



2023

Electric Report



About This Report

Based on a survey of more than 650 U.S. power industry stakeholders, Black & Veatch's *2023 Electric Report* explores an evolving sector grappling with a slew of challenges mixed with opportunity.

In an increasingly complex energy ecosystem, survey respondents again cited the need to integrate the surging influx of renewables and distributed energy resources onto the grid as their foremost challenge. That narrowly outranked the nagging issue of aging infrastructure, long the sector's biggest headache.

U.S. electric utilities are continuing to press for ways to lower their carbon footprints and bolster grid resilience against the effects of climate change, including severe flooding, hurricanes, droughts and wildfires. But forces that include a problematic supply chain continue to slow that process by crimping the availability of components.

The expanded adoption of electric vehicles – a bedrock of President Joe Biden's administration's decarbonization strategy – continues to accelerate, pressuring U.S. power providers to find ways to meet the expected, sizable charging needs. Cybersecurity threats haven't abated, requiring renewed and robust vigilance and investment.

All the while, new generational federal funding – through the Bipartisan Infrastructure Law and the Inflation Reduction Act – slowly is making its way through the pipeline, committing billions of dollars to grid upgrades by those willing to pursue that taxpayer help.

As the sector pursues heightened sustainability, reliability and resiliency, this report takes the pulse of an industry modernizing with new technologies and improved concepts to keep the power flowing to industry, businesses and homes.

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

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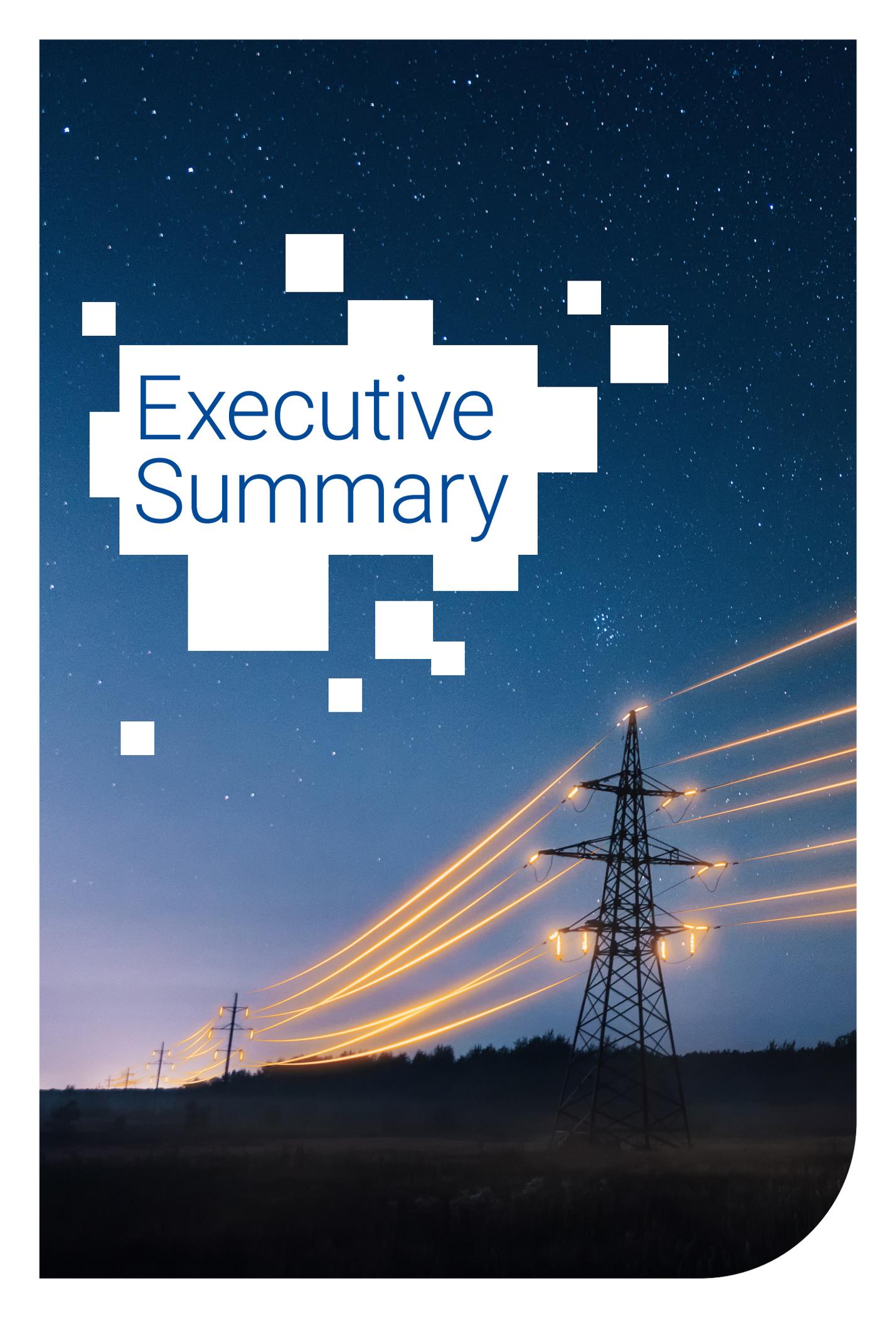
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The background of the page is a composite image. The upper portion shows a dark blue night sky filled with numerous small, bright stars. The lower portion features a long-exposure photograph of a high-voltage power line tower. The tower is a dark metal lattice structure. The power lines extending from the tower are captured as bright, glowing orange streaks that curve across the sky. The ground below the tower is dark and indistinct. The overall composition is vertical and has a rounded bottom right corner.

Executive Summary



As the Energy Ecosystem Evolves, U.S. Electric Sector Navigates Headwinds, Opportunities

About the Author

Laszlo von Lazar is president of Black & Veatch's Energy & Process Industries (E&PI) sector and serves on the company's board of directors and leadership team. Before being named to head E&PI, he was president of BV Operations and was a key architect in successfully establishing the group as part of a companywide transformation. Having joined Black & Veatch in 2019 as leader of global projects for the company's previous power organization, he oversaw engineering, procurement, construction, quality and business excellence. He has more than three decades of worldwide project experience – including global project leadership for GE and Bechtel – comprising work in conventional power generation, solar and wind generation, transmission and distribution, oil and gas, and industrial markets.

As the U.S. energy ecosystem continues evolving, megatrends compounding challenges of an already complex electric sector are stoking an urgent call for changes.

As more and more companies and communities pursue clean energy and transportation solutions to serve their near-term decarbonization goals, the need is growing for practical, tactical plans with intensifying scope and ambitions. Renewable energy – largely from the sun, wind and hydro – continues to proliferate, pressing electric utilities to accommodate it onto an aging grid. Electric vehicle (EV) adoption is accelerating, raising legitimate questions about whether this aging grid system will meet the rising demand. And cyber threats that exploit vulnerabilities aren't abating.

What does it all mean? In the interest of electric system resilience and reliability, it may be merely the fact that the industry is at an inflection point with an infrastructure in need of upgrades, if not reinvention.

In many ways, grid modernization – “grid mod,” in industry parlance – is an imperative. It ensures the nation's sprawling electrical transmission and distribution network will be up to the task of handling ever-increasing renewable energy, the volatility of floods, droughts and wildfires fueled by climate change, and the EV segment's growing appetite for electrons, among other things.

Black & Veatch's *2023 Electric Report* encapsulates this sector's world of headwinds and opportunities, drawing upon expert analyses of survey results of more than 650 U.S. energy industry stakeholders to detail the complexities.

In many ways, modernizing is a matter of money, with utilities searching out the most cost-effective ways to decarbonize their energy portfolios. Federal legislation signed into law in recent years is meant to ease the burden, devoting a generational influx of billions of dollars in available funding and tax credits to upgrade the grid. Only now is that infusion for such things as climate mitigation, clean energy projects and other zero-emissions technologies beginning to flow.

As survey responses make clear, modernizing the grid – whether in small or sweeping ways – gets more doable when many things align. And for now, issues with things such as supply chains, workforce availability and regulatory lags simply aren't cooperating.

Renewables and the Grid

As the industry knows, renewable energy is on a march.

In March, the federal government's chief keeper of energy stats – the U.S. Energy Information Administration (EIA) – reported that U.S. electricity from renewable sources, largely from the wind, sun and hydro, surpassed coal-fired generation for the first time.

Renewables again outranked nuclear power generation in 2022 for the second consecutive year as energy from coal continued its slide, from 23 percent in 2021 to 20 percent last year as more coal-fired power plants were retired and those that remained got less use. By 2050, the EIA forecasts solar and wind power will account for 40 to 69 percent of U.S. electricity generation.

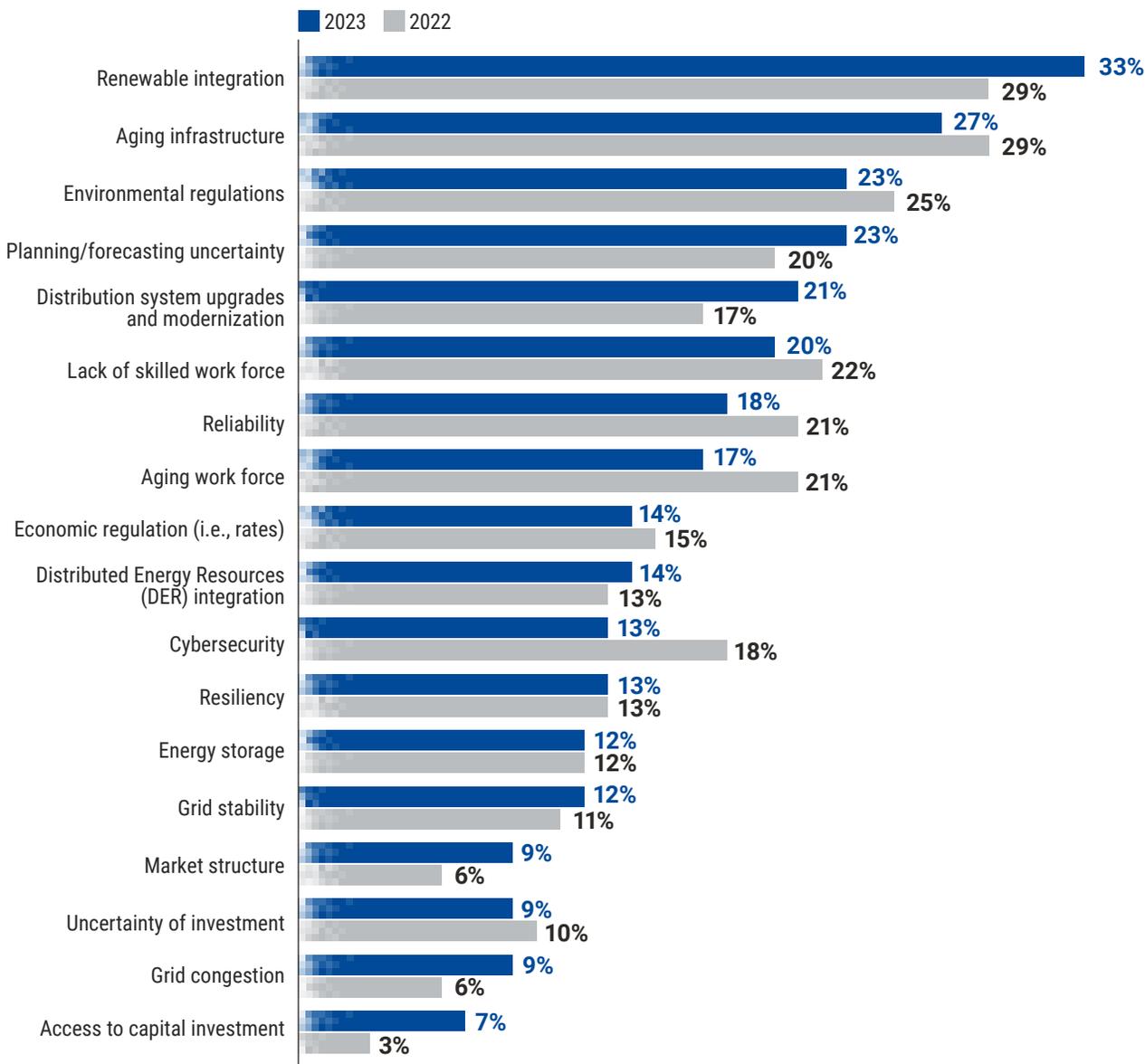
Fanning the growth of renewable energy in recent years has been the sizable drop in the cost of producing wind and solar power – including the sharp decline in the price of solar photovoltaic cells – as well as customer decarbonization goals. That growth is despite the downside that solar and wind power is prone to intermittency – the lack of energy produced when the sun isn't shining, and the wind isn't blowing – and must be paired with batteries or other energy storage types.

Yet it's of little surprise that the survey shows an industry grappling with the growing wave of green energy. One-third of respondents cited integrating renewable energy and distributed energy resources onto the grid as their enterprise's foremost challenge, edging aging infrastructure by 6 percentage points (*Figure 1*). It's an especially notable outcome, given that aging infrastructure had ruled the roost of the list of top industry headaches for years before renewable integration suddenly tied it last year.

Figure 1

What are the TOP THREE most challenging issues facing the electric industry in your region today? (Select up to three)

Source: Black & Veatch



Resilience and Reliability: The Need for Grid Mod

The U.S. electric grid is an engineering marvel, with thousands of electricity-generating units and its web of hundreds of thousands of miles of transmission and distribution lines, powering millions of homes and businesses.

This breadth involves complexity, which invites questions about the aging grid’s resilience and reliability – wonders amplified by rising concerns about outage-causing extreme climate events, greater load demands for a rapidly expanding EV segment, and the proliferation of such things as energy-intensive cloud computing and data centers. Of course, that’s in addition to questions about the grid’s ability to accommodate more renewables in a decarbonizing world.

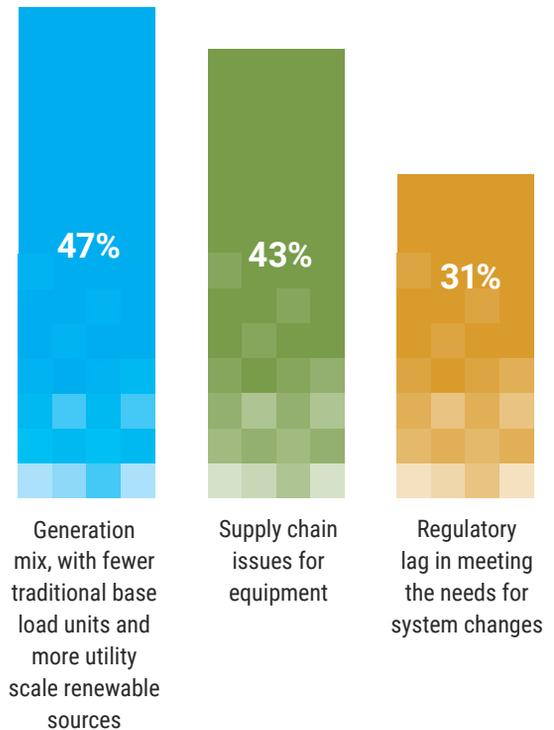
All of it has fueled a growing sense of urgency to modernize the grid, and the U.S. electric sector hears it. The issue now is choosing the path forward.

When it comes to the industry’s biggest concerns for developing the grid in the short term – three to five years – survey respondents cited as their largest concern (47 percent) the issue of their generation mix, with fewer traditional base load units and more utility-scale renewable sources. That narrowly edged the frustrations of procuring what’s needed for much-needed grid modernization in a bottlenecked supply chain; in a separate question, seven in 10 respondents said their organization’s resilience and reliability projects are impacted by the availability of components for transmission and distribution improvements (Figure 2).

Figure 2

What are the TOP THREE biggest concerns for future grid development in the next 3-5 years? (Select up to three concerns)

Source: Black & Veatch

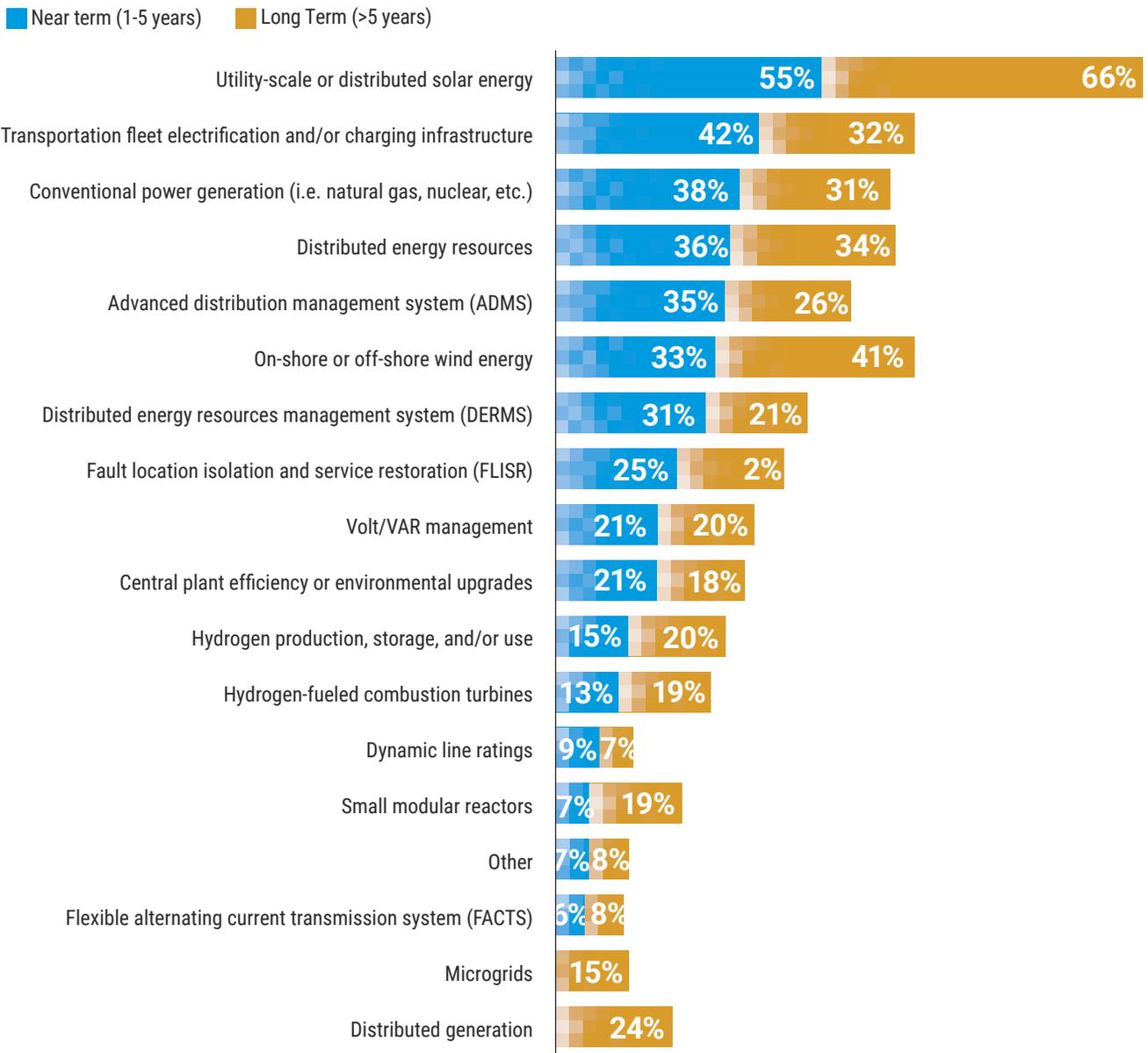


Lack of sufficient transmission facilities and system control assets	23%
Lack of qualified workers to engineer, maintain and operate the more complex system	22%
Ability to invest in and maintain a more resilient grid.....	22%
Talent availability.....	20%
Increases in DER	15%
Lack of sufficient levels of investment to maintain and operate	13%
Commodity inflation	13%
Supporting systems/component availability.....	11%
Available capital	10%
Other	8%
Firm pricing of equipment	8%
Safety for energy professionals and the public with greater dispersed resources	3%
Unionization of the workforce	2%
Importing challenges	2%

Figure 3

Which technologies do you intend to make investments in the near-term one to five years and long-term more than five years? (Select all that apply)

Source: Black & Veatch



For now, the survey shows the industry’s mindset is centering on decarbonization, with renewable energy at its core. When asked what technology investments they’ll be prioritizing in the immediate future – the next one to five years – respondents cited utility-scale or distributed solar energy (55 percent) and transportation fleet electrification and/or charging infrastructure (42 percent). Investments in conventional power generation, distributed energy resources,

advanced distribution management systems, and wind energy were tightly bunched, each drawing respondent reply percentages in the mid-30s (Figure 3).

Looking five to 10 years out on the technology investment front, two-thirds of respondents said they’ll invest more in solar, followed by wind (41 percent), distributed energy storage (34 percent) and fleet electrification and/or charging infrastructure.

Hydrogen: Alluring, Evolving

Given the undeniable migration by U.S. electric utilities to cleaner sources of power, the role of hydrogen in the equation is drawing mixed perspectives as the technology evolves, with survey respondents still curious about hydrogen's technical and economic viability.

There's little question that hydrogen is advantageous in efforts to lower carbon footprints through greener energy portfolios. Respondents who were asked what trends most interest them, long-duration energy storage in the form of hydrogen placed third (41 percent), behind small modular reactors (SMRs) at 50 percent, and around-the-clock dispatchable power from renewable resources and battery energy storage.

When asked how they view hydrogen and their electrification strategy, roughly four in 10 respondents said they are researching hydrogen, while more than one-quarter (27 percent) view hydrogen and their electrification road map as complementary. In a separate question, 44 percent see hydrogen as very or somewhat viable as a long-duration energy storage option, perhaps reflecting cautious optimism about the technology even as some utilities are beginning to realize just how expensive and long-horizon — mid-2030s or later — those projects might be before coming online.

Some ambitious projects are looking for solutions. Last year, Mitsubishi Power Americas and Magnum Development — co-developers of what will be among the world's largest industrial "green" hydrogen production and storage facilities — announced its selection of Black & Veatch for engineering, procurement and construction (EPC) services for the Advanced Clean Energy Storage (ACES) Delta Hydrogen Hub in Delta, Utah. That project will be next to the Intermountain Power Agency's IPP Renewed Project and support an 840-megawatt, hydrogen-capable gas turbine combined cycle power plant expected to be powered entirely by hydrogen by 2045 after using a blend of hydrogen and natural gas.

In the Canadian province of Nova Scotia, EverWind Fuels Company announced last December its selection of Black & Veatch to provide front-end engineering design (FEED) services for its green hydrogen and ammonia production and storage facility in Point Tupper, with initial commercial operations planned for 2025. EverWind is a private developer of green hydrogen and ammonia production and storage sites.

As this report makes clear, there is a prevailing need for economical solutions to decarbonize the U.S. power system. These solutions are needed now, regardless of the technology, funding source or infrastructure challenge.



Elsewhere in This Report

Climate Change (page 26): The escalating frequency and strength of hurricanes, wildfires, floods, droughts and environmental impacts offer tangible evidence that climate change is making severe weather events increasingly unpredictable and more costly. Despite such uncertainty, one thing is clear: no utility or locale is immune from climatological risk. Or the need to harden infrastructure.

Cybersecurity (page 36): As federal regulations require electric utilities to comply with certain cybersecurity standards for protecting their systems from keyboard predators, cyber attacks persist as advancing technology expands the attack surface and creates new vulnerabilities. Find out how utilities rate their cyber postures and their approaches to bolster their defenses.

Vehicle Electrification (page 31) : In the fight to minimize carbon emissions, electric vehicles continue gaining mindshare as a viable solution, begging the question: Is the U.S. power sector positioning itself sufficiently to scale up its infrastructure to accommodate the expected, sizable charging needs. Black & Veatch's industry survey shows that the sector is well aware of change on the horizon but slow in making the necessary investments.

Resilience





Confidence in U.S. Power Grid Requires More Proactive Approach to Reliability, Resiliency

Facing more challenges than ever, the U.S. power grid is drawing increasing scrutiny about its resiliency and reliability. Load demands are on the rise due to growing consumer electric vehicle (EV) charging networks, enterprise fleet electrification, cloud computing and manufacturing growth. Extreme climate events in the form of flooding, droughts, ice storms, hurricanes and wildfires are causing outages and damaging aging infrastructure that for more than a generation has been the sector's biggest headache. Utilities are grappling with integrating renewable energy onto the grid.

While upgrading and hardening the grid has been a hot topic for decades, the need is edging closer to an inflection point in an industry with an array of competing interests, many of them carrying a considerable price tag.

Black & Veatch's new *2023 Electric Report* – with expert analyses of survey results from more than 650 U.S. power sector stakeholders – shows an industry with a widening awareness of what needs to be done to strengthen distribution and transmission systems in a rapidly decarbonizing world. Along the way, the report highlights the sector's strategies for addressing headwinds such as disruptive high-impact, low-frequency events that test grid reliability and resilience, how digitalization of systems comes into play, and how priorities in grid modernization are being addressed.

The key takeaway: Being proactive rather than reactive always is the winning strategy.

High-Impact, Low-Frequency Events are Widely Recognized

Although the grid impact differs across geographies, extreme weather events – from Texas ice storms to New Jersey hurricanes and California wildfires – are widely accepted as grid-impacting emergencies that demand the attention of the power and utility industries. Over the past decade, the frequency and level of impact of extreme weather events has increased, and it’s now more widely accepted that such events are inevitable. The ability of the energy system to better absorb impact and recover quicker in the wake of these occurrences is a significant part of the investment impetus for bolstering system resiliency.

When asked if resiliency is being given more consideration in investment decisions due to high-impact, low-frequency events, more than eight in 10 respondents – 83 percent – answered “yes,” with more than half of that pool responding “definitely” (Figure 4).

While the majority of respondents said they are taking extreme climate events into consideration, less than half (48 percent) have incorporated any high-level or long-term climate risk analyses into their resilience planning. Still, it’s encouraging to see momentum rising, with 13 percent more respondents planning to address climate risk modeling over 2022’s survey.

In the world of risk management, it’s no small matter. According to a Black & Veatch eBook, [“Three Climate Modeling Considerations for Utilities,”](#) natural disasters have caused \$1.4 trillion in damage in the past four years. Utilities that leverage climate modeling and data analytics can better prepare for future extreme weather events.

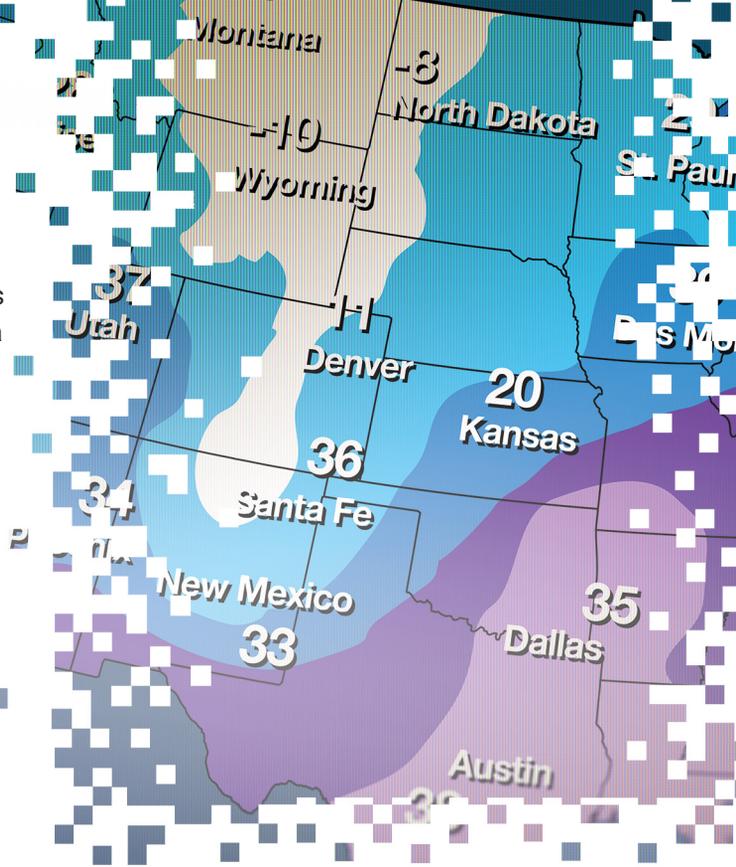
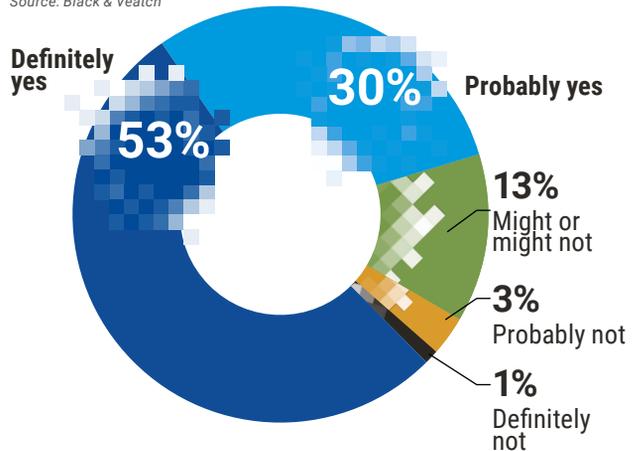


Figure 4

Is resiliency being given more consideration in your investment decision making due to high-impact, low-frequency events (ex. wildfires, freeze events, hurricanes)?
(Select one)

Source: Black & Veatch



Supply Chain Issues Aren't Improving

Despite the end of the pandemic, procurement challenges — supply chain issues — are still rampant due to the sheer volume of work. Seven in 10 of those surveyed by Black & Veatch said their organization's resilience and reliability projects are impacted by the availability of components for transmission and distribution improvements (Figure 5). This data — up from 66 percent in 2022 — validates that the supply chain remains a significant obstacle to deploying much-needed grid modernization projects.

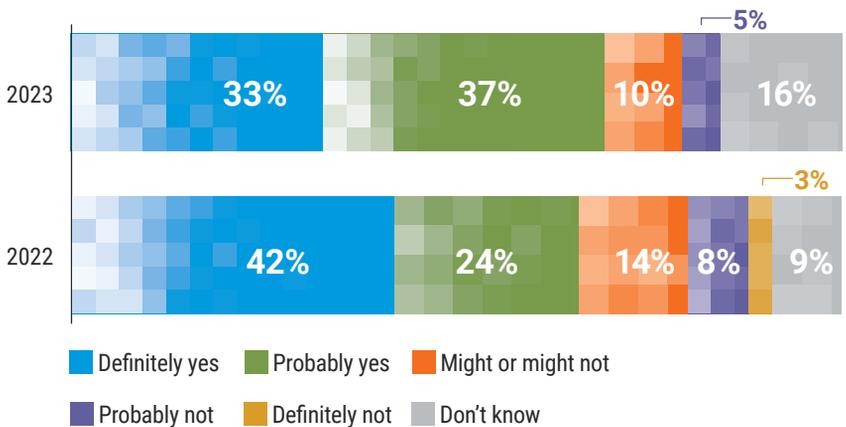
Drilling a bit deeper, 30 percent of respondents report that their enterprises are delaying resilience and reliability projects because they cannot get firm pricing, project financing or have equipment concerns. Specific to the question of how their utility has addressed supply chain challenges, half of respondents say they've delayed projects because of them — below only contingency planning (67 percent) and selected different vendors (51 percent). Only 4 percent said they either didn't experience or didn't choose to address supply chain issues.

Delayed solutions mean the situation will only worsen as infrastructure continues to age and load continues to grow.

Figure 5

Are your organization's projects being impacted by the availability of components for transmission and distribution grid enhancements? (Select one)

Source: Black & Veatch



Renewable Energy is Growing, but Integration is Lacking

As the world presses to lower its carbon footprint through an evolving energy ecosystem that features more renewable energy, deploying increasing amounts of low-carbon energy is a great step in combating climate change. But the absence of an effective way to efficiently manage interconnections is causing quite a strain on the grid. As detailed in a Black & Veatch whitepaper, [“Five Trends Energy Utilities Can’t Ignore When Preparing for the Future,”](#) infrastructure improvements and capacity upgrades are needed to harness the resiliency and reliability benefits of renewables.

Contrary to what the industry saw in prior decades when load growth on the grid was stagnant, there’s now a notable increase. Some 83 percent of respondents reported emerging and/or significant impacts from new load additions (*Figure 6*). Although 30 percent anticipated significant impacts and 18 percent did not expect them, almost all respondents agreed that load growth is affecting their network resiliency and reliability in some capacity.

Respondents also expressed little confidence that queue reform, contemplated by the Federal Energy Regulatory Commission (FERC), will positively impact renewable interconnections; only 12 percent said “definitely yes.” Pessimism lingers within the industry that regulation can solve this major problem at a time when hundreds of gigawatts in the queue cannot connect to the grid. As long as the industry is slow to integrate renewable energy, decarbonization efforts and generation additions needed to maintain reliability are increasingly at risk.

All told, the survey data confirms that U.S. energy utilities agree on the main resiliency and reliability challenges they are facing: high-impact climate

events, supply chain obstacles, and inefficient mechanisms to spur grid deployment that supports generation interconnects. Fortunately, many utilities also are embracing relevant solutions such as climate risk modeling, infrastructure improvements and grid modernizations.

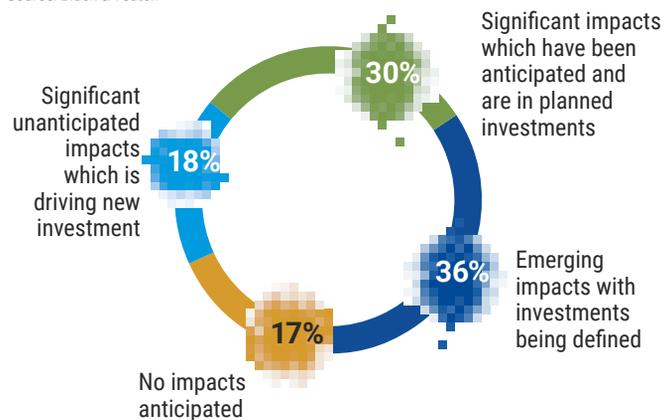
Grid-modernizing pursuits promise high returns on infrastructure investments through improved reliability and reduced operating costs – if these investments are strategic. Passed in late 2021, the Infrastructure Investment and Jobs Act (IIJA) – also known as the Bipartisan Infrastructure Law – continues to influence these improvements and associated regulations; nearly \$65 billion has been allotted to fund grid upgrades around the country. But Black & Veatch’s survey data also revealed that utilities need more guidance (potentially from expert advisory partners) on how to secure funding and strategize when and where to spend it.

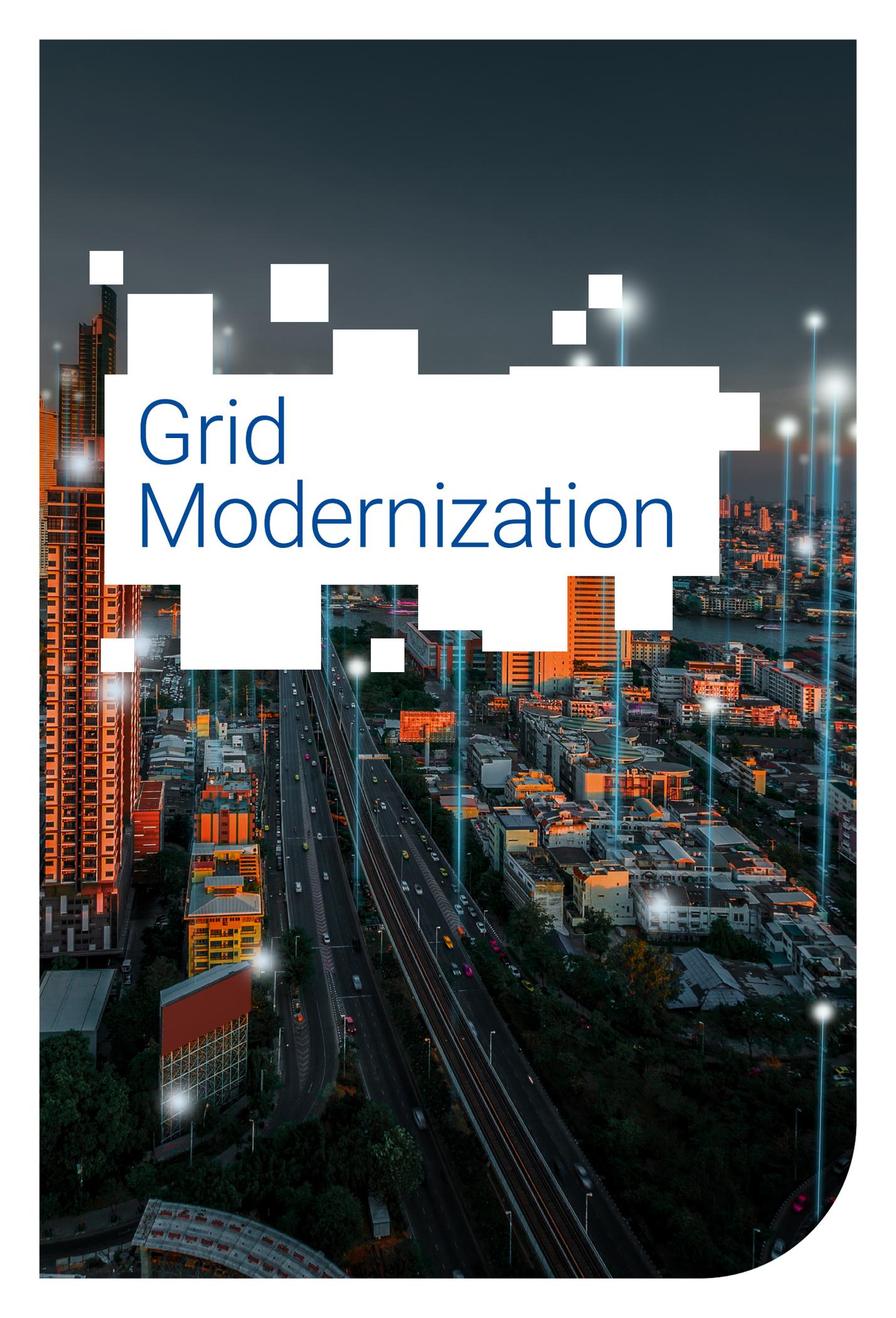
In many ways, fate favors those who are proactive rather than reactive, knowing that challenges to resiliency and reliability aren’t going away any time soon.

Figure 6

To what extent is your network resiliency and reliability being impacted by new load additions (either transmission-connected large load consumers or new load additions on the distribution network)? (Select one)

Source: Black & Veatch



An aerial night view of a city featuring a multi-lane highway with traffic. The city is illuminated with warm lights, and a digital grid overlay with glowing blue lines and white squares is superimposed on the scene. The text 'Grid Modernization' is centered in a white box.

Grid Modernization



Grid Modernization: A Story of Great Promise, Necessity and Challenges

Across the landscape of U.S. electric utilities, no two words better encapsulate both the frustration and promise in tackling the growing need to update and harden chronically aging grid infrastructure against an onslaught of threats as well as to capitalize on emerging opportunities.

Grid modernization.

Pressures come with better integrating distributed energy resources (DERs) and improving reliability of the grid while bolstering its resilience against severe weather. From cybersecurity to the outage-causing effects of a changing climate and the push to accommodate growing uses of renewable energy onto the grid in an evolving energy ecosystem, the demands for modernized grid infrastructure are real – and rising. Widening adoption of electric vehicles, distributed energy storage and solar photovoltaics will require more infrastructure to accommodate customer vehicle charging, decarbonization and reliability needs.

The sector has reached a tipping point. After more than a decade of especially intense concerns about

the resiliency of infrastructure that, in many cases, is past its prime, the chorus of calls to modernize is reaching a growing pitch. Federal lawmakers hear it and, with the stroke of President Joe Biden's pen, have greased the pipeline with billions of dollars of available funding to make change happen, though that infusion only now is beginning to flow.

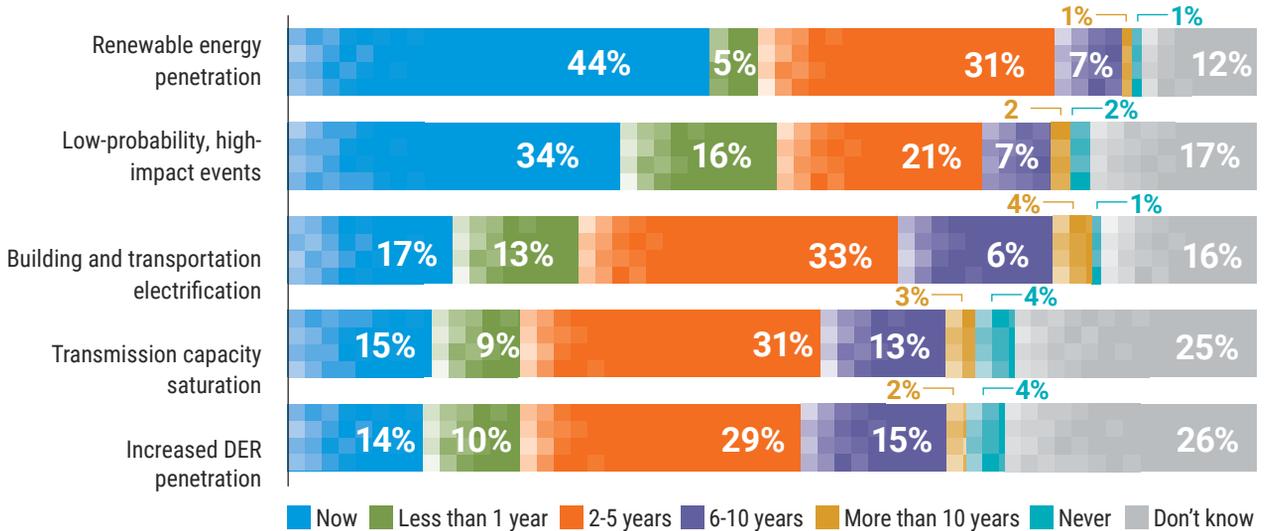
At this moment, it's simply about fundamentals. Supply chain bottlenecks first manifested by the COVID-19 pandemic continue to frustrate efforts to get what's needed in any timely fashion. As older workers continue to retire – taking their intimate knowledge of the nuances of grid infrastructure with them – utilities are having a tough time recruiting skilled workers in a tight, competitive job market. And sadly, utilities still aren't making the most of their data that, in the absence of actual investment in new technologies, can help operators get the most out of infrastructure past its prime.

It's a complicated picture illustrated by other data, this time from Black & Veatch in a survey of more than 650 U.S. power sector stakeholders for the global critical infrastructure leader's *2023 Electric Report*.

Figure 7

When do you anticipate the following to be drivers of grid modernization for your organization?
(Select one for each)

Source: Black & Veatch



The Time to Modernize is Now

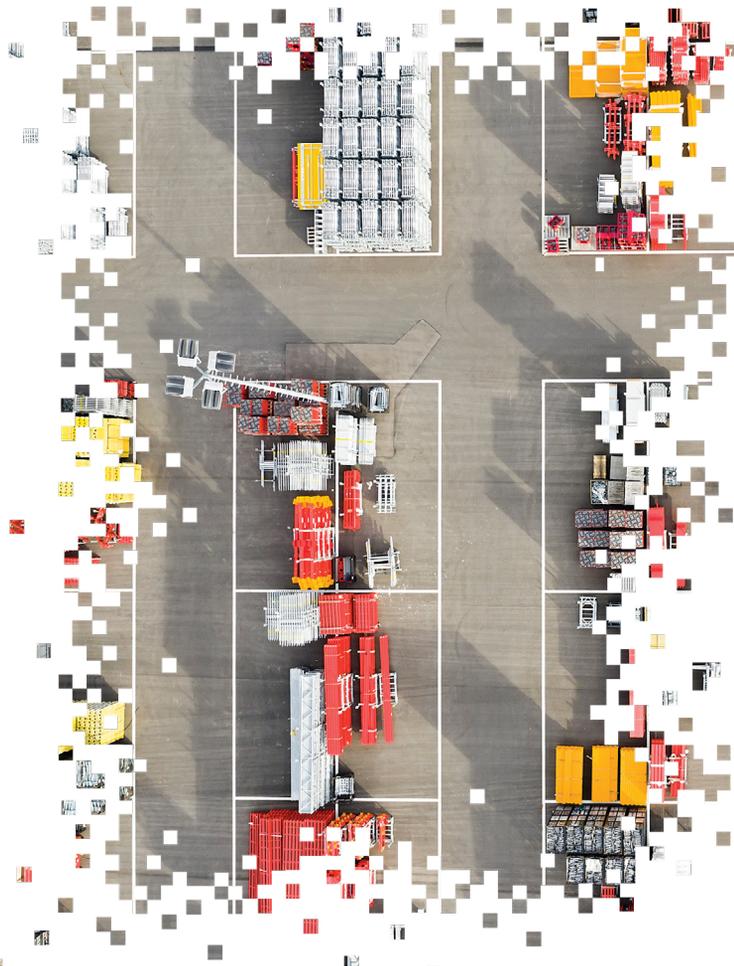
Without question, strategically modernizing the grid inherently carries great opportunity, including the potential of greater value from infrastructure investments, lower operating costs, improved resiliency and the enhanced reliability that comes with replacing aging assets.

So, what’s the appetite for such investment, and what’s the time horizon among U.S. electric utilities? Black & Veatch survey respondents cited as the top driver of grid modernization now and within the next year for their enterprises as low-probability, high-impact events (34 percent) that include increasingly frequent extreme events – droughts, hurricanes and wildfires – fueled by climate change (50 percent). That narrowly outranked renewable energy penetration (49 percent) (Figure 7).

The takeaway: At least in the short-term, utilities worry most about their grid’s resiliency against catastrophic events.

Supply Chain Issues a Big Headwind

Confounding the eagerness of U.S. electric utilities to proactively update their grid, supply chain issues persisting since the COVID-19



pandemic are stoking uncertainty and slowing needed progress. Availability of everything from transformers to other vital components has reached unprecedented delays, and their costs in many cases are higher and more volatile given the tight supply, slowing efforts to modernize and decarbonize the grid.

When asked when they anticipate their enterprise will face certain challenges to grid modernization, nearly two-thirds of respondents – 62 percent – cited supply chain constraints as their most-pressing issue. Three other challenges – competition for capital dollars, concerns about ongoing maintenance costs, and resource constraints – were tightly bunched at about 50 percent (Figure 8).

Plotting a Path

As the wait continues, Black & Veatch – a global leader in grid modernization solutions – has advised U.S. electric utility clients to remain engaged, among other things by ramping up dialogue with suppliers for a better understanding

of what lead times look like in the pursuit of what’s needed. Another suggestion is to widen their net of possible suppliers, understanding the varying state standards that apply to what equipment and components are approved.

In essence, it’s about prioritizing and sequencing phases of upgrades. That means having everything queued up to ideally coincide with the federal infusion of funds and tax credits through the Bipartisan Infrastructure Law (BIL) and the Inflation Reduction Act (IRA) fully flows, underwriting some of the cost of the upgrades for those willing to secure the funding. Having a guiding financial model lining out a roadmap for operational and maintenance priorities will be key, given the expected, intense competition for the federal financing incentives that could have a rush of recipients putting in their orders and launching upgrade projects all at the same time.

Central to grid modernization strategy is having a plan that brings maximum value to the consumers, considers all the constraints and is defensible to regulators and other constituents.

Figure 8

When do you anticipate your organization facing the following challenges to grid modernization? (Select one for each)

Source: Black & Veatch

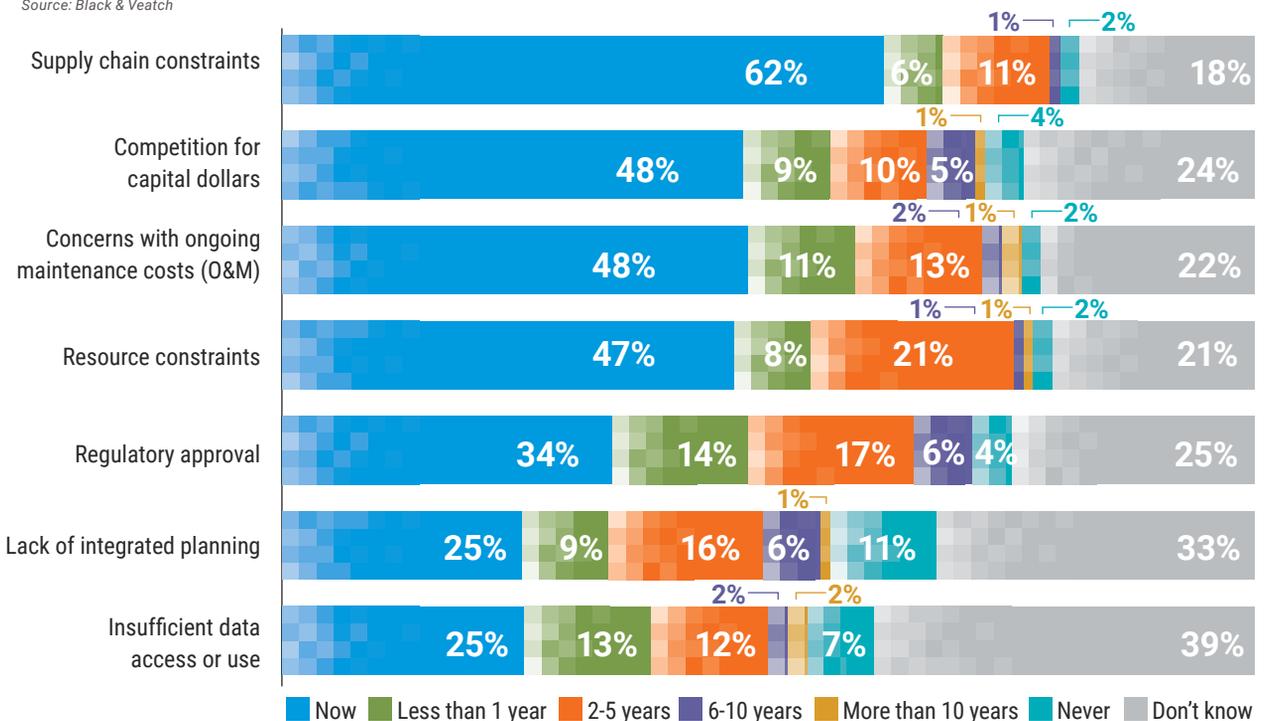
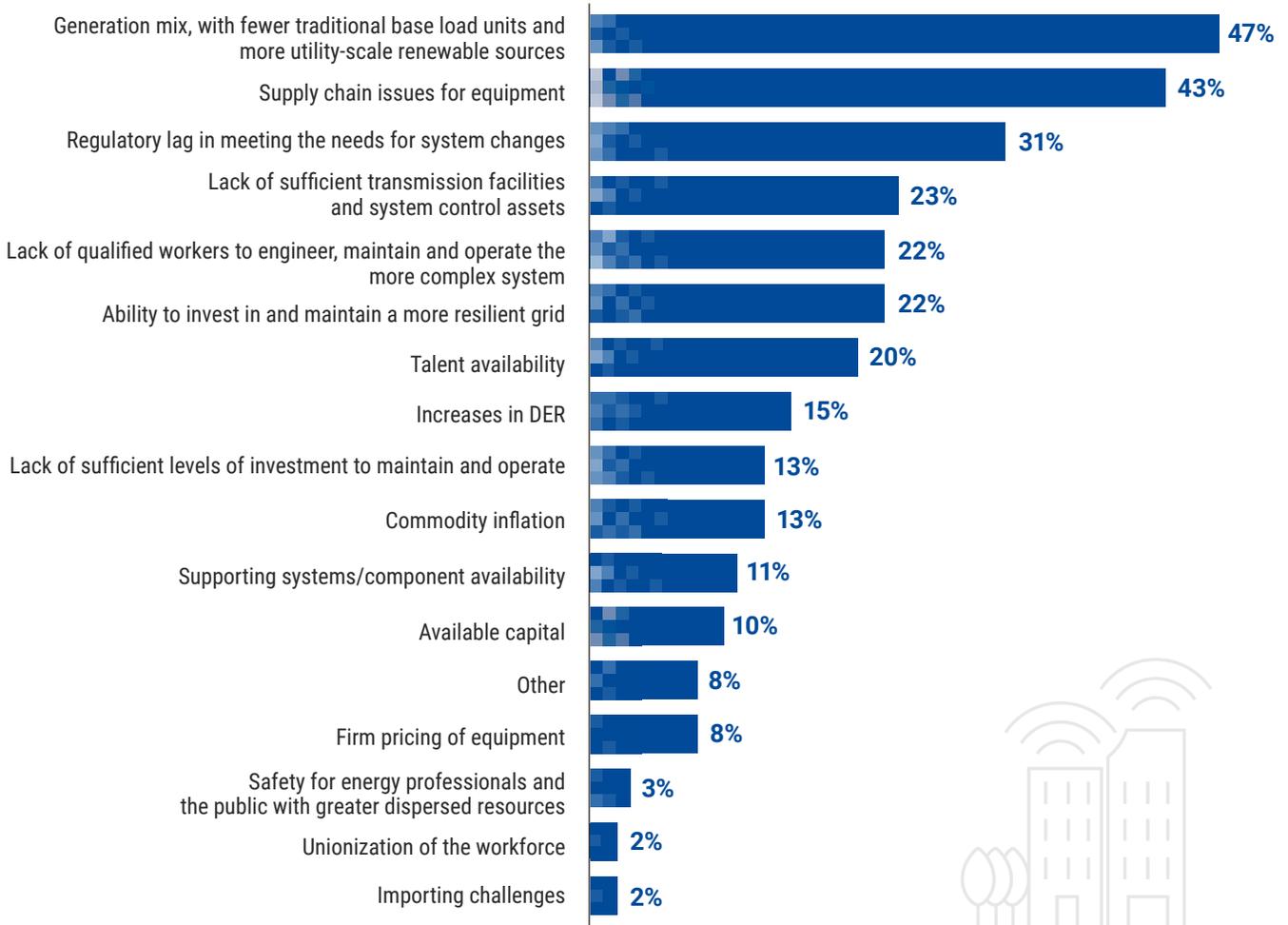


Figure 9

What are the TOP THREE biggest concerns for future grid development in the next three to five years? (Select up to three concerns)

Source: Black & Veatch



What to Expect: A Crystal Ball

When it comes to supply chain constraints, pessimism abounds that this challenge is not likely to abate anytime soon.

Looking ahead over the next three to five years, the top concern among survey respondents about tomorrow's grid development is the generation mix with fewer traditional baseload units and more utility-scale renewable sources (47 percent), localizing a utility's grid constraints. That's followed closely by – you guessed it – supply chain issues for equipment (43 percent), with the lag in getting regulatory approvals for system changes drawing 31 percent (Figure 9).

Workforce worries also are in the mix, with more than one in five respondents citing the lack of qualified workers to engineer, maintain and operate the more complex system as something that's keeping them up at night.

For U.S. electric utilities, it's a world of growing complexities that demands collaboration, both with suppliers and outside experts who can offer clarity that cuts through the clutter and offer the smart path forward.



Decarbonization

As Decarbonization Pressures Mount, Power Producers Evaluate Investment Priorities, Trade-Offs



Image courtesy of: HydrogenPro

A year after President Joe Biden signed into law the \$369-billion Inflation Reduction Act (IRA), U.S. energy sector stakeholders are beginning to see pathways to achieve their decarbonization targets through a combination of mature solutions – such as energy efficiency, battery energy storage and renewable power generation – and emerging low-carbon fuels and technologies.

Yet, as they accelerate toward the United States’ ambition of 100 percent clean electricity by 2035 in a rapidly evolving energy ecosystem, they

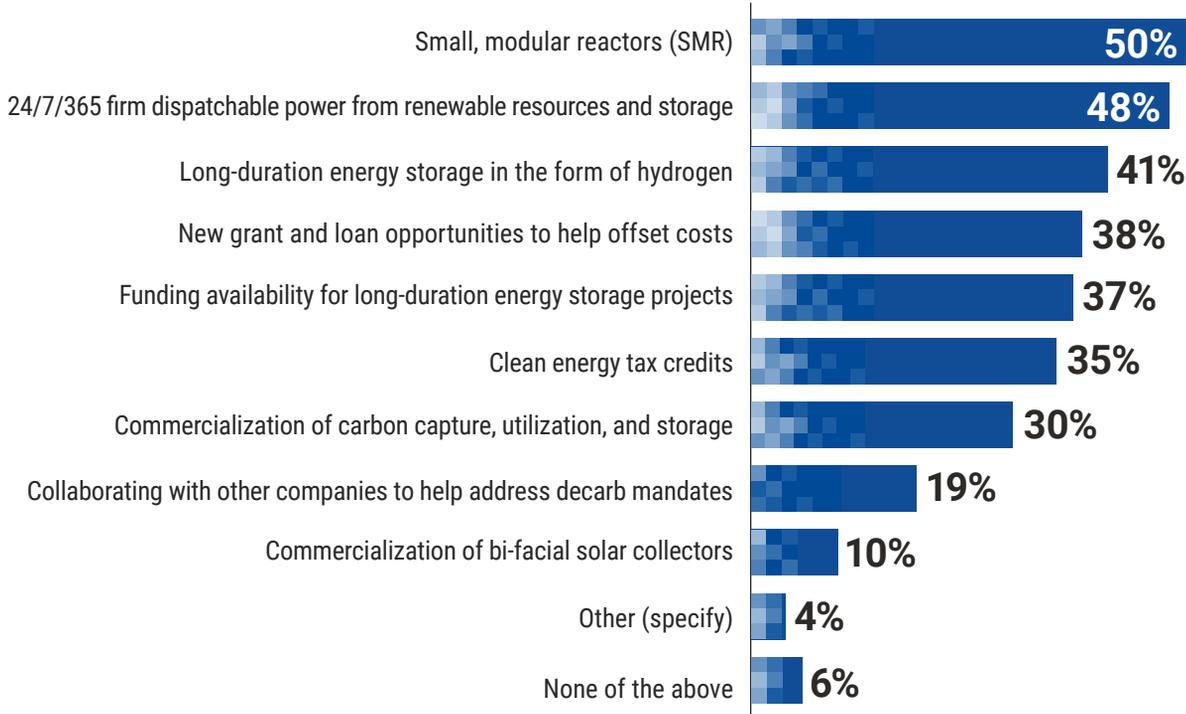
remain curious about the technical and economic viability of hydrogen, carbon capture and small modular (nuclear) reactors (SMRs). Many seem to be taking a wait-and-see approach as the distribution of IRA funding takes shape and best practices emerge in the battle for the most cost-effective decarbonization solutions.

Black & Veatch’s *2023 Electric Report* – expert analyses of more than 650 responses to a survey of U.S. power sector stakeholders – offers valuable context about it all.

Figure 10

Which of the following trends, if any, are you most interested in? (Select all that apply)

Source: Black & Veatch



Given captivating headlines over the past few years about the carbon-cutting potential of SMRs and long-duration energy storage in the form of hydrogen, it wasn't surprising to see those technologies take two of the top three spots among trends in which stakeholders were most interested (*Figure 10*). Sandwiched between those technologies were increasingly economical renewables and complementary battery energy storage.

Because financial trends made the next three spots on the list – most likely due to uncertainty about when and where government dollars would be released – respondents seemed most in search of answers about the IRA's climate- and energy-related incentives that would help them further their decarbonization efforts.

Offsetting Investment Costs with Federal Funding

Although the IRA has encouraged carbon capture and "green" hydrogen production that's electrolysis with renewable energy resources, some utilities are beginning to realize just how expensive and long-horizon (mid-2030s or later) those projects might be before coming online.

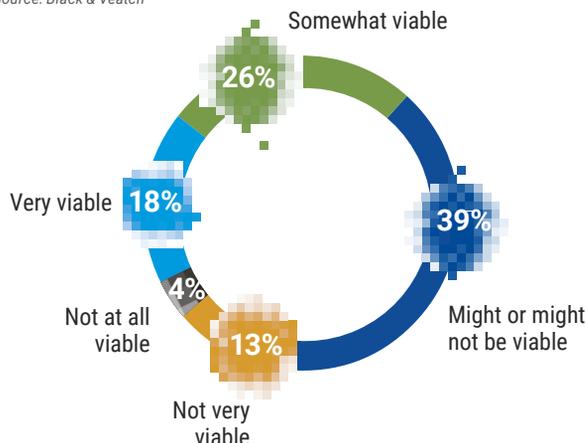
Forty-four percent of respondents consider hydrogen very or somewhat viable as a long-duration energy storage option (*Figure 11*), indicating there appears to be cautious optimism surrounding use of the technology, even as utilities compare it to other more economical generation and energy storage options, all similarly backed by the IRA. The less expensive technologies certainly are appealing to utilities facing imminent clean-energy mandates as well as pressure from stakeholders to make investments that achieve decarbonization goals now and beyond.

There also are regional considerations when it comes to the feasibility of hydrogen and carbon capture. For example, the hydrogen viability response simply might come down to geography, including whether a U.S. power producer has nearby access to and can store hydrogen in geologic formations. So too with carbon capture, as power producers in regions with fewer hours of daylight might be more likely to invest in the technology; for those in regions with more sun such as the Southeast, investments in solar

Figure 11

In your service territory, how viable do you consider hydrogen as a long-duration energy storage option compared to more traditional technologies (ie., batteries, pumped hydroelectric)? (Select one)

Source: Black & Veatch



power likely will continue to accelerate. State and local politics also will continue to play a role when it comes to regional investments in carbon sequestration, for the inescapable reason that taxpayers and policymakers must decide under whose backyard the carbon dioxide gets buried.

Hydrogen Poised to Provide Tomorrow's Green Energy

In 2022, Black & Veatch announced it had been chosen by Mitsubishi Power Americas and Magnum Development – co-developers of what will be among the world's largest industrial "green" hydrogen production and storage facilities – to provide engineering, procurement, and construction (EPC) services for the Advanced Clean Energy Storage (ACES) Delta Hydrogen Hub in Delta, Utah. The project will be adjacent to the Intermountain Power Agency's IPP Renewed Project and support an 840-megawatt, hydrogen-capable gas turbine combined cycle power plant. That plant will initially operate on a blend of hydrogen with natural gas starting in 2025, then incrementally expand to use 100 percent hydrogen by 2045.

Hydrogen as a long-duration energy storage solution allows renewable energy to be deployed in times of highest demand, and indeed, demand should be high given the plant will first serve

the Intermountain Power Agency's electricity customers in Utah and Los Angeles. But that additional renewable energy presents another grand challenge associated with decarbonization: the increasing pressures placed on the country's aging electrical transmission and distribution systems.

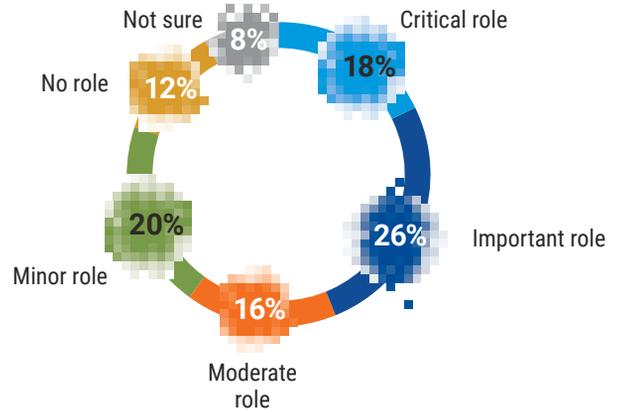
Meeting Heightened Electrification Demands

With the Biden administration's goal of net-zero emissions by 2050, paired with increasing calls to electrify the grid more rapidly to power electric vehicle fleets and passenger cars, electricity demand by 2035 is expected to increase 38 percent from 2022 levels, according to [CNBC](#). Transmitting high-voltage electricity to major cities across the nation will require costly transmission infrastructure upgrades, replacements and new buildouts. To address that concern, the bipartisan, \$1.2-trillion Bipartisan Infrastructure Law signed by Biden in late 2021 included a \$73 billion commitment to grid improvements, including thousands of miles of new, resilient transmission lines to help expand access to power generated by renewable technologies.

Figure 12

What role do you think distributed energy resources (DERs) will play in helping your company achieve its decarbonization targets? (Select one)

Source: Black & Veatch



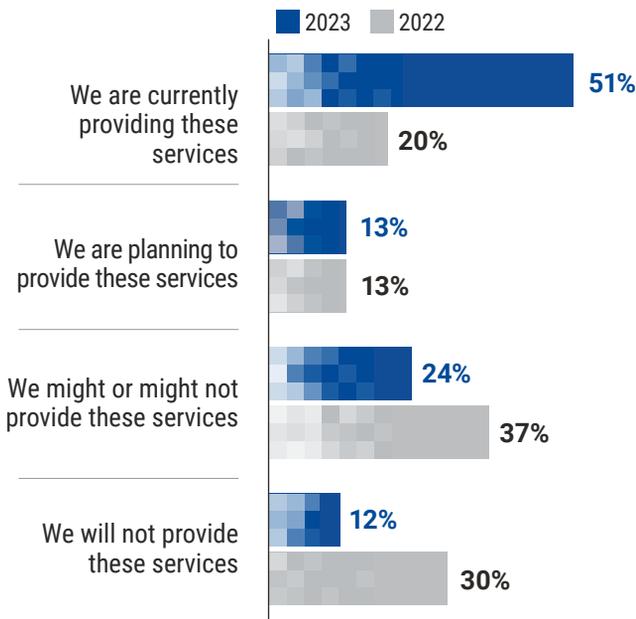
Along with the anticipated acceleration of electrification and associated expansion of grid infrastructure comes a worthwhile reexamination of the importance of distributed energy resources (DERs) to a decarbonized future – for example, using excess power from rooftop solar panels, household battery storage systems and wind generation units owned by utilities' customers. Most respondents to this year's survey said DERs would play a role in helping them achieve decarbonization targets (Figure 12).



Figure 13

Is your utility providing distributed energy resources (DERs) and related services (including integration, dispatch, compensation) to your customers? (Select one)

Source: Black & Veatch



The increased deployment of DERs is being accelerated by three dynamics. First, full decarbonization cannot only be met by retiring old fossil-based supply-side (wholesale) generation assets and adding renewable generation assets to the mix; DERs will be key to unlocking carbon reductions on the demand-side (retail) as well. Moreover, the interconnection queue for wholesale projects is becoming longer; diversification of assets to achieve targets is important. The typical duration from connection request to commercial operation increased from less than two years for projects built between 2000 and 2007 to nearly four years for those built from 2018 to 2022, with a median of five years for projects built in 2022, [according to the Lawrence Berkeley National Laboratory](#) in April 2023. Finally, DERs are being incentivized through wholesale market design (FERC Order 2222) and targeted tax credits, grants and loans.

Perhaps a more compelling case for the future importance of DERs, though, was a significant increase from 2022 to 2023 in the percentage of respondents that said they were providing DERs and related services to customers (*Figure 13*). The percentage went up to 51 percent in 2023, more than doubling the 2022 figure. Still, that additional power must go somewhere, making regional power grid upgrades even more important.

No matter the technology, source of funding or infrastructure challenge, most power sector stakeholders likely agree on one thing: they need economical solutions to decarbonize the U.S. power system, and they need them now. Companies such as Black & Veatch will help them find pathways toward the most viable investments that will perform profitably – and most sustainably – for decades to come.



Climate Change





No Escaping Climate Change: Preparedness Means Planning

Each month, it seems there's a new report — or often, alarm bells — illustrating that climate is changing around us, dramatically and quickly. Case in point: June was the hottest on record, according to the National Oceanic and Atmospheric Administration. Record-breaking days followed the next month.

All the while, the escalating frequency and strength of hurricanes, wildfires, floods, droughts and environmental impacts offer tangible evidence that climate change is making severe weather events increasingly unpredictable and more costly.

With the ever-present effects of climate change influencing the world, how are electric utilities dealing with the risks? Black & Veatch's survey of more than 650 U.S. electric industry stakeholders for its *2023 Electric Report* offers some perspective, beginning with the certainty that no utility or locale is immune from climatological risk.

Threats from Every Direction

No matter the location of the utility, some level of threat exists and is top of mind for power providers.

In the Northeast and South, respondents cited hurricanes as their top risk to successfully delivering reliable operations over the next three to five years, while those in the Midwest pointed to cold and ice. In the West, wildfires topped the list of climatological concerns (*Figure 14*). And even though many utilities in the same region may face the same risks, the biggest risk they identify varies across the numerous types of threats. In other words, it seems that nothing is off the table when it comes to climatological events that could impact system operations.

Mitigating Risk

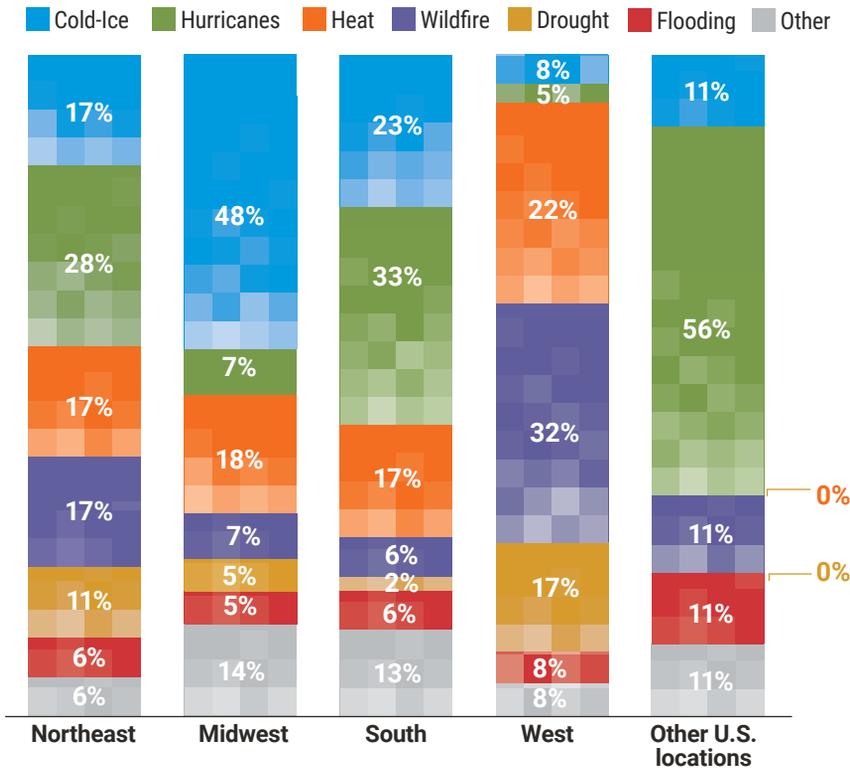
When it comes to U.S. electric utilities, the U.S. Department of Energy has been beating the drum about the need to harden assets in pursuit of resilience and reliability, appreciative that there's no panacea to the issue.

"There is no silver bullet technology to guarantee a reliable system, and every resource and system is at risk for failure: coal or natural gas fuel supplies can freeze, extended periods of low wind resource can occur, and transmission lines can fail," the DOE warned in July 2022. "Reliability and resilience of the system stems from a portfolio of technologies and strategies that limits exposure to common risks and includes forward planning that considers the evolving threats from climate change, extreme weather and other unknown sources."

Figure 14

Which climatological event represents the biggest risk for delivering reliable system operations in the next three to five years? (Select one)

Source: Black & Veatch



Mitigating climate risk will require utilities to make sizable investments to bolster their infrastructure – an approach that champions being proactive rather than reactively addressing the fallout – both monetary and in terms of public perceptions and relations – after a disaster hits.

While many electric utilities see merit in bolstering their infrastructures’ climate resilience, getting regulatory signoff for the often-steep price tag – and recovering that cost from ratepayers likely to object – keeps such projects from being viable, no matter the utility’s commitment to it.

But Uncle Sam is offering some help with climate-related investment infusions that started with the \$1.2-trillion Infrastructure Investment and Jobs Act (IIJA) that earmarks \$73 billion for grid upgrades, including the buildout of thousands of miles of new, resilient transmission lines to help expand renewable energy ostensibly meant to mitigate climate change. That single biggest federal investment in power transmission in U.S. history comes at a time of runaway expansion of renewables.



The Inflation Reduction Act (IRA) that followed became the single biggest climate investment commitment in U.S. history, with \$369 billion over 10 years devoted to climate and clean energy provisions. That includes some \$30 billion in grant and loan programs for electric utilities and states to advance the transition to cleaner, greener energy.

These historical measures will significantly benefit utilities looking to harden their systems against climate change events, especially given that respondents cited the chief obstacles to climate-related mitigation measures as affordability (48 percent). However, other challenges remain, including both regulatory scrutiny and supply chain logjams (both at 27 percent), the latter manifested by the COVID-19 pandemic and not expected to ease in the near-term (Figure 15). Difficulty in modeling future weather events and their impact on assets drew one-quarter of respondents, reflecting the complexity of modeling the dynamic variables related to climatological changes and their impact on electric utility infrastructure.

Figure 15

What are the biggest hurdles to obtaining investment in climate-related mitigation measures?

(Select all that apply)

Source: Black & Veatch

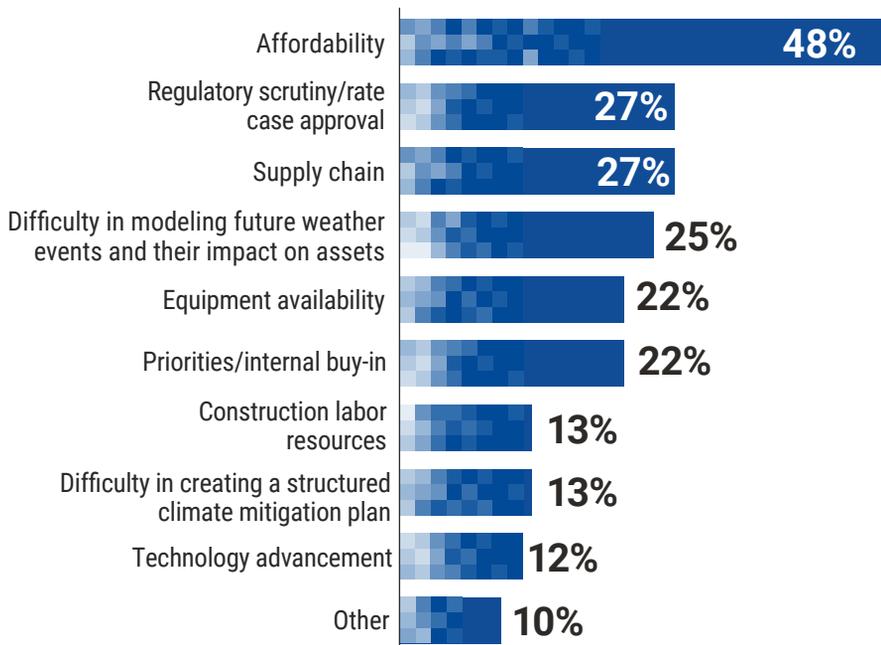
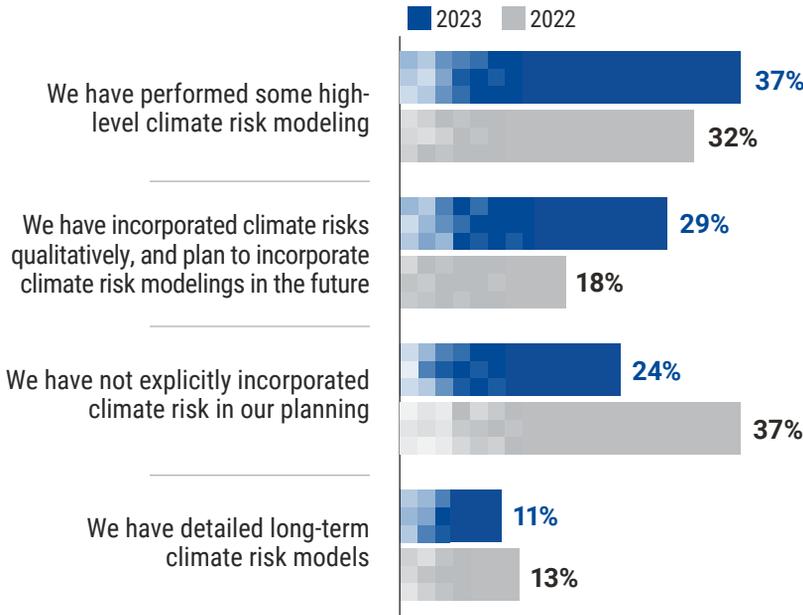


Figure 16

How far along are you in incorporating climate risk analyses into your resilience planning? (Select one)

Source: Black & Veatch



A Focus on Planning

Despite the hurdles, the U.S. electric sector appears to be putting a major focus on planning efforts.

According to respondents, two-thirds of utilities have incorporated climate risk analysis into their resilience planning or performed high-level climate risk modeling. This number has gone up substantially from 50 percent last year, punctuating the point that utilities are taking this risk more seriously (Figure 16).

Developing Unique Solutions

Climate change is real, and utilities seemingly are taking the risks seriously by implementing planning into their strategies, knowing that there's no one-size-fits-all approach, even within one geographic region. It is imperative that we act now by discarding outdated planning methods and adopting new ones that incorporate climate modeling and other innovative climate-mitigation strategies to enhance our resilience against the escalating frequency and severity of climate-related events.

When it comes to effective climate modeling and other tools to help utilities better prepare for their futures, the analysis comes to three key considerations – location, past weather event history and climate change models. To learn more about this topic in a Black & Veatch eBook, [click here](#).

Electric Vehicles





As the Race to Electrify Vehicles Gains Speed, Electric Utilities Must Get in Gear

In the fight to minimize carbon emissions, electric vehicles (EVs) continue to gain mindshare as a viable solution. As cars and trucks that run on fossil fuels contribute what the U.S. Department of Energy says amounts to [1.4 billion tons of greenhouse gas emissions](#) into the atmosphere every year, the path forward is clear: electrify the vehicle industry.

Most major car brands — from Japan-produced Toyotas to American-made Fords — have expanded their EV model lineups, wagering those cleaner, quieter conveyances are the future. Lux market entrants from Tesla, Rivian and performance models from Porsche are seen as the new status of wealth. That all begs the question: Are image and accessibility the only hurdles to overcome in the race to electrify transportation?

In April 2023, [the U.S. Environmental Protection Agency proposed](#) what, if finalized, amount to the most ambitious U.S. vehicle emissions reduction standards ever, meant to accelerate automakers' shift to EVs. The plan expands the electrification of ridesharing, rental car and federal agency fleets and establishes community charging and more. While President Joe Biden and the auto industry are gearing up to electrify, are U.S. power suppliers ready for the increased demand for electricity?

Black & Veatch's *2023 Electric Report* — based on expert analysis of a survey of more than 650 U.S. electric sector stakeholders — paints a picture of an electric industry well aware that change is on the horizon but slow in making the necessary investments crucial to making it happen.

Forecasting the Future

The success of vehicle electrification is only as strong as the electric utilities that supply the load. Signed into law in late 2021, the federal, \$1.2-trillion Bipartisan Infrastructure Law aims for a net-zero emissions economy by 2050, with half of new U.S. car sales to be electric by 2030. Funding upwards of \$7.5 billion is earmarked for EV charging and infrastructure that communities across the country need to support the desired uptick in electrified fleets.

Companies such as [Uber](#), Lyft and Amazon are committing to transition their fleets to electric by 2030, just seven years from now, while federal agencies are chasing an ambitious 100-percent EV fleet as early as 2035. As companies and government agencies plan and prepare for the future, the assumption remains that electric utilities are doing the same.

When asked how much their enterprise’s forecasting of future load included the expectation for vehicle electrification, nearly two-thirds of respondents said that they were either unsure, only included some forecasting or did not forecast for it at all. That included forecasting for investments in supply needs as well as in distribution grid infrastructure. (Figure 17).

Given the broad incentives in the Bipartisan Infrastructure Law – and appealing and capable vehicles coming to market in all segments – this is money in the bank for utilities due to their selling considerably more of their product – the humble electron. The question remains when and how to share the benefits of future electrification revenue with all stakeholders via the promise of downward pressure rates.

With a 70/30 split between utilities adequately forecasting for the future vehicle electrification load and those who are not quite there yet, we can’t help but ask, “if not now, when?”

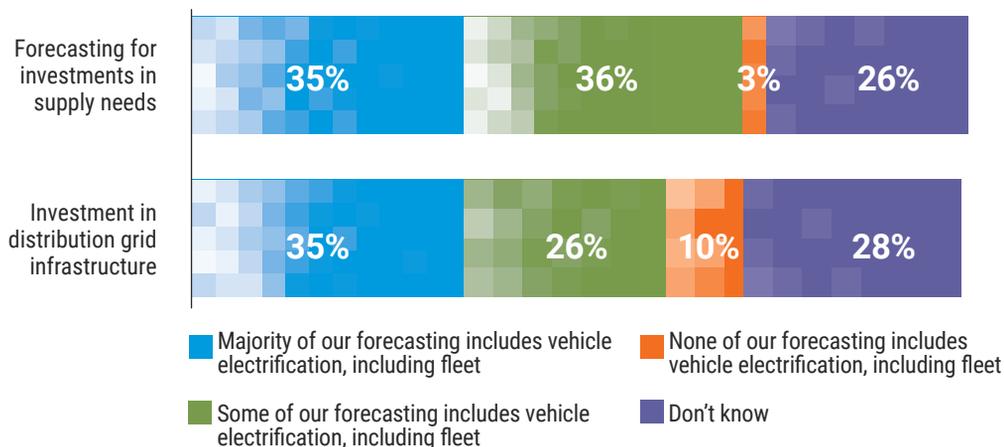
Mapping EV Charging Site Timelines

According to a 2022 whitepaper by National Grid, an investor-owned energy company serving more than 20 million people throughout New York and Massachusetts, a larger, highway-side charging station serving both personal EVs and heavy-duty battery electric trucks could need to provide up to [19 megawatts of electricity by 2035](#) – the same year the federal government aims for a 100-percent electric fleet. That’s approximately the same amount a small town uses.

Figure 17

How much has your forecasting for future load integrated the expectation for vehicle electrification, including fleet? (Select one for each column)

Source: Black & Veatch



Given this scale of charging and the roughly 11 years to this benchmark, the level of urgency should be seemingly high. When asked how many EV charging site requests are expected over the next 12 months, about two-thirds of respondents consistently said they didn't know. Conversely, about one-third cited anywhere from zero to 1,000 or more requests in ranges from one-half of a megawatt to more than five megawatts. Notably, one in five respondents expect no charging site requests over five megawatts in the next year (Figure 18).

As noted in the National Grid example, the size and duty cycle of commercial fleet and large travel center facilities can range into tens of megawatts. Planning for and provisioning power at this magnitude can take years – even a decade – if serving the load requires new substations, transmission and distribution lines, real estate and associated right of ways.

Based on our knowledge, numerous requests for megawatt and larger sites are being submitted to utilities across the country. Examining the results, respondents either are not in a position to know about these requests and answered incorrectly or they simply are not seeing the new demand. Either scenario is alarming for triggering infrastructure planning efforts at the level needed.

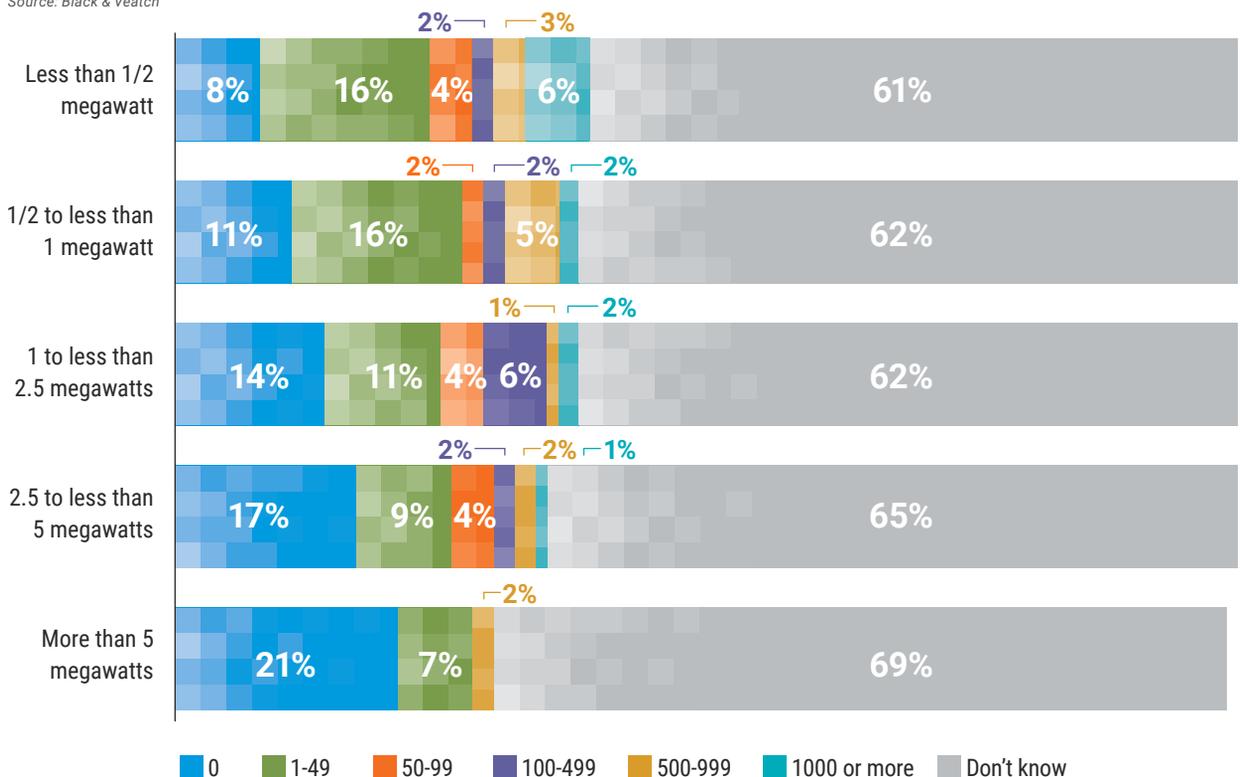
Electrifying Early

With almost 70 percent of utilities seemingly unprepared and 30 percent in the early stages of planning, a common denominator has emerged: ready or not, electrification is here. While consumer adoption is driven by choice, commercial fleet trajectories follow regulatory considerations and economics. All indications are that electrification is the new normal, and the sooner organizations embrace the change, the more benefits they can accrue by design versus playing catch up later.

Figure 18

How many EV charging site requests (unique locations/addresses) do you expect over the next 12 months, for each charging threshold below? (Select one for each)

Source: Black & Veatch



Many U.S. electric utilities are taking a proactive posture. When asked how they are responding to the federal, state and local goals of significant electrification, nearly half of the respondents said they are establishing new programs, rates and education programs while transitioning the utility fleet to electric. More than six in 10 respondents — 62 percent — are incorporating EV loads into load forecasting and grid planning (*Figure 19*). Only 12 percent replied that they are not doing anything at this time — a small enough group to evoke optimism and hope.

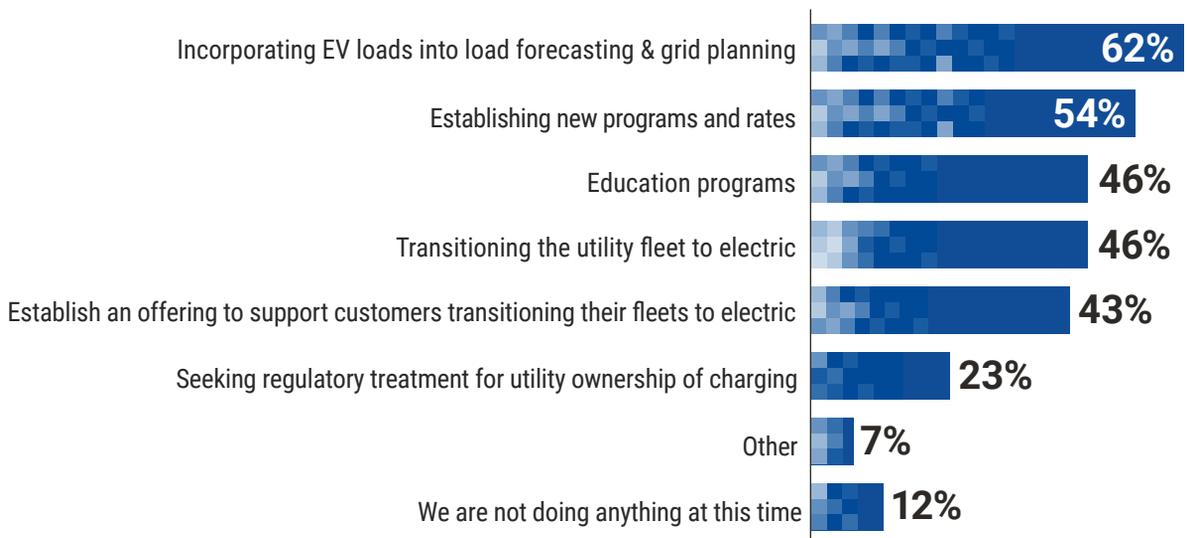
All told, the keys are making the most of the investment, market growth opportunity and catching up with other countries that have shown this can be done. Slowly but surely, the vehicle supply chain is getting resolved with huge investments, but the energy supply chain to power those vehicles is at risk without more thoughtful planning.

Utilities can both get ahead of the needs of communities and set themselves up for increased revenues and profits by intensifying their infrastructure planning and investments — or getting off the sidelines in the first place — as the pace of electrification picks up speed.

Figure 19

How are you responding to the federal, state and local goals of significant electrification?
(Select all that apply)

Source: Black & Veatch





Cybersecurity

Cybersecurity and the Grid Edge: Planning, Investment Key to Safeguard Infrastructure

As if U.S. electric utilities didn't already have enough to worry about in hardening their assets against severe climatological events, protecting their critical infrastructure from cyber or physical attacks increasingly are keeping operators up at night.

A report last December by [Politico](#) sounded the latest alarm, noting that federal records showed that the number of physical and computerized assaults on electric infrastructure spiked in 2022 to their highest level in at least a decade. That included 101 reported events over the first eight months of last year, eclipsing the previous peak of 97 incidents.

While federal regulations require electric utilities to comply with certain cybersecurity standards for protecting their systems from keyboard predators, cyber-attacks persist as advancing technology — notably digitalization that helps manage utility operations — expands the attack surface and creates new vulnerabilities. The grid's aging infrastructure and legacy technology also significantly increases the risk of attacks that can lead to power outages, endangered public safety and financial loss.

So how are U.S. electric utilities responding? With expert analyses of a survey of more than 650 U.S. power sector stakeholders, Black & Veatch's *2023 Electric Report* finds that utilities understand the challenges and are working to bolster their cyber defenses.

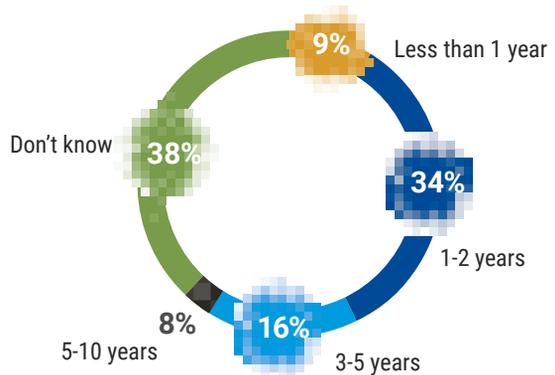
New Technology: Risk and Reward

As technology advances, pressure mounts on utilities to maintain a competitive edge. This means some may feel compelled to adopt new technology quickly, without fully considering the impact it might have on their business or operations. As such, there's been a fundamental shift within operational technology (OT) as survey respondents report — for a second consecutive year — a shorter vetting process for adopting new technologies, with half assessing a new technology for five years or fewer before their organization will adopt it, consistent with 2022 (*Figure 20*).

Figure 20

How long does a technology need to be vetted before your organization adopts it? (Select one)

Source: Black & Veatch



While new technology has its benefits, it can also open the network to vulnerabilities that put the organization at risk of cyberattack.

These potential risks are further emphasized by nearly half of respondents (46 percent) replying that they don't know where they are in the implementation phase of their security plans. That perhaps illustrates that utilities' security programs haven't yet caught up with this rapid adoption of new technologies.

Utilities must adjust their cybersecurity plans to accommodate the rapid adoption of new technologies. Implementing a comprehensive risk management strategy that includes evaluating the potential risks and threats associated with the new technology, identifying and implementing the necessary security controls, and ongoing monitoring and testing of the system will be paramount to the success – and security – of technology adoption.

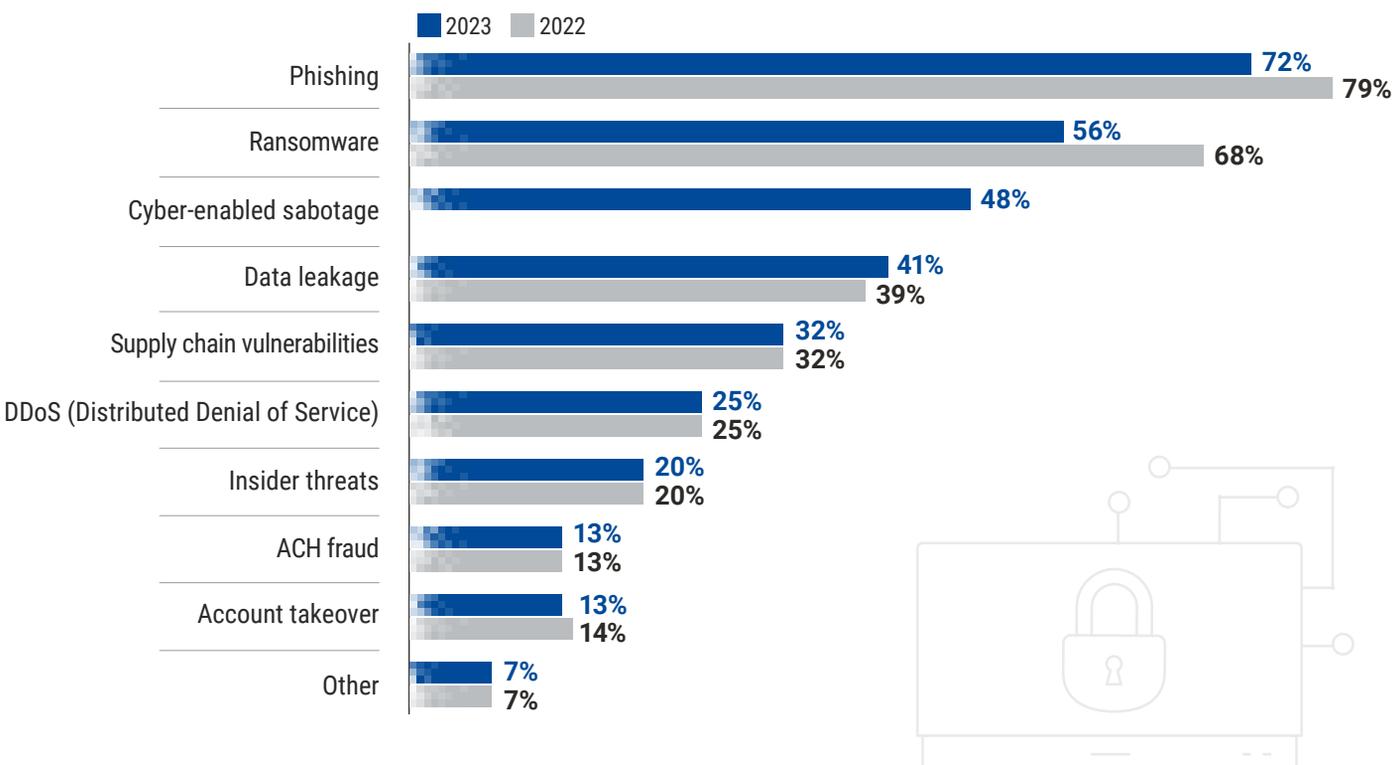
Concerns around ransomware and phishing both have decreased among respondents since last year's report. But both remain the top two cyber threats of concern to utilities, with 72 percent citing phishing and 56 percent pointing to ransomware as their top worries (Figure 21). Given that phishing is a major gateway to ransomware, this may indicate that utilities have more understanding of the nuances of ransomware and feel more confident in their ability to mitigate potential risks. In addition, a recent report from [Egress](#), a cybersecurity company that provides intelligent email security, said phishing attacks are becoming more sophisticated, especially as cybercriminals continue to hone their skills by using AI-powered technologies.

New to the list – ranking third – was cyber-enabled sabotage, added as a survey response option this year because the U.S. Department of Homeland Security actively is working to prevent such activity through initiatives with

Figure 21

Which cyber threats is your organization most concerned about? (Select all that apply)

Source: Black & Veatch



the Idaho National Laboratory (INL). Those strategies include Cyber-informed Engineering (CIE) and Consequence-driven Cyber-informed Engineering (CCE). Black & Veatch is a licensed CCE partner with the INL.

Based on this year’s data, it’s clear that utilities understand the importance of mitigating the risk of a ransomware attack and are taking the proper measures to protect their data and systems. In fact, nearly 70 percent of those surveyed report a high level of confidence (48 percent are somewhat confident and 21 percent are extremely confident) in their ability to recover from a cybersecurity attack (Figure 22). This is true for both OT and IT teams.

While this appears optimistic on the surface, when viewed with other data, it may indicate over-confidence. For example, more than four in 10 (44 percent) respondents don’t know if they

are using a risk-based framework, and nearly 10 percent say they are not using one. In addition, 81 percent are unsure about how much of their budget they are spending on cybersecurity.

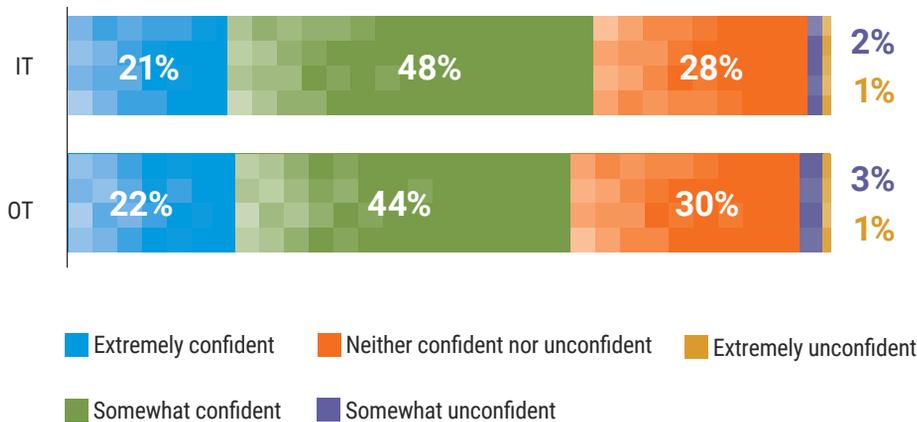
Without question, a false sense of confidence about the robustness of a utility’s security posture could be dangerous as it may lead those enterprises to overlook vulnerabilities exploitable by would-be cyber predators.

The current state of cybersecurity in the U.S. power sector demands constant vigilance and attention. As technology rapidly evolves, so do the threats targeting utility vulnerabilities. But with increased awareness, education and investment in cybersecurity measures, utilities will be better positioned to safeguard their systems and customers from the potentially devastating consequences of a cyberattack.

Figure 22

How confident are you in your utility’s ability to recover from a cybersecurity attack? (Select one)

Source: Black & Veatch



About the Authors

Alex Bettencourt is a member of Black & Veatch Global Advisory Consulting group and leads the advanced transportation and decarbonization practices globally for the company. He and his team are working with many leading organizations around the world looking to meet their decarbonization goals, including through the electrification of their transportation fleets. Before coming to Black & Veatch, he led grid-modernization efforts of leading utilities around North America.

Mike Bianco is a managing director on the Black & Veatch Global Advisory team. He brings more than 20 years of consulting in power and utilities, focusing on solutions development and delivery in grid modernization and resiliency, smart grid program design and execution, DER strategy and planning, and IT strategy and systems integration.

Shibu Cherian is the global chief information security officer at Black & Veatch. He leads all aspects of the cybersecurity management program and strategy aligned to industry-leading controls and regulatory best practices to ensure that confidentiality, integrity and availability of critical systems are implemented and maintained to enable the business to deliver secure solutions to build and protect critical human infrastructure. Cherian has more than 20 years of global experience in cybersecurity strategy and risk management and has led in the areas of cybersecurity program management, security architecture, security engineering, cloud enablement, cyber operations and risk management in various industries, including financial services, retail and ecommerce, consulting, healthcare and telecommunication.

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Scott DeGeeter is the vice president of operating asset services, leading the operating support solutions. With more than 30 years of experience in the energy industry, he leads the solutions development and deployment to solve client operational infrastructure support needs, including data analytics, AI tools deployment, engineering services support, project management and outage management services, resiliency planning, and operations and maintenance services.

Kristie Deuliis is a managing director at Black & Veatch, leading decarbonization strategy and planning initiatives. With more than 25 years in the energy industry, Deuliis leads strategic initiatives, driving the development of all economic, policy, technology, and feasibility assessments for a broad range of global top-tier clients. Her experience spans energy industry domains, including wholesale and retail (regulated and competitive) markets, distributed energy resources, market entry and expansion business cases, and investment strategies for companies seeking to pivot or accelerate specific goals.

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Ryan Hoyer is licensed professional engineer who has worked with Black and Veatch for 10 years as an instrumentation and controls engineer, with an emphasis on cybersecurity. Hoyer is bridging the gap between engineering and cybersecurity through his training at Idaho National Labs in Consequence-driven Cyber-informed Engineering (CCE) and his participation in the Cyber Informed Engineering (CIE) Community of Practice. He regularly works on control system designs from the instrumentation up through the network design, and also assists utilities in the development of their internal cybersecurity practice through assessments and implementation guidance of cybersecurity programs.

David Hulinsky is the private networks leader in Black & Veatch's energy and process industries business. He previously served as the company's director and business unit lead for telecom, automation and distribution services for electric utilities. Hulinsky has more than 20 years of experience successfully developing and leading some of Black & Veatch's largest utility turnkey communications and smart grid EPC projects for leading utilities.

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Jaimin Jani is a management director at Black & Veatch. He advises utilities in North America on aligning investment to maximize value for customers. Jani has more than 16 years of expertise in business strategy, road mapping, risk assessment, investment planning and engineering across various sectors, including electric transmission and distribution, water, electric generation, electric vehicles, data centers, microgrids and other emerging solutions. Jani has successfully led and directed engagements related to complex utility markets in 21 countries, assisting customers to participate in rapidly changing business ecosystems.

Arron Lewis is a vice president and the energy utility West Region managing director at Black & Veatch. With more than 30 years of experience, Lewis previously served in Black & Veatch's global power distribution business, heading the global deployment of services for power distribution infrastructure. His focus is on solutions to client's needs for the energy transition, digitization and grid modernization, as well as infrastructure construction and upgrades that deliver reliable and resilient energy to customers.

Kevin Ludwig is a vice president and grid portfolio leader at Black & Veatch. With more than 20 years of experience in the power industry, Ludwig serves as the solution leader for Black & Veatch's offerings in transmission, distribution and private networks across all markets and industries.

Deepa Poduval is a Black & Veatch senior vice president and the company's sustainability leader, responsible for continuing to implement the company's sustainability strategy while further shaping sustainability as part of the company's next-generation strategy. She also leads the global advisory practice within Black & Veatch, providing executive leadership for the company's strategic and digital advisory services. Poduval and her team partner with a wide variety of clients spanning governments, and electric, water, oil and gas, commercial, industrial and financial sectors who seek integrated solutions related to their critical infrastructure as they pursue goals around sustainability, growth and resilience.

Leslie Ponder is a global solutions leader for Black & Veatch's energy and process industries market segment. She is responsible for developing industry-leading solutions through technology innovation. Ponder uses her industry experience and technical acumen to align Black & Veatch's portfolio of advanced energy storage technologies, grid modernization, IT/OT integration, renewable and distributed energy, electrification, decarbonization, and environmental and sustainability solutions for small-scale services engagements through large-scale engineering, procurement and construction projects.

Algert Prifti leads the carbon capture, sequestration and utilization (CCUS) efforts at Black & Veatch. He focuses on exploring existing and emerging decarbonization technology solutions that contribute directly

to new and traditional industry clients seeking to manage their carbon emissions and generate value-add opportunities. Prifti has experience assessing and implementing CCUS solutions across the value chain, including point-source, carbon capture and sequestration (CCS), CO₂ dehydration and compression, CO₂ pipeline and storage, and CO₂ utilization technologies. As part of the New Energy Solutions team at Black & Veatch, Prifti also is involved with projects focused on implementation of other advanced decarbonization technologies.

Douglas Preece is a managing director of Black & Veatch Global Advisory and a co-lead of the digital grid practice. He leads programs spanning the energy ecosystem to meet today's challenges and prepare for the distributed energy future. His recent focus has been in development of strategies and roadmaps, advanced distribution management systems (ADMS), grid modernization, the integration and management of distributed energy resources (DERs), and demand response management (DRM). With more than 37 years of experience in and serving the energy and utility industry, Preece's knowledge and experience spanning field operations, engineering, business, information and operational technology, and consulting enable him to immediately add value and assist clients with their most challenging, multi-faceted issues.

Mike Prescher is a principal network and cybersecurity architect for Black & Veatch, contributing to critical infrastructure digital modernization projects and cybersecurity strategy and planning initiatives. With more than 25 years in the packet networking and cybersecurity industry, Prescher participates in strategic initiatives, supporting development of policy, technology and feasibility assessments for a broad range of technologies and clients. His experience spans investigation and product development work for OEMs and consultancies and includes contributions to industry standards and frameworks organizations, including the NIST and NERC energy and cyber domains, as well as extensive participation in various thought leadership groups and contributions to IEEE, UTC and others.

Craig Preuss is a system architect for utility automation at Black & Veatch. Preuss, who is a professional engineer in the states of Illinois and Washington, performs many different tasks since he works in utility integration and automation. Preuss is a senior IEEE member who chairs of the Power System Communications and Cybersecurity Committee (PSCCC), providing strategic electric industry direction in the PSCCC for cybersecurity standards and supporting the development of those standards as well as implementing cybersecurity designs on various projects for electric and gas utilities.

Jason Rowell is a vice president and sustainable solutions leader at Black & Veatch. He is responsible for aligning Black & Veatch's technology portfolio across the full breadth of project execution capabilities, from small services projects to our largest engineering, procurement and construction projects. Technology portfolio areas under his direct leadership include decarbonization, hydrogen, carbon capture, and sustainable fuels.

Paul Stith is associate vice president of global transportation initiatives for Black & Veatch. He focusses on building the ecosystems needed to plan, finance, deploy and operate sustainable transportation and distributed clean energy infrastructure at scale. Stith's projects support investors, utilities, fleets, energy and transportation providers in electrifying, decarbonizing and automating their ground, aviation and marine fleets. With more than a decade of zero-emission vehicle infrastructure experience he is a member of numerous industry advisory and working groups and serves on the Forth and North America Council for Freight Efficiency boards of directors.

Sean Tilley is the emerging renewable energy solutions leader within Black & Veatch's energy and process industries power business. He is responsible for the optimization and growth of the company's portfolio of renewable energy project solutions, with the expertise to meet current and future client needs. Tilley leverages more than 20 years of global experience on more than 100 renewable energy projects ranging from 1 MW to 3 GW in capacity. His experience across the lifecycle of projects includes portfolio planning, project development, technology selection, detailed design engineering, major equipment procurement and construction contracting, project execution and repowering for a wide range of clients. His experience also extends into strategy development, marketing and business development, technology innovation and process improvement.

Rob Wilhite is a senior vice president and leader of the strategic advisory business line at Black & Veatch. He and his team provide advisory services on the topics of zero-emission transportation, distribution grid planning, decarbonization, strategic planning, clean fuels strategies, transaction services, and rates and regulatory services. With 37 years of experience in energy business strategy and utility operations, Wilhite serves as a board director and executive committee member for GridWise Alliance, is chairman for the city of Belmont's Environmental Sustainability Board and is co-chair of the technology & innovation pillar for Dentons' Smart Cities & Community Think Tank. In 2009, he was recognized as one of the top 25 consultants in the United States by Consulting Magazine in 2009.

Shane Williams is a managing director at Black & Veatch, leading gas operations and compliance initiatives. With more than 25 years in consulting to the utility industry, Williams leads various system planning and implementation efforts, cybersecurity risk and compliance assessments for gas, electric and water utilities. His experience spans industry domains, including customer engagement, wholesale settlements, asset and work management, outage management and SCADA operations.



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