trained professionals with verified business needs.

Regulations will continue to evolve. Investing holistically in security can prevent utilities from a cyber attack, decrease risk to physical assets and build a strong corporate risk-based culture.

Figure 37
[Electric Service Providers] What are your company’s top security concerns?
 (Select top two choices.)



Source: Black & Veatch

GLOBAL PERSPECTIVE

*In Africa, A Promising Gas-to-Power
Market in the Making*

By Webb Meko



For centuries, Africa has been renowned for its abundant natural resources. Gold, diamonds, coal, oil and other commodities have captured worldwide interest, yet global competing economies – and the need for reliable power to fuel growth – is paving the way for the continued exploration of reliable, lower emission and increasingly cost-effective sources of energy.

With more than seven percent of the world's gas supply – about 30 trillion m³ of potential and proven reserves – Africa's plentiful natural gas reserves hold great promise. The sheer volume of Africa's gas supply alone has spurred significant levels of exploration and investment that if properly harnessed to support gas-to-power, could see Africa electrifying and industrialising on a large scale. Once Africa's needs are met, the region may also benefit from increased revenue in becoming a formidable exporter of gas to other countries in need.

Though the end of the commodity super cycle and subdued economic growth worldwide has tempered global capital investment, continued project development work and planning to facilitate gas-to-power generation is the prudent path to one day meeting Africa's demand for power.

AMPLE RESOURCES READY FOR CONVERSION

Attention on Africa's generous natural gas reserves signals that a significant gas market is-in-the-making. This is beneficial for the growing and industrialising of Africa's economies, where an adequate supply of power will position the continent favourably in the minds of businesses and investors alike - and can create a secure energy future that brings new jobs.

Currently, more than 65 percent of Africans are younger than 30 and 200 million are aged between 15 and 24. By 2045, this figure is predicted to double, meaning Africa

will have the largest workforce in the world, surpassing both China and India. Creating jobs – and the power to create industries – will be critical for Africa's future workforce. The promising connection between the continent's gas and enhanced quality of life means this initiative should remain top of mind for those regulating the industry and others doing business in Africa - ensuring the region's resources are harnessed to full potential.

Despite declining near-term GDP growth projections for the continent resulting from challenges in the global commodities market – the World Bank envisages 3.3 percent on average in 2016 and a pick up only likely to occur in 2017-18 – infrastructure investors should be encouraged to position now for long-term success – establishing an early market position and bringing reliable power to 600 million people and businesses in Africa who currently don't have access to electricity to turn their economies around.

Africa's abundant natural gas reserves hold the promise of quick and relatively cost-effective solutions for generating power. Confidence in this source of energy grows daily, with indications that gas will gradually gain a larger share of the region's energy mix as investment continues.



INVESTING IN GAS OR GROWTH BEFORE GAS?

What should African countries rich in gas do – invest in gas-to-power infrastructure or grow economies first? Numerous economic studies indicate that investments in electricity infrastructure and greater energy capacity have significant correlations to higher levels of economic growth.

Creating a gas-to-power industry involves a strong infrastructural foundation, made up of investment heavydrilling operations, pipelines, storage, roads, towns and more. Costs may seem prohibitive to participants, and further decisions centre on clear rules, financial concerns, policy & regulation, political will, favourable agreements, adequate skills, adequate investment returns, and ultimate buy-in from domestic, host country citizens and groups.

A firm, competitive fuel supply is also an imperative – and can only be achieved through dedicated investment. Partnerships also help, bringing the world's best industry players together and applying their strengths. In the natural gas business, the results is the ability to supply gas long-term in a consistent manner through distributed infrastructure. This is particularly important in a country such as South Africa where the future demand for electricity could outstrip energy infrastructure build, and create a market for cheaper imported gas and liquefied natural gas (LNG).

LNG is appealing to countries that do not have an indigenous supply of natural gas, making it favourable to convert to clean natural gas fuel to expand power generation capabilities.

Supporting infrastructure also needs due consideration and attention. While pipelines are featured predominately as a means of high volume cross-border LNG transport, a typical terminal is also comprised of several other primary systems. These include ocean water access, storage and transportation tankers and others. Each of these have a unique role in vapourisation, which converts gas for reuse, including sales readiness. In addition, LNG terminals also require supporting facilities and control and safety systems to ensure safe and reliable gas supply.

All of these systems are integral – and illustrate the extent of the infrastructure required as well as technical depth. Sound project plans are needed if gas-to-power is pursued – and balanced against available funding so growth supported by investment is not compromised. Further, expertise must be applied by industry providers who are knowledgeable about LNG and power integration.

THE IMPORTANCE OF GAS-TO-POWER – SOUTH AFRICAN EXAMPLE

There are immense benefits of gas-to-power projects on the continent, yet there are also barriers. Many agree that greater certainty around policy will help provide confidence and accelerate investment and provider participation. In South Africa, finalization of the Department of Energy's Gas Utilisation Master Plan - the department's roadmap to the gas economy - is critical for stimulating much-needed localised demand for which gas-to-power is key. Project progress moving forward and sound policies go hand in hand.

A move to address the critical demand for power in South Africa can come from regional coordination with countries such as Mozambique. In late 2015, the South African Gas Development Company Limited (iGas), Companhia Limitada de Gasoduto and Sasol Gas Holdings jointly formed the Republic of Mozambique Pipeline Company to build a pipeline between Mozambique and South Africa. It is envisaged that the Loop Line 2 project will become operational in 2017 to initially transport gas to South Africa and serve additional markets in both countries.

While this is a significant development for regional integration, the entire project is a milestone for supplying domestic gas – rather than simply exporting it overseas. This will prove to be especially beneficial to Mozambique's economy long-term where annual electricity demand is expected to grow significantly over time.

In its global practice and having completed gas to power work, Black & Veatch has seen that the integration of gas terminals with neighbouring facilities is a proven route to achieve fuel supply and electrification goals in a win-win manner. In addition, production of a high value LNG product in conjunction with reliable terminal operations can be advantageous from a gas quality viewpoint and for increased revenues.

CONCLUSION: TAKING GAS-TO-POWER FORWARD

Africa has the potential to solve its energy challenges through significant gas reserves that can be converted to power. Additionally, the region has an opportunity to develop a robust global gas industry that will increase and sustain economic growth and prosperity well into the future. Critical policy, funding, and technical issues must be addressed to advance this sector and harness this promising opportunity for reliable power, lower emissions and a more diversified electricity portfolio. At the same time, transparent policies, global participants, and proven planning, engineering, and construction methods associated with LNG, power generation, and related infrastructure also should not be overlooked.

Integrated gas-to-power projects are complex endeavours, and successful deployment in Africa will require well-defined plans established early in development, adequate project funding, LNG supply and import infrastructure, efficient and reliable power generation equipment, capable partners with strong development and execution expertise, and appropriate risk sharing. These factors will help to set the continent on its path of regional growth and continued sustainability, while strengthening intra-African and global ties.

Webb Meko is a Regional Business Development Manager for Black & Veatch South Africa. He has provided technical expertise, management and advisory services for more than 20 years to South African and international clients in the energy sector within Africa. His areas of expertise include power system planning and electrical power system design, electrification, project management, program management, feasibility studies, private power projects development and power plant maintenance. Meko is based in Johannesburg.

CLOSING COMMENTARY

Electric Utilities Past, Present and Future

By John Chevrette

Ten years ago, Black & Veatch produced its first *Strategic Directions* report focusing on the electric utility industry's top issues. Like today's report, its data was grounded in the thoughts, concerns and opinions of utility leaders. What a difference a decade makes.

Results of our inaugural survey showed little faith in the emergence of renewables, let alone the exponential growth in consumer-owned renewable assets like rooftop solar. Coal was king, and as a result of rising natural gas and oil prices, a renaissance in nuclear power represented the next generation of carbon-free baseload power. Physical security ranked dead last in our Top 10 industry issues list, with the threat of an event viewed as "Highly Unlikely," compared with today's headlines of high-profile data breaches.

While we can sit back and reminisce on how much has changed during the past decade, the focus should be on the next. History shows that technology disruptions impact every industry at some point. Change is slow at first, but as a model takes hold and is rapidly refined, change accelerates and moves at lightning speed. For the utility industry, traditional services and customers will be a thing of the past by the time the 20th annual *Strategic Directions: U.S. Electric Industry Report* is published.

WHAT THE TELECOM INDUSTRY CAN TEACH US

The recent history and evolution of the telecom industry provide a glimpse into the future for electric utilities. Like electric utilities, telecom providers were natural monopolies, benefiting from economies of scale, integrated and reliable networks and sophisticated technologies. Then mobile phone technology turned the century-old industry sideways.

In 2003, approximately 95 percent of all U.S. households had a landline telephone; then the price of mobile phone technology began to drop significantly. It was no longer a technology for the rich and famous or the "techie." Still, with peak and off-peak pricing, geographic restrictions and a limited amount of minutes customers could use on such devices, customers continued to rely upon their wired landline.

In the power industry today, solar photovoltaic technology is no longer just for the rich and "greenies." The price has dropped and government incentives make this technology increasingly accessible. Customers see value through reduced energy costs but are not yet able to become energy self-sufficient.

In June 2007, the percentage of households with a landline telephone had fallen to 84 percent. By the end of the month, Apple began selling its first iPhone. As the smartphone market grew, the landline market fell. Advances in billing and rates for mobile users took away peak and off-peak pricing and the metering of minutes, focusing more on the emergence of data. Consumers increasingly viewed the landline as an unnecessary expense. By December 2015, only 46 percent of households had a landline.

Today, emerging technologies, such as Tesla's battery storage systems and electric vehicles, provide opportunity to bridge the gap between solar's peak and evening demand for power. When combined with natural gas services, customers do have the ability to disconnect from the power utility; however, the price to do so and technologies available are not yet mature enough to facilitate widespread defection.

As distributed energy, storage and microgrid technologies continue to improve, the electric industry will experience more and more customers "pulling the plug" with their utility provider in the same way they "cut the cord" with their landline. Survival will require evolution. Again, the telecom industry provides the example.

The largest landline providers of the 1990s and early 2000s are also the largest mobile carriers and providers of broadband services today. The Big Three – AT&T, Verizon and Sprint – all transformed their businesses and the services they offer. Today, you see retail stores under each brand selling the very equipment that has made their traditional model obsolete. They evolved to offer new services, such as broadband to the home and cellular services, among others, by leveraging their existing infrastructure and shared networks.

These same opportunities exist for the power industry.

SEIZING THE OPPORTUNITY

Today's grid was designed for central bulk power flowing one way. This system, like the landline network, will become uneconomical to support if widespread grid defection occurs. The key is to prevent defection from the utility by reinventing utility services and operations. To borrow from the popular 1970s television show "The Six Million Dollar Man", we can rebuild it. We have the technology. We can make it better than it was. Better, stronger, faster.

Utilities can begin their own evolution by taking the lead on distributed energy resources (DER) deployments. Again, the telecom industry provides this example. Google Fiber is prioritizing where and when it builds its network by encouraging customers to sign up in mass, creating a demand that makes for efficient deployment. For utilities, the where and the when can be based on the infrastructure you have in place today, the upgrades you have planned and the areas with the greatest generation value.

Engaging customers through new services, such as community solar or on-bill financing of DER systems and maintenance, enables utilities to leverage existing infrastructure to expand beyond their core services. In doing so, utility leaders can also drive the regulatory discussion regarding traditional rates and what must change to maintain reliability and affordability.

Given the pace of technological advancements, the next 10 years will represent the likely end of the traditional utility model and usher in a new era of enhanced competition and a consumer-driven approach to energy services. Utility leaders can no longer afford to fight the change, as was the prevailing mood in 2006. The time has come to lead the change.

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