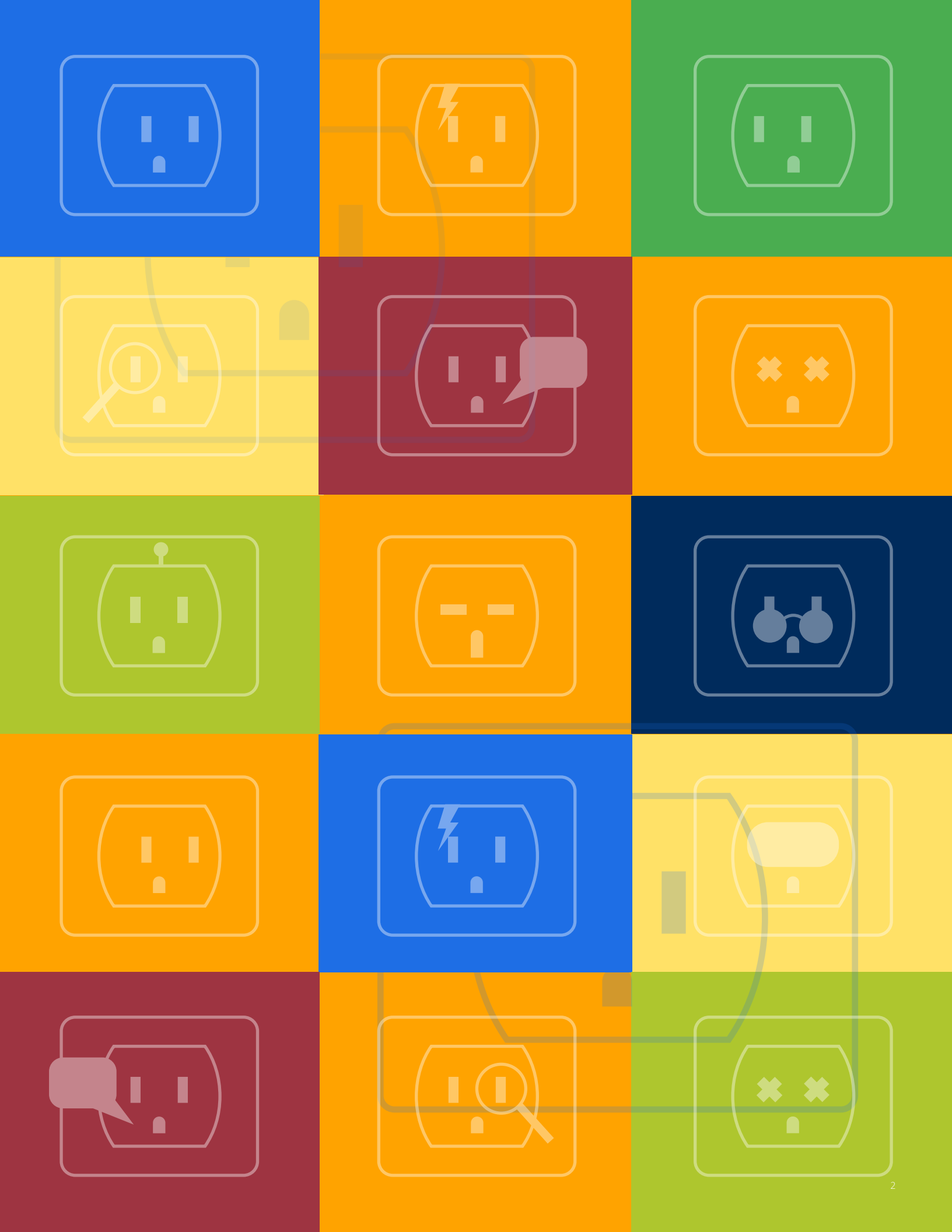
Smart Utility eBook

Industry Benchmarks for Progress and Future Actions

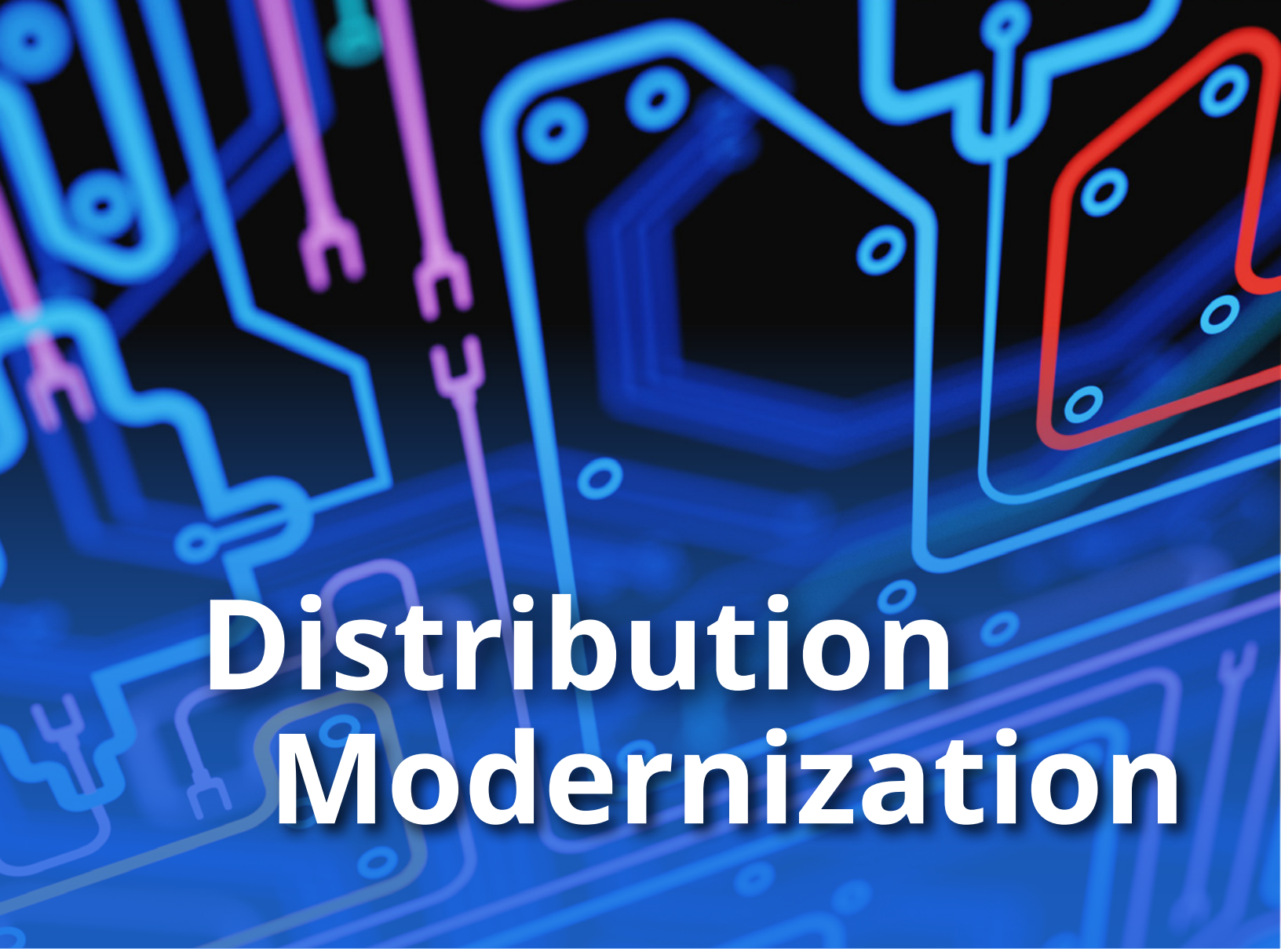


Introduction

The U.S. electric grid is a focal point of 2021 as the nation's emphasis swings strongly towards decarbonization to slash greenhouse gas (GHG) emissions. The federal government is setting aggressive goals, and distributed energy resources (DER) such as residential solar and battery storage are a large part of the strategy. Recent federal regulations build momentum towards sustainability and indicate no retreat from our changing energy landscape or the actions needed to achieve objectives. As a critical component, utilities are expected to expand grid integration of DER, which is often a double-edged sword for utilities large and small. DER could provide utilities with new revenue opportunities, but they require granular data and control at the local level, which most utilities still struggle to achieve.

As regulation creates new power generation and distribution dynamics, the traditional methods of grid operation are giving way to a more integrated approach. Utilities must integrate system planning and operating capabilities to be fully modernized and flexible to the volatile energy environment. Through integration, utilities can comprehensively view system data to understand DER impacts. With a system view, they can think and act in new ways and formulate innovative strategies to manage current-day energy generation and distribution risks.

To understand U.S. utility grid modernization progress and obstacles, Black & Veatch conducted surveys in 2020[1] and 2021[2] and researched industry trends and data points to form a comprehensive snapshot. This eBook helps electric utilities reflect on successes and continue to prioritize approaches best suited to the business models and technologies that will reinforce next-generation electricity. In an era of ever-increasing risks and investment in rapidly changing technologies, this eBook benchmarks utility progress and provides signposts to guide future actions in Distribution Modernization, Cybersecurity, Asset Management, and Resilience.



Distribution Modernization

Source: Black & Veatch

According to Surveyed Utilities:

Top Drivers for Distribution Modernization

50%
Reliability

38%
Increased monitoring, control, and automation capabilities

31%
Aging infrastructure

The U.S. energy transformation is well underway. Black & Veatch's benchmark surveys and industry research show that grids are becoming further decentralized and digitalized.[3] Now is the time to pilot technologies that enable utilities to manage DER, position themselves to capture new revenue opportunities, and secure a place among new energy competitors.

The U.S. is on a Net-Zero Path

In September 2020, the Federal Energy Regulatory Commission (FERC) approved Order 2222 that enabled DER participation in wholesale capacity, energy, and ancillary services markets. FERC 2222 could ignite innovative technologies, business models, products, services, and aggregations of rooftop solar arrays, electric vehicles (EV), and intelligent building devices. FERC's order could be the disruptor that leads to DER economies of scale, contributing to a faster transformation of the electric system.

Source: Black & Veatch

Top Barriers to Distribution Modernization

50%
Other competing priorities

44%
Budget constraints

25%
Communication network capabilities

Source: Black & Veatch

Critical Distribution Management Technologies

60%
SCADA

47%
AMI

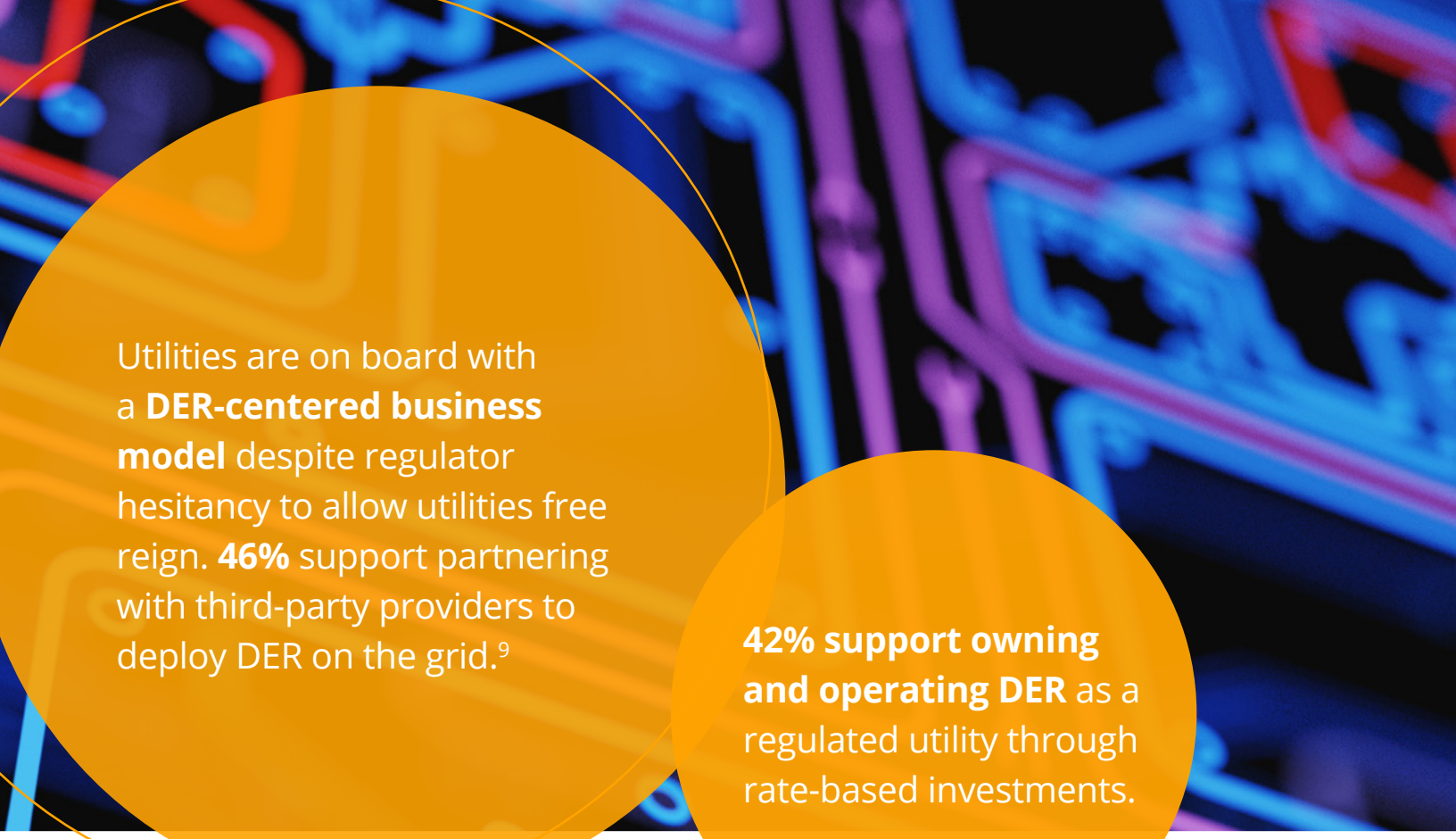
53%
FLISR

FERC 2222 could trigger unprecedented growth in the sheer volume of connected grid devices related to DER. Electricity customers are already installing rooftop solar, smart thermostats, battery storage units, home EV charging, and smart water heaters. Internet of things (IoT) connections in enterprise and automotive markets were expected to grow to 5.8 billion endpoints in 2020,[4] up 21% from 2019. Utilities were expected to be the highest user of IoT endpoints, reaching 1.37 billion endpoints in 2020. Smart metering and physical security connections, like surveillance cameras, accounted for a substantial portion of the IoT endpoints in 2020.[5] Alarmingly, these numbers do not account for growth due to FERC 2222.

For utilities to support FERC 2222 and new rate structures, they must ensure that critical communications and distribution grid technologies are in place. It is unknown how much time utilities have before new rate structures have to be developed to support FERC 2222. However, the slower progress utilities make, the greater their risk of being caught without the essential apps and technologies needed to manage the ever-expanding DER and IoT endpoints. Now is time for utilities to set up pilots for programs and technologies such as a distributed energy resource management system (DERMS) and intelligent regulators to support bidirectional power flow. As generation sources continue to diversify, utilities will need a smarter grid to support DER and use them to their advantage.

At the core of greater grid intelligence are communications. Now is also the time for each utility to evaluate communication options, such as public cellular versus private long-term evolution (PLTE), to identify and deploy the right technologies in time to address the operational impacts initiated by FERC 2222. More importantly, communications and an intelligent grid will help utilities capitalize on the potential value of an open DER market.

Black & Veatch learned that **31% of surveyed utilities** invest based on a clear modernization strategy. **20%** are integrating smart grid deployments across the organization, **realizing improved performance.**



Utilities are on board with a **DER-centered business model** despite regulator hesitancy to allow utilities free reign. **46%** support partnering with third-party providers to deploy DER on the grid.[9]

42% support owning and operating DER as a regulated utility through rate-based investments.

The Grid's New Value Proposition

FERC 2222 is fundamentally shifting markets toward decarbonization of transportation and energy. As a result, utilities could change more than just rates—they could add to their revenue streams. FERC 2222 and subsequent related regulations will further disrupt the status quo in grid operation and markets. Utilities are realizing that traditional approaches to energy and business operations will not carry them through the inevitable transformation. Innovation is the platform from which utilities can pivot into new markets.

Utilities can create new values as they respond to the disruption of DER, such as EV charging connections and solar photovoltaic (PV) systems. Black & Veatch discovered that about 70% of surveyed utilities are considering making a change to their revenue model or plan to in the near term. Many see electrification as a clear opportunity—49% are considering EV charging networks as a source of revenue. There is state-level support for this; 24 states recently approved $2.6 billion for utility investment in transportation electrification.[6] Additionally, attractive solar PV economic incentives could spur deployment, help utilities advance renewable energy targets, meet long-term planning needs, and offer renewable electricity to large consumers.[7] Power demand that has declined in many regions is expected to double in the next 30 years to reach President Biden's net-zero goals and support transportation electrification. As sales grow, utilities can spread fixed costs of DER investments over more kilowatt-hour sales.[8]

The regulatory environment makes DER integration tricky if the structure is designed for large, centralized infrastructure when utilities need to focus on DER integration at a distributed, localized level to meet customer needs best. Recent rulemaking that strongly backs clean energy and creates new monetization pathways could be confidence-builders for utilities. But to truly sleep well at night, utilities need an integrated modernization plan and a sound decision-making framework to guide grid outlays and minimize the potential for stranded investments. A plan will help sort competing priorities (a top barrier to modernization) and extract value from localized grid investments through new business case development.

Integrated Utility Planning is Critical to Manage Rising DER

Despite DER potential value to utilities, Black & Veatch found that 32% of surveyed utilities felt the introduction of too much intermittent renewable energy was one of the biggest threats to a reliable grid in their region. That anxiety is real. SAP found that 42% of midsize utilities believe that at least 10% of their total power generation will come from rooftop solar and battery storage as customers produce their own power.[10] Intermittency and unbalanced load cause significant ripple effects across the distribution grid as utilities struggle to get the correct dispatch of resources at the right time. But if the grid cannot handle intermittency, then maybe the grid is not as intelligent or flexible as it should be.

Utilities will need to integrate system planning and operating capabilities better to understand how DER affect their load profile. Integration will also inform price signals and controls that can be implemented to allow DER integration.[11] This also means updating planning models more frequently and enabling near-real-time data—tasks that utilities admit remain a challenge. Black & Veatch sees utilities starting to prioritize data-driven integration of utility planning across formerly siloed functions, with 80% of respondents ranking planning integration as "very" or "extremely" important. Utilities must address DER impacts from the inside out to take advantage of opportunities and choose technology investments with staying power.

Support DER and Boost Grid Reliability

For the second year in a row, Black & Veatch found that utilities ranked supervisory control and data acquisition (SCADA), advanced metering infrastructure (AMI), and fault location isolation and service restoration (FLISR) as critical apps. These apps provide system data and outage functions, which explains why deployments have increased. In 2019, U.S. electric utilities had about 94.8 million AMI deployments,[12] up from 87 million in 2018.[13] The question is whether utilities derive value from their investments. Despite growing installations, McKinsey surveyed 52 utilities and found that just one deployed AMI and harnessed the full suite of available use cases.[14] This shows that utilities need to do more than deploy technologies and apps; they need to integrate data streams into core business workflows to improve their work processes.

With DER on the rise, utilities may see their technology apps like FLISR disrupted by these diverse energy sources when regulations change. For this reason, Black & Veatch recommends a centralized DERMS integrated with an advanced distribution management system (ADMS). Contrary to a decentralized approach that uses peer-to-peer communications and pushes analytics out to the grid edge, a centralized solution accesses required data to make the right decisions at the right time with a comprehensive system view that is difficult to achieve using a decentralized approach. DERMS/ADMS works alongside critical apps to help utilities predict how DER affect load, which is vital to navigating growing energy complexity.

Despite Regulatory Setback, Cloud-Based Adoption Rolls On

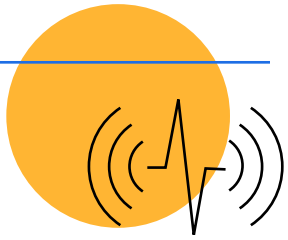
In 2020, Black & Veatch found that 37% of surveyed utilities already transferred or were in the process of transferring some operations to the cloud. In 2021, this accelerated to 60% of surveyed utilities as they consider moving low-impact or non-critical services to the cloud. SAP found that nearly half (47%) of midsized utilities plan to increase their investment in cloud computing by 25% or more in the next three to five years.[15] Cloud-using utilities are concerned with meeting North American Electric Reliability Corporation (NERC) Critical Infrastructure Protection Program (CIP) requirements in a cloud environment. NERC is reviewing comments on the proposed changes to NERC CIP for virtualization.

The recent decision by the Illinois Commerce Commission to assign cloud-based costs as expenses is a blow to utility and grid innovation. The proposal would have allowed Illinois utilities to partially recover contracting costs for cloud-based data processing through higher customer rates. Instead, cloud costs will be considered operating expenses that cannot be included in a utility rate base.[16] Industry regulation decisions like this could be why 36% of Black & Veatch survey respondents say regulatory lag in meeting the needs for system changes is a top concern of future grid development. And it is not just innovation that is at risk. Over 40% of utilities in our survey said regulatory uncertainty impacts their ability to recover infrastructure investments from modernizing the grid.

Despite this regulatory setback, Black & Veatch expects utilities to continue to evaluate both on-premise and cloud-based solutions. While utilities survey options, they will also hope that regulations evolve to better mirror grid advancements in technologies such as cloud services.

3 Ways to Deploy Private Wireless Networks

Communication networks are a key enabler of apps that modernize the grid. Private wireless networks best support many utilities with dedicated spectrum to support thousands of new endpoints that extend to the edge of the distribution grid. Black & Veatch helps utilities deploy private long-term evolution (PLTE) wireless networks typically through one of these approaches:



1 Purchase Licensed Spectrum

A utility buys spectrum from Black & Veatch and our spectrum partner. The utility:

- Owns the spectrum for Partial Economic Areas
- Subleases to share spectrum with adjacent utilities
- Resolves interference and synchronizing networks with all adjacent networks
- Designs network coverage, performs implementation, and operates network per FCC requirements

2 Lease Licensed Spectrum

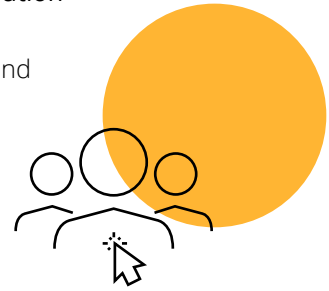
A utility leases spectrum over a specified term from Black & Veatch and our spectrum partner. The utility's responsibility is the same as Approach 1, but Black & Veatch:

- Works with the utility on subleases to share spectrum with adjacent utilities
- Operates network per FCC requirements

3 Turnkey Solution Spectrum + Private LTE Network

A turnkey solution to lease spectrum and implement PLTE. This solution is like Approach 2, but Black & Veatch:

- Designs the PLTE for performance, including coverage bandwidth and network, security, and vertical infrastructure (towers)
- Obtains permits
- Constructs the towers
- Implements the radio frequency and network
- Provides performance and coverage guarantees



Cybersecurity

As a cybersecurity framework emerges from NERC related to virtualization and the cloud, hackers continue to increase their attacks using new methods. Recent attacks on other critical infrastructure have generated publicity and serve as a warning to other industries. Combined with COVID-19's impact on remote access, a perfect storm is forming for an attack on the power grid. Now is the time to close cybersecurity gaps.

Source: Black & Veatch

According to Surveyed Utilities:

Top Cyber and Physical Security Needs of Utilities in five to ten years

44%
Maintaining Compliance

43%
Endpoint management and vulnerabilities

39%
Retaining cybersecurity talent

35%
Security education and training

COVID-19 and Cyber Unrest

Attempted cyberattacks have risen in recent years, and increasingly, cyber-attackers target industrial sectors whose leaders are more willing to shell out a payment because of an inability to keep up with system changes. This trend of cyberattacks accelerated during the COVID-19 pandemic as more people worked remotely, which increased hacking, ransomware, phishing, and data leaks.

Cybersecurity experts have long warned of potentially significant attacks on the North American power grid and other industries. This warning materialized in May 2021 when operators of Colonial Pipeline—one of the nation's most extensive fuel pipelines—shut down its entire pipeline network because hackers used ransomware to lock up Colonial Pipeline's business computer systems. Amid public fears of fuel shortages and panic-buying in the southeastern U.S., Colonial Pipeline paid $4.4 million to regain control (of which $2.3 million was recovered).

Global cybercrime costs are expected to grow 15% per year over the next five years, totaling $10.5 trillion annually by 2025, increasing from $3 trillion in 2015. The impact of cybercrime extends beyond the affected corporation, so these costs relate to a range of impacts, including damage/destruction of data, stolen money, lost productivity, theft of intellectual property, disruption to the normal course of business, forensic investigation, and reputational harm[17] among other impacts. This latest example of digital extortion reminds electric utilities of their vulnerability. Many utilities report tens to hundreds of probing attacks per day.[18]

Failed cybersecurity investments create protection gaps. Research shows that **20-45% of utility operations are not actively protected** by the security program.[22]

The grid and its communications networks are becoming more integrated and complex, with grid modernization adding new technologies and their vulnerabilities. As a result, utilities have broader exposure to exploitation and disruption by cyberattack. Dragos reports four new threat groups emerged in 2020; however, the number of active threat groups in the U.S. electric sector remains constant at ten.[19] Through our extensive project work, Black & Veatch observes that utilities are vulnerable because:

- Threat activity groups that target electric utilities have grown over the past several years
- Grid modernization deploys networks that increase operational technology (OT) networks with overall visibility not keeping pace
- Separation of OT and information technology (IT) infrastructures is key to reducing horizontal attacks from IT that compromise OT
- Security is not built in by design using a holistic, risk-based approach

Black & Veatch discovered that nearly 25% of utilities say their cybersecurity investments have not moved in lockstep with digital assets and customer engagement investments. This statistic shows a lag between the operational improvements and the programs, processes, and training to make them secure. Education and training are essential to reduce the vulnerabilities of human error, which is the root cause of 23% of data breaches.[20] Accenture notes that successful utility leaders drive value from new cybersecurity investments through frequent staff training.[21]

Closing the Gaps

Electric utilities are dealing with cyberattacks that originate from IT and migrate into OT. Additionally, IBM notes that 41% of ransomware attacks in 2020 targeted organizations with OT-connected networks because attackers think that these companies cannot tolerate downtime and are more likely to pay the ransom.[23] Black & Veatch found 20% of respondents indicated that while they have a program for IT cybersecurity, they have yet to implement one for OT, despite NERC CIP requirements.

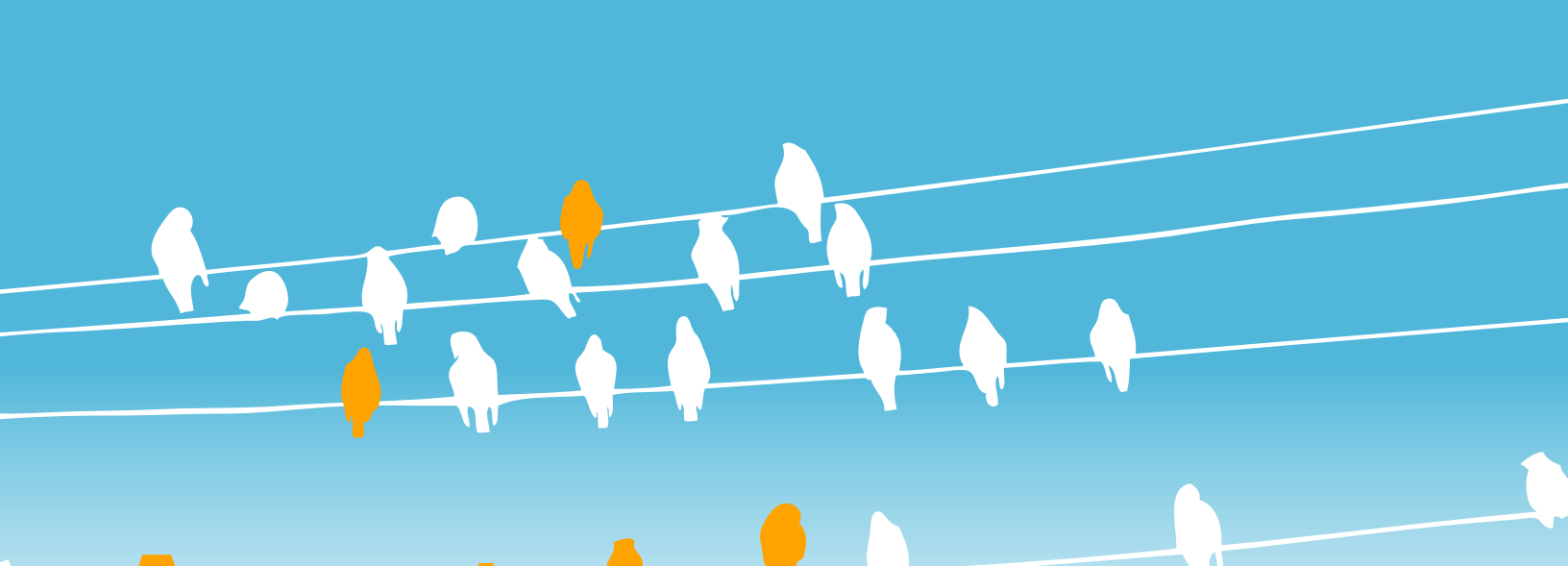
Cybersecurity programs are accomplished strategically by identifying the cyber risk gaps and prioritizing a closure strategy. Closing gaps is especially relevant at the OT level. The industry is working to close the gaps with new IT adoptions and manage the increased device connectivity of upstream (production controls) and downstream (consumer-focused and grid edge) devices. Dragos observes that preventative controls, such as segmentation, are often atrophied due to misconfigurations, additional devices, or increased connectivity. So, utilities need to monitor internal OT networks to gain constant visibility into these intersecting IT/OT connections.[24]

As part of its cyber-informed network architecture process, Black & Veatch recommends that IT and OT structures maintain proper separation and segmentation with advanced firewalls and coordinated policies. These measures will ensure only authorized access to shared functions and data on each network. We also recommend creating DMZs with well-defined rules for protecting shared services.

As hackers grow more sophisticated, utilities must respond in kind. With the uptrend of adopting cloud computing and packetized Internet Protocol (IP) networks in the OT telecommunications environment, utilities benefit from cyber defense via formal, robust network operations center (NOC) or SOC. Utilities are starting to evaluate, plan, and build security operations centers (SOC) designed explicitly for an OT environment. Investments in a SOC—ideally positioned in tandem with, but isolated from, any NOC—help utilities safeguard their critical infrastructure and highly sensitive operational data. Creating a SOC can be time-consuming and expensive, often leading utilities to outsource security monitoring and doing without their own NOC/SOC. Black & Veatch found that more than half of utilities use a SOC that operates around the clock.

Black & Veatch notes cybersecurity is second only to asset management regarding prioritized financial investment into technological improvements, capturing 14% of their total technology budget. This investment is wise because data governance and cybersecurity underpin the analytics functions central to asset management programs and smart grids.

The average cost of energy sector data breaches **rose 13%** from 2019-2020. **52% of breaches are caused by malicious attack,** with 19% due to misconfiguration of cloud servers.[25]



Asset Management

Source: Black & Veatch

According to Surveyed Utilities:

49.5%

feel asset management is a significant challenge facing their current electric distribution system

52%

feel the increase in their distributed asset portfolio will require improvements to their communications network

18%

feel the accuracy of their distribution equipment data (as it relates to risk assessment) is "extremely good," and **15%** feel the data is "extremely bad"

As our energy landscape shifts and becomes more multifaceted, utilities will deploy more assets on the grid to manage the multi-layered environment. If utilities are challenged by asset management now, then the problem will only intensify as the grid becomes more complex.

Data-Rich or Data-Poor?

Superior asset management starts with superior data. Managing data on a growing scale is a challenge, particularly as assets become more distributed and complex. Black & Veatch learned that 68% of utilities describe themselves as "somewhat data-rich," and 22% feel they have "plenty of available data." Data richness probably comes from continued distribution modernization. As data piles up, utilities realize that they need to invest in tools that quickly capture, store, and analyze grid edge, supply chain, and customer data. Adopting data analytics applications to interpret that data expands situational awareness, which improves power quality, reliability, operational efficiency, and asset management while reducing maintenance costs. For example, utilities can use AMI data to improve distribution transformer management, system reliability, and distribution losses.

Utilities continue to gain a deeper understanding of data's potential to find anomalies and use that information to guide investments, provide predictive management, and build resilience. In 2020, smart grid investments centered on hardware—digital substations, smart metering, and other power engineering equipment—but green-lighting sophisticated software tools is increasing to better use collected data.[26]

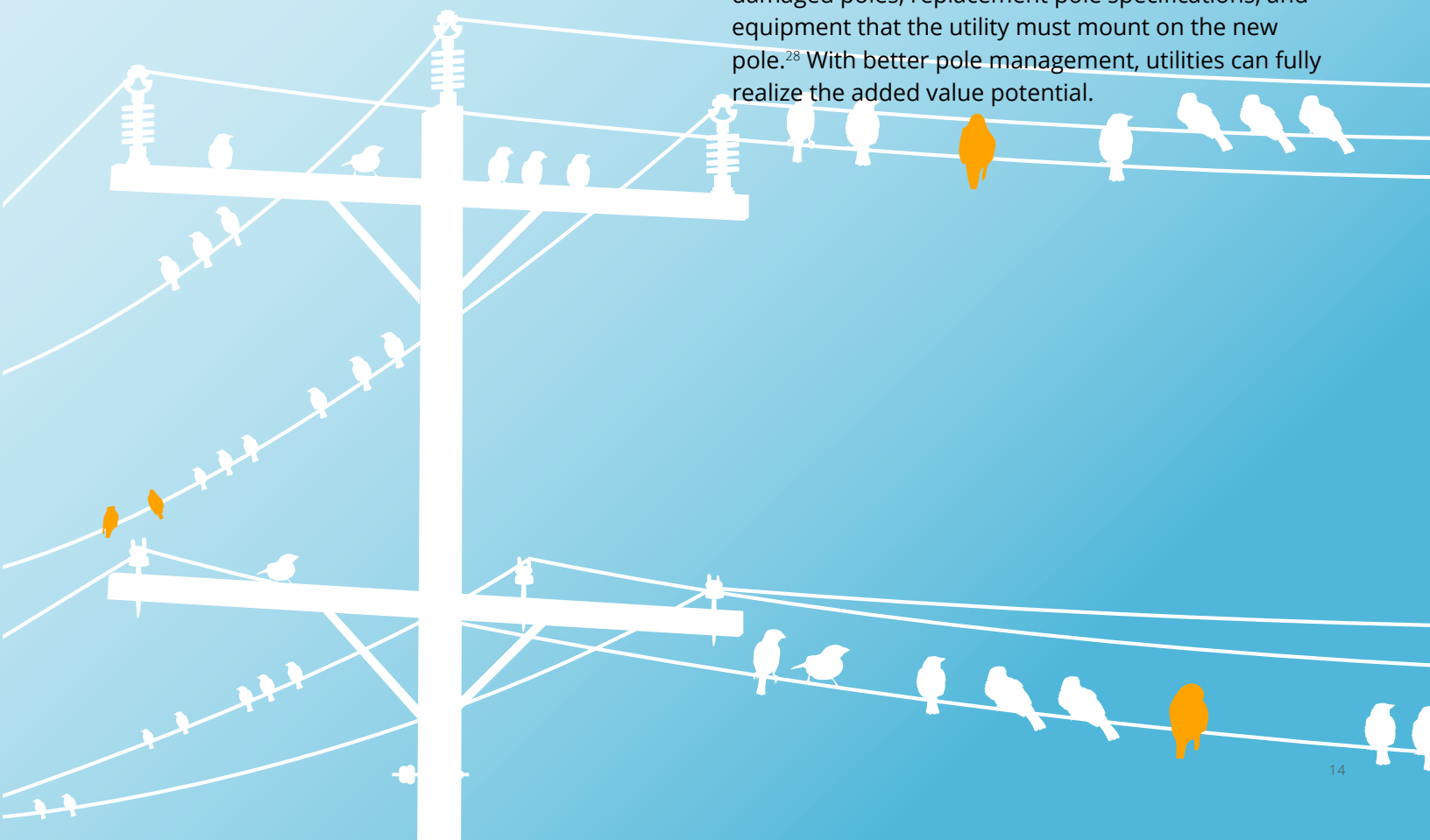
Wooden You Like more Asset Value?

Wood distribution poles comprise a sizable portion of a utility's assets. Because of their dispersed geographies, 25% of surveyed utilities say that poles are difficult assets to manage. Poles are becoming a growing source of revenue generation through charging monthly and annual fees to use the real estate for customer-owned devices such as illuminated signs and telecommunications equipment. But if utilities do not know the health and assets already on pole, then revenue generation becomes jeopardized.

Black & Veatch found that 41% of utilities find that value of distribution utility poles is greater today than in previous years, and 37% of utilities receive more requests for 5G attachments. The Utilities Technology Council found that 79% of surveyed utilities allow attachments on their wooden poles. Still, far fewer (39%) allow them on their streetlights, often due to inadequate structural strength, space, or channels inside the pole for the cabling or required power.[27] Black & Veatch found that 49% of utilities see 5G attachment as an opportunity via upgraded infrastructure and improved communication capabilities, not to mention new partnerships with carriers.

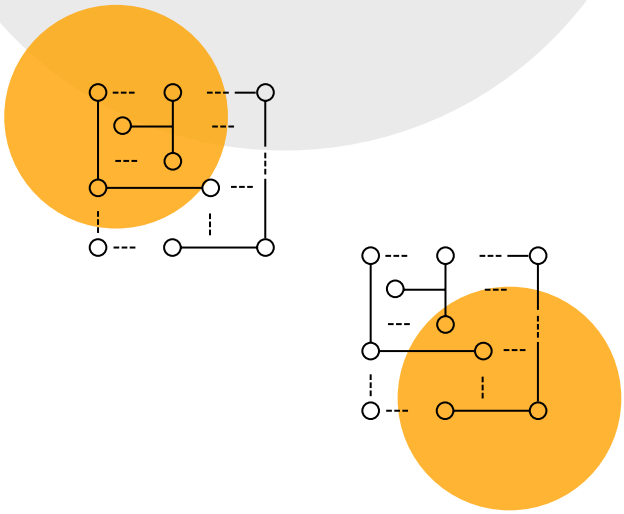
What is attached to utility poles is not as much concern as the condition of poles. Black & Veatch learned that 43% of utilities use Google Street View daily or weekly to view poles and other assets. While useful, Google Street View is not ideal for asset management, so utilities are also testing out emerging technologies in the asset management space. We found that 55% have considered drone technology—drones with cameras or aerial sensing technology—to inspect power lines, gather data on the condition of wires, poles, and other equipment, and spot potential equipment failures. Utilities with advanced technologies such as 5G, artificial intelligence (AI), and cloud capabilities will capitalize on beyond-line-of-sight drone flight that enables real-time streaming video from remote drones and enhanced visibility.

Traditionally, utilities manage poles using fixed inspection cycles—they consider all poles and inspection areas equally. This approach often leads to inefficient maintenance and potentially compromised grid resilience. Software programs track location, load status, and pole attachments. Use of software speeds pole-loading calculations and informs asset procurement forecasts. When combined with geospatial data, the software system guides accident or storm restoration and disaster recovery by indicating the location of damaged poles, replacement pole specifications, and equipment that the utility must mount on the new pole.[28] With better pole management, utilities can fully realize the added value potential.



5 Things to Know about Digital Twins

In Black & Veatch's October 2019 survey, 47% of utilities were unfamiliar with digital twins. But simulation, interoperability, sensors, and visualization have advanced since then, and now utilities are increasingly building digital twins to optimize operations, lower costs, and run predictive maintenance.



1 The Market: The global digital twin market is expected to hit $48.2 billion by 2026 centered on:

- Energy applications
- Buildings

2 The Advantages: Digital Twins accurately map physical assets into a digital replica to support:

- Physical asset performance
- Utility digital transformation
- Grid and operational efficiencies
- Enhanced reliability of energy infrastructure and operations
- Merged information silos across a utility

3 The Use Cases: Dynamic simulations provide real-time and historical data for decision-making.

- **Real-time predictive analytics:** Enables predictive maintenance and efficiency optimization to prevent downtime and high physical repair costs.
- **Demand response:** Reduces variability and intermittency of distributed generation (DG), improves asset performance, and maintains peak performance. Forecasts DG and demand-supply aggregation.
- **Remote asset management:** Visualizes asset performance, reduces service costs, and substitutes for physical proximity. Drives asset performance and predicts outages and asset failure.

4 The Technologies: Smart technologies add a layer of knowledge that goes beyond reality. Connected data or graph technologies pairs with digital twin data to improve situational awareness.

- Deep learning
- Artificial intelligence
- Computer vision
- Sensors
- 3D GIS
- Lidar

5 Get Started: Now is the time to plan pilots and prototypes. Utilities need to:

- Gather system data
- Invest in digital tools
- Adopt cloud infrastructure to scale digital twins and reduce significant upfront costs

Sources: Black & Veatch. 2021. Information from Ed Sutton, Program Manager and Systems Architect.

Electronic Design. 2020. Digital Twins Fuel the Transformation of Utility Asset Management.

Gunjan, Pritil. 2018. Digital Twinning in the Energy Industry. Guidehouse Insights.

Two Persistent Asset Management Challenges: Aggregation and Communications

Asset management systems and solutions require a lot of data to support their analytics, but there is a tendency to fall short on data aggregation, collection, and advanced communications. These capabilities are essential for utilities to maximize the operational value of their asset investments. Over the next two to three years, asset managers will focus on breaking down internal silos to aggregate and standardize data from disparate systems and multiple networked assets into one source.[29]

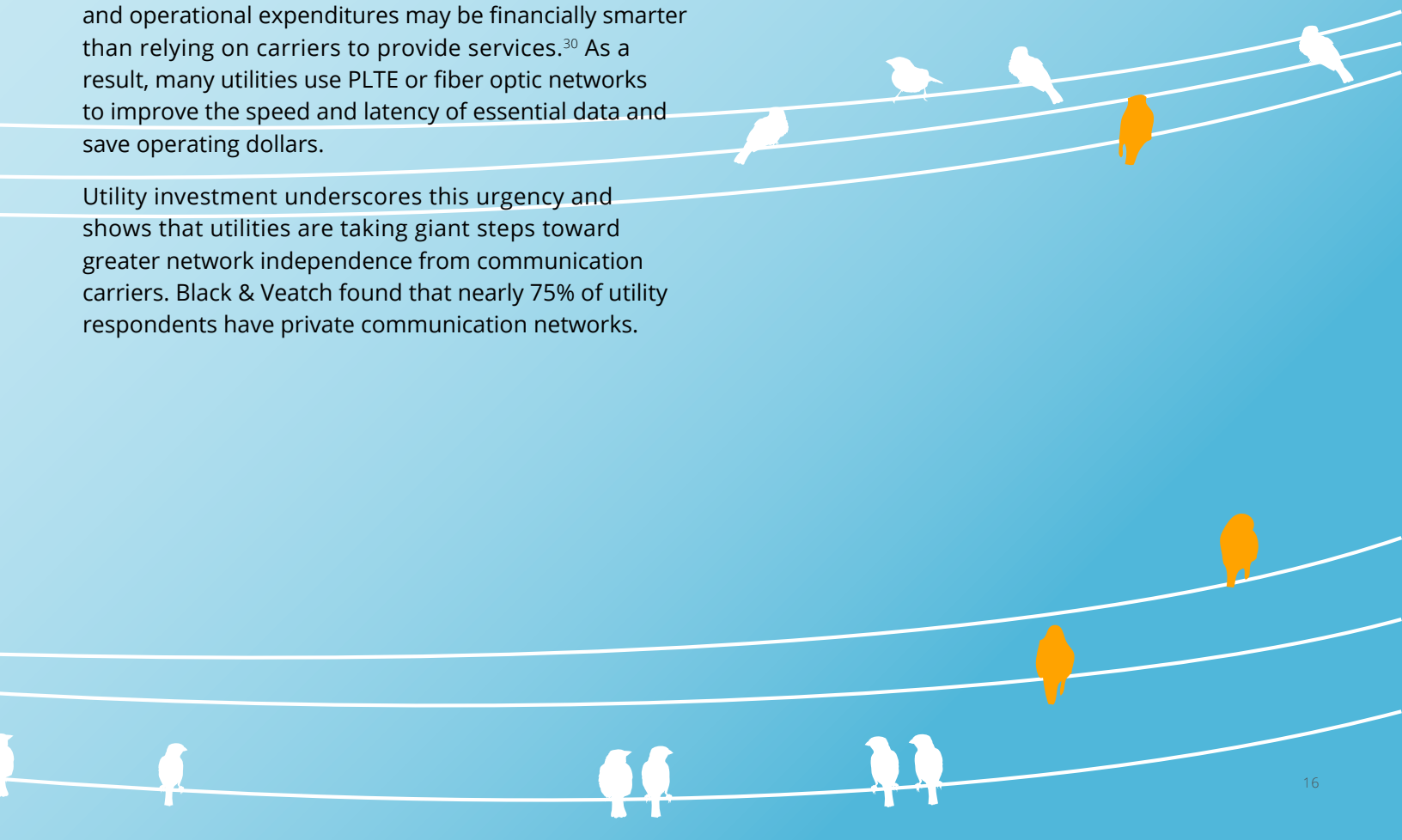
By investing in cloud capabilities, utilities could incorporate geospatial inputs, AI, and machine learning to glean relationships among connected asset data sets across the enterprise enhanced by cloud support. These functions provide predictive analytics, which is especially important because the aging assets most likely to fail are less likely to be equipped with sensors. Sensor placement on prioritized assets provides critical grid intelligence for data analytics to help utilities meet their operational goals.

Advanced communications networks must transmit massive data to feed asset management programs with reliability requirements above carrier-grade networks. Using a private network with known capital and operational expenditures may be financially smarter than relying on carriers to provide services.[30] As a result, many utilities use PLTE or fiber optic networks to improve the speed and latency of essential data and save operating dollars.

Utility investment underscores this urgency and shows that utilities are taking giant steps toward greater network independence from communication carriers. Black & Veatch found that nearly 75% of utility respondents have private communication networks.

But interestingly, our survey indicates that many doubt the adequacy of their current communications network infrastructure. As a result, many respondents are busy upgrading either their wireless or fiber optic networks. These upgrades may be driven by the need to upgrade city distribution networks[31] to support distributed generation and capture the benefit from residential solar and expanding residential and utility-scale energy storage.[32] With a focus on the local level, utilities will boost their operations while meeting customers' unique characteristics, needs, and challenges.

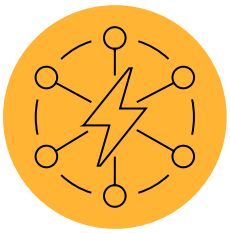
Southern California Edison (SCE) points out that the underlying design and architecture of the grid have not evolved alongside its component technologies. For this reason, utilities need to make fundamental changes in how the grid is planned, designed, built, and operated to support future energy dynamics. SCE recommends prioritizing communication upgrades such as advanced grid control platforms, AI analytics, optical and fixed networks, edge computing, and power flow controllers in the near term.[33] These upgrades help develop critical grid capabilities and fortify the most valuable asset a utility has: communications. If communications are not resilient, then applications go down.



3 Essential Goals of Data Management

Black & Veatch developed a cloud native platform that supports intelligent applications to streamline data management, discern data relationships, visualize their meaning, and increase productivity while reducing costs. Built on Black & Veatch's 100 years of industry experience, the platform mirrors industry requirements and emerges as a powerful execution excellence tool.

1 Data is Streamlined



Unify data. Simplify access. Drive informed business decisions and improve execution.

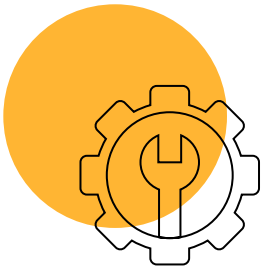
- GIS Integration for design and client master asset data
- Native spatial support and analytics
- Drag & drop webforms, fast and consistent data entry
- Data unification engine and API Integration
- Remote data collection tool; mobile app enabled

2 Data is Visible

Connect task-based workflow to insightful visualizations for real-time earned value and improved forecasts.

- Direct query real-time data
- Critical path visibility
- Low-code graph analytics
- Standardized business process modeling & workflow automation
- KPI metric reporting and BI reporting tool integration
- OMG/ISO certified BPMN2.0

3 Operations are Optimized and Secure



Reduce execution person-hours, increase productivity, and reduce cost.

- PMO & EPC total project awareness
  - Engineering
  - Land Services
  - Procurement
  - Construction
- Multi-factor authentication single-sign-on and other features to support cybersecurity

Source: Black & Veatch. 2021. Information from Ed Sutton, Program Manager and Systems Architect.

Resilience

Source: Black & Veatch

According to Surveyed Utilities:

The most significant risk to the reliability and safety of T&D assets are:

65.1%
Aging infrastructure

37.6%
Natural disasters (other than fire)

25.7%
Adapting to load changes from distributed generation

In terms of weather and climate events, 2020 set a new annual record of more than 22 events with values greater than $1 billion, crushing the previous record of 16 events.[34] Utilities have an uphill climb to build resilience considering climate events, ballooning cyber threats, and reliability challenges. Innovative thinking could be the best path forward.

Thinking Ahead is Half the Battle

Utilities are familiar with cyberattacks, disasters, and crisis response. They also know that thinking ahead is a large part of resilience. To this end, Black & Veatch found that utilities are fortifying their grids by applying several proactive resilience strategies, including:

- **Physically Harden the Grid:** Black & Veatch found that 56% of utility respondents proactively conduct vegetation management and pole assessment/replacement programs to boost resiliency, alongside increased sectionalizing, moving power lines underground, and improving damage prediction models. Black & Veatch recommends evaluating hardening projects based on a comprehensive system view that reveals shared points of failure.

- **Integrate Planning:** Electric utilities broaden their planning lens to look at integrated resource blueprints that include supply and demand across central and distributed assets. They are knocking down internal silos to merge data streams to bring generation, distribution, transmission, and customer resources into one shared platform for better insight and planning.
- **Pursue Advanced Asset Monitoring and Inspection Technologies:** Because of its expanse, the grid is difficult to monitor, but the stakes are high because 90% of outages originate from the distribution grid.[35] Utilities are eyeing advanced technologies like automated remote monitoring and drones with cameras.
- **Sleuth Vulnerabilities:** Finding problematic vulnerabilities is becoming part of utilities' holistic examination of operations, including consultation with infrastructure experts and hiring them to test a system's defenses.
- **Explore Non-Wires Alternatives:** Utilities have been slow to embrace NWA because they are deemed either more expensive or less reliable than standard options. But Black & Veatch found that 24% of utilities consider NWA as part of their standard operating procedures, and 25% have NWA cost studies/pilot programs underway or planned.

Source: Black & Veatch

Black & Veatch learned that utilities are investigating single points of failure:

20%

Have addressed them and have built-in redundancy

46.5%

Are currently addressing areas identified by executing projects

19.6%

Have identified areas but are not prioritizing them with projects

Out with the Old, in with the New

When it comes to modernizing the grid and boosting resilience to mitigate present-day threats, the "old" ways of thinking and doing will not work. Rocky Mountain Institute (RMI) found that the "status quo" approach to grid resilience risks reinforces and perpetuates vulnerabilities inherent to the current grid's infrastructure. Worse, outdated practices lead to missed opportunities to think in new ways and advance resilience by design.[37] RMI recommends that utilities:

- **Address Linear Dependencies and their Shared Points of Failure.** Hardening individual components or subsections of grid infrastructure may reinforce the system's vulnerability to attacks or disasters spanning the entire grid value chain across broad areas.
- **Use the Dynamic Market as a Tool.** Account for technological evolution of grid technologies and resource mixes instead of staying static. This action yields a more comprehensive foundation.
- **Prioritize Loads for Targeted Restoration Plans.** Consider how much power is available to customers to meet electricity demand according to the highest societal value.
- **Maximize Resilience Investments.** Seek technologies and approaches that provide net benefits during normal operations to lower or offset the net cost of scaling resilience solutions.

Through a fresh lens, utilities better understand the changing economics and dynamics of grid technologies. With this understanding, utilities capitalize on market opportunities to evolve the grid's resilience fully.

87% of utility executives **say severe weather is increasing** in their regions. **Only 24% of utilities in North America feel well prepared** to deal with extreme weather.[36]

Endnotes

1 U.S. Black & Veatch. 2020. 2020 Strategic Directions Smart Utility Survey Results. N = 627 survey respondents. 557 respondents qualified and completed the full survey, 70 partial records. Response rate: 1 percent.

2 Black & Veatch. 2021. 2021 Telecommunications Smart Utility Survey Results. N = 63 survey respondents. 45 respondents qualified and completed the full survey; 18 partial records. Response rate: <1 percent.

3 IEA.2020. Smart Grids.

4 Gartner. 2019.

5 Ibid.

6 Wall Street Journal. 2020.

7 IEA. 2020. Renewable Energy Market Update 2020-2021. Technology Summaries, Solar PV.

8 Utility Dive. 2021. State of the Electric Utility Survey Report.

9 Ibid.

10 SAP. 2020. The Future of Midsized Utilities and Energy Service Providers.

11 Ibid.

12 U.S. Energy Information Administration. 2020. How Many Smart Meters are Installed in the United States, and Who Has Them?

13 Utility Dive. 2020. Making the Case for Billion-Dollar Investments in Grid Modernization by Answering 3 Key Questions

14 McKinsey & Company. 2020. Modernizing the Investment Approach for Electric Grids.

15 SAP. 2020. The Future of Midsized Utilities and Energy Service Providers.

16 Utility Dive. 2020. Illinois Regulators Reject Proposal to Allow Utilities Cost Recovery for Cloud-Based Computing

17 Cybercrime Magazine. 2020. Cybercrime To Cost The World $10.5 Trillion Annually By 2025

18 Dyson, Mark and Li, Becky. 2020. Reimagining Grid Resilience: A Framework for Addressing Catastrophic Threats to the US Electricity Grid in an Era of Transformational Change. Rocky Mountain Institute.

19 Dragos. 2021. 2020 ICS Cybersecurity Year In Review

20 IBM Security. 2020. Cost of a Data Breach Report.

21 Accenture. 2020. Third Annual State of Cyber Resilience Report for Utilities

22 Ibid.

23 IBM. 2020. Ransomware 2020: Attack Trends Affecting Organizations Worldwide.

24 Dragos. 2021. Recommendations Following the Colonial Pipeline Cyber Attack.

25 IBM Security. 2020. Cost of a Data Breach Report.

26 IEEE. 2020. Smart Grids.

27 Utilities Technology Council. 2020. Joint Use Study. May.

28 Ibid.

29 Deloitte Insights. 2021. Digital Utility Asset Management.

30 Utility Technology Council. 2019. Utility Network Baseline. April 2019 Update.

31 Underground Construction. 2021. 2021 Utility and Communications Construction Outlook, Update. January.

32 Utility Dive. 2021. 2021 Outlook: The DER Boom Continues, Driving a 'Reimagining' of the Distribution System.

33 Southern California Edison. 2020. Reimagining the Grid.

34 National Oceanic and Atmospheric Administration. 2021. Billion-Dollar Weather and Climate Disasters: Overview.

35 Deloitte Insights. 2021. Digital Utility Asset Management.

36 Accenture. 2020. From Reliability to Resilience: Confronting the Challenges of Extreme Weather.

37 Dyson, Mark and Li, Becky. 2020. Reimagining Grid Resilience: A Framework for Addressing Catastrophic Threats to the US Electricity Grid in an Era of Transformational Change. Rocky Mountain Institute.

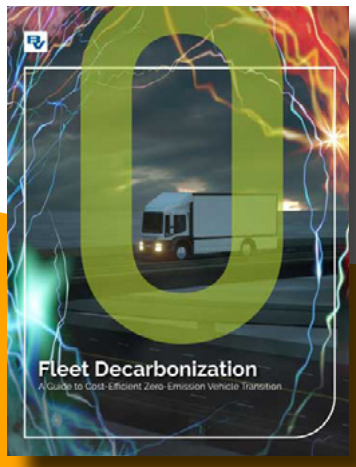
Conclusion

Federal goals and recent regulations are spurring action towards decarbonization. They also signal that there is no retreat from energy and grid transformation. As the energy playing field levels, the floodgate opens for DER, new energy suppliers and services, and innovative technologies and business models. As a result, utilities must grapple with the best ways to handle energy diversity and the grid impacts while dealing with the threats of increasing cyberattacks and climate change that threaten resilience. Utilities may benefit from the new load, technologies, and business models, but for now, they are on an uphill climb.

The energy industry is in the "messy middle" of transformation—regulations, rate structures, and business models often seem mismatched, obscuring and even preventing energy evolution. Utilities are the driving force of grid modernization, and while barriers exist, they are making substantial progress. As Black & Veatch observes, utility leadership rests on the realization that the old ways of thinking and doing must evolve into next-generation grid management. It is critical that utilities integrate systems and processes internally, merge data sources, and deploy the communications, management platforms, and technologies needed to control the grid with comprehensive intelligence, predictability, security, and speed—this is a modernized grid.

The energy industry is advancing, and utilities are critical to our success. Black & Veatch is a leader in smart grid infrastructure, with expertise in communication networks, grid technologies, cybersecurity, and distributed energy. We are proud to be a part of the ecosystem that innovates and collaborates to accelerate grid modernization in our communities.

Digital technology deployment is accelerating. **Our eBook series fast-tracks** industry transformation.



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