Exh. ANH-2
Dockets UE-190529/UG-190530 and
UE-190274/UG-190275 (*consolidated*)
Witness: Aimee Higby

BEFORE THE WASHINGTON
UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, **Complainant,** **v.** **PUGET SOUND ENERGY,** **Respondent.**	**DOCKETS UE-190529 and UG-190530 *(consolidated)***
In the Matter of the Petition of **PUGET SOUND ENERGY** **For an Order Authorizing Deferral Accounting and Ratemaking Treatment for Short-life UT/Technology Investment**	**DOCKETS UE-190274 and UG-190275 (*consolidated*)**

EXHIBIT TO TESTIMONY OF

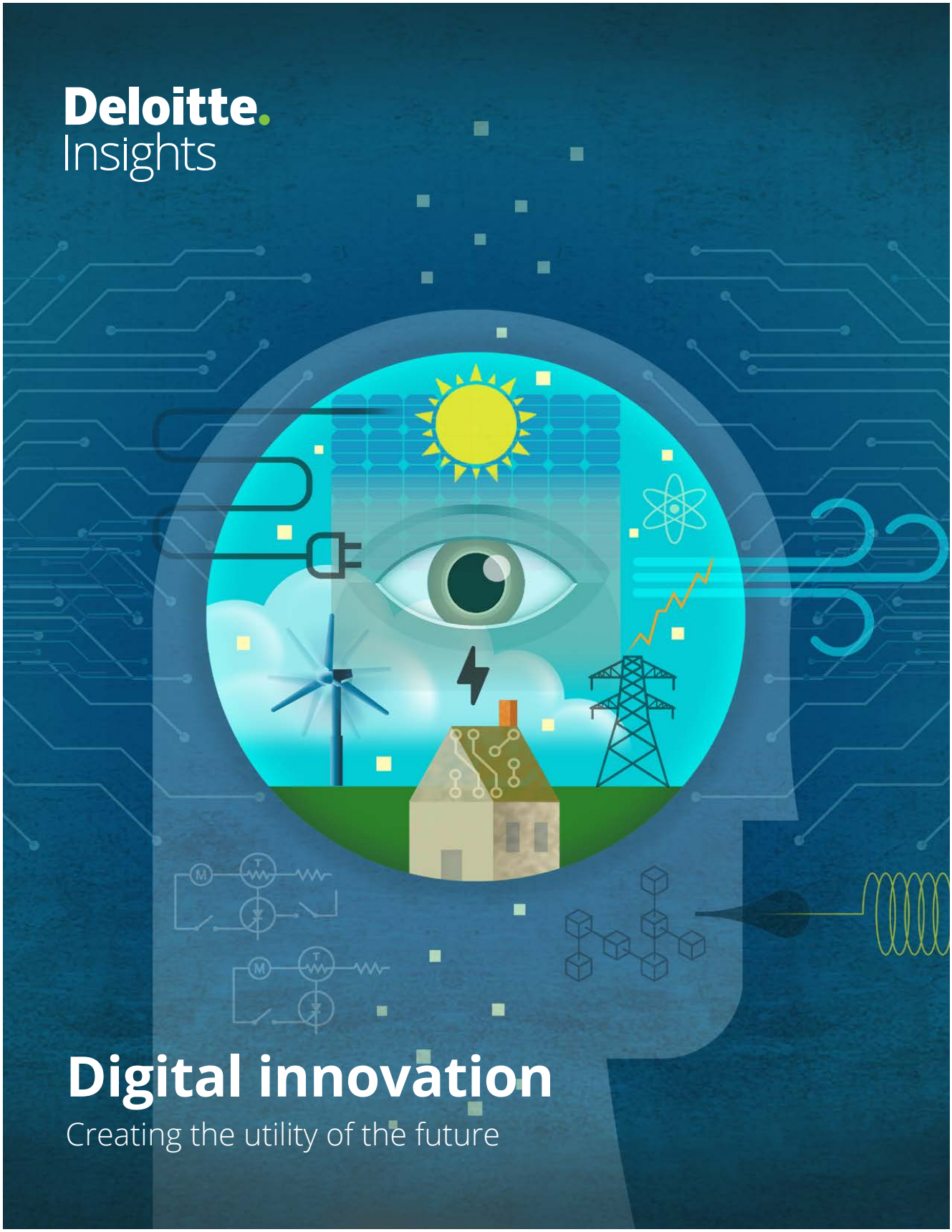
Aimee Higby

STAFF OF
WASHINGTON UTILITIES AND
TRANSPORTATION COMMISSION

Digital Innovation: Creating the Utility of the Future

November 22, 2019

Deloitte.
Insights



Digital innovation

Creating the utility of the future

Contents

Introduction

The power and utilities sector was traditionally where many parents or grandparents parked their savings as they got older, attracted by low volatility and stable returns. While solid and dependable, the sector wasn't generally considered cutting-edge, innovative, or exciting by any stretch of the word. Its main goal was to keep the lights on without breaking the bank. Fast forward to today and, while still laser-focused on reliability and affordability, the power and utilities sector appears to be morphing into an increasingly attractive, high-tech magnet for a multitude of new players. From large conglomerates in the technology, retail, oil, and other sectors to asset managers and hot new tech startups, a lot of outsiders are looking to enter this market.

WHY? THE SECTOR is being reshaped by forces that have been evolving and converging for more than a decade. From rising costs and changing load patterns, to newly viable technologies, regulatory change, and the growing call to decarbonize, disruptive forces are transforming the industry, driving it toward a new and different future. And that future could be bright.

Opportunities abound in today's power and utilities sector, and more will likely open as the future unfolds, marked by three growing trends: electrification, decarbonization, and decentralization. To further reduce carbon emissions, some groups are advocating electrification of end uses such as transportation, water and space heating, and industrial processes. In transportation, a projected 55 percent of global new car sales and 33 percent of the global fleet may be electric by 2050, accounting for about 9 percent of electricity demand.[1] And that electricity is becoming cleaner, with emission-free sources such as wind and solar power projected to reach as much as 48 percent of total global electricity generation by 2050 from about 8 percent currently.[2] In the United States, power sector carbon emissions were down 28 percent from a 2005 baseline at the end of 2018, and many power companies have voluntarily committed to reduce emissions as much as 80 percent from the 2005 level by 2050.[3] At the same time, the traditionally centralized, hub-and-spoke power grid continues to decentralize, as deployment of distributed energy resources such as solar PV and battery storage rises rapidly. Global battery storage capacity at customer sites is projected to rise by 516 GW by 2050.[4]

Overlaying these trends is the advance of digital technologies, sometimes at a breath-taking pace. Technologies such as artificial intelligence (AI), Internet of Things (IoT), cloud, and blockchain can catalyze new business or operating models, help new entrants disrupt the sector, and enable incumbents to reach new levels of performance. For those incumbents, a lot may be at stake, and even more may be possible. But to thrive in this bright future, power and utility companies will need to develop

new capabilities and transform their working environment. Continuing what they've been doing for the last century is likely not going to work.

This report will discuss the multitude of forces disrupting and driving change in the power and utilities sector, explore the exciting future the industry is moving toward, and help companies plot a digital path to thrive in that future.

Disruptive forces are reshaping the power sector

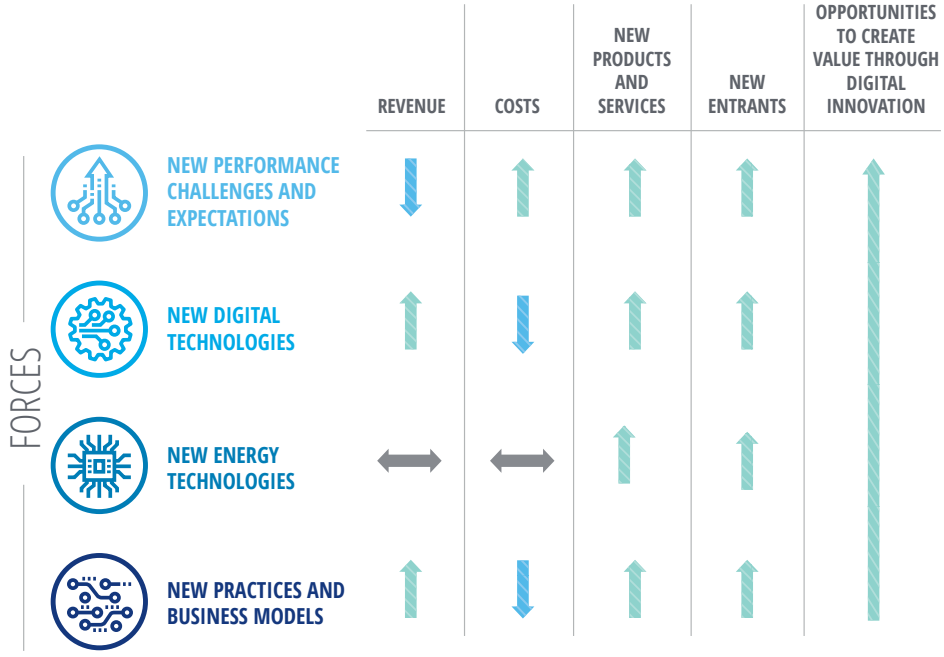
Disruptive forces are transforming the electric power sector, and many power company leaders are planning their digital journeys based on the impact of these forces (figure 1). We'll discuss these forces in the next few pages, as well as the market shifts and events that industry leaders see as most impactful, based on responses to a Deloitte survey (see sidebar, "Deloitte global Industry 4.0 survey"). The forces span four categories:

POWER COMPANIES FACE UNPRECEDENTED CHALLENGES AND EXPECTATIONS

It's by now a well-established trend that, due to energy efficiency gains, electricity consumption in developed countries no longer grows in tandem with GDP growth.[5] This often means utilities must operate, maintain, and modernize their systems without the benefit of increased load-based revenue to pay for it. In fact, capital expenditures have trended upward in recent years as utilities boost spending to upgrade aging infrastructure; harden systems against increasingly severe climate events; modernize and digitize systems and processes; defend against increasingly virulent cyberattacks; and address the growing mandate for cleaner energy sources from legislators, regulators, and

FIGURE 1

Disruptive forces' potential impact on businesses in the power sector



Source: Deloitte analysis.

customers.[6] Other societal changes pose additional challenges, such as sophisticated consumer expectations set by high-tech companies and the need to replace retiring workers and attract new ones. Such rapid and multipronged change may, in turn, compel organizational and cultural transformation to manage and adapt to new technologies. In many of these challenges lie opportunities to create value through innovation.

NEW DIGITAL TECHNOLOGIES ARE SPARKING CHANGE ACROSS INDUSTRIES

Another well-established trend is the acceleration of technological advances across industries as innovation drives rapid cost declines for key building blocks such as computing power, data storage, and internet bandwidth. Faster, cheaper, more powerful computing and improved connectivity are fueling growing deployment of technologies such as sensors, mobile, advanced analytics, robotics, additive manufacturing, cloud computing, IoT, AI, and virtual and augmented reality. Such innovations are ushering in new and disruptive competitive risks—and opportunities—for enterprises that have historically enjoyed dominant positions in their industries, including the power industry.

ADVANCED ENERGY TECHNOLOGIES ARE INCREASINGLY COMPETITIVE AS COSTS FALL

The power and utilities industry is seeing unprecedented opportunities for innovation and growth from rapid technological advances and cost declines in areas such as solar power, battery storage, wind power, electric vehicles, smart buildings, two-way power flows, microgrids, and more. Of course, these opportunities are also opening doors for startups, entrepreneurs, and companies from adjacent industries who may compete with incumbents and disrupt the industry. But at the same time, large enterprises such as today's electric companies can take advantage of these opportunities to disrupt the industry status quo themselves and remain competitive and profitable.

NEW PRACTICES AND BUSINESS MODELS ARE SHAKING UP MARKETS ACROSS INDUSTRIES

New twists on design, processes, and ways of doing business also offer opportunities and fresh ways to approach challenges—or to challenge the status quo. For example, human-centered design, agile and adaptive business practices, trends shaping the future of work, crowd-sourcing, the sharing and subscription economy, and mega-platform ecosystems are all accelerating disruption and amplifying opportunities to start or grow enterprises and industries.[7]

A common thread runs through these four types of forces—digital. Digital technologies can act as **catalysts** that help incumbents or new entrants

DELOITTE GLOBAL INDUSTRY 4.0 SURVEY

To understand how companies are investing in the connected web of digital and physical technologies that enables digital transformation, known as Industry 4.0, Deloitte fielded a survey of 361 executives in 11 countries in the Americas, Asia, and Europe. The survey was fielded in association with GE Digital in spring 2018 by Forbes Insights, and captured insights from respondents in seven industrial sectors, including power and utilities. The responses discussed here are from the 81 respondents in the power and utilities sector. All power and utilities respondents were director level or higher, including CEOs (6 percent), CFOs (9 percent), COOs (10 percent), CDOs (7 percent), CIOs (5 percent), CTOs (7 percent), CSCOs (3 percent), business unit presidents (6 percent), executive VPs (9 percent), VPs (12 percent), executive directors (7 percent), and directors (19 percent). All power and utilities executives represented organizations with revenue of US$500 million or more, with more than half (51 percent) from organizations with more than US$1 billion in revenue.

develop new business and operating models, such as using advanced analytics to segment customers and target prospects for new services. Or they can be **disruptors** that open the door to new market entrants—such as technology platforms that aggregate output from distributed energy resource (DER) owners and bid it into wholesale electricity markets. Nothing is protected. Digital technologies can also be **enablers**, enabling new levels of performance, such as cutting maintenance time and costs by using automated drones backed by cognitive capabilities to inspect assets in the field.

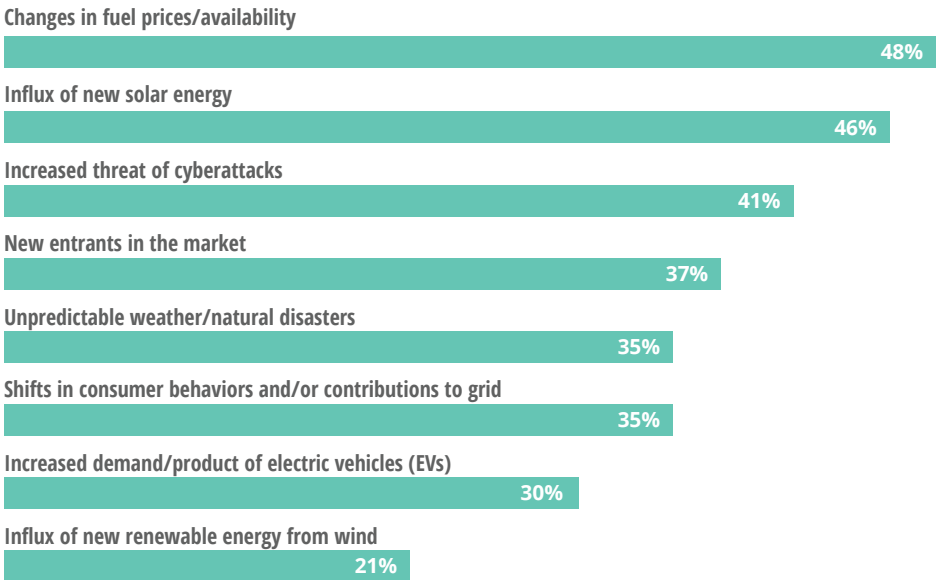
WHICH FORCES ARE IMPACTING POWER COMPANIES THE MOST?

In the survey, the events and market shifts that power sector leaders said impact their businesses the most track closely with the trends outlined earlier. Almost half (48 percent) cited changes in fuel prices and availability, most likely referring not just to an abundance of relatively low-priced natural gas, but more broadly to the rapid decline in the cost of solar and wind power, which increasingly undercut other resources for power generation (see figure 2). Nearly as many (46 percent) chose the influx of solar energy, which may reflect in part the impact of competition from distributed solar, and in part the impact of solar power's variability on the grid. New market entrants, increasingly frequent cyberattacks, and natural disasters are also high on the list of impactful events and concerns. Many respondents also noted shifting customer behaviors, electric vehicles, and wind power in another nod to the new products and technologies that are helping to transform their sector.

FIGURE 2

Forces with the biggest impact

What events/shifts in the electricity market are having the biggest impact on your business? (Select up to three)



Note: N=81.
Source: Deloitte global Industry 4.0 survey.

The future looks bright

GOING FORWARD, POWER and utility companies will likely see increased opportunities to create value based on data, insights, and services, in addition to moving electrons. The following three vignettes illustrate digitally enabled innovations that are coming into focus over the next few years from the perspective of the future utility customer, power company employee, and asset manager.

Customer

The utility customer of the future has a personal relationship with their utility, which provides a dedicated "smart home platform" that they can access through their phone, laptop, tablet, or smart home speaker. The platform delivers a personalized, data-driven customer experience in real time, as well as services such as home energy management enabled by AI; transactions management; and other products and services in addition to electricity. Figure 3 illustrates a sampling of customer services, products, and applications offered through the platform. Some are already available today but integrating them all on one platform, accessible through multiple channels, is a goal of many power companies. Figure 3 also indicates some of the digital technologies and other requirements necessary before these services can be offered, though the list is not comprehensive.

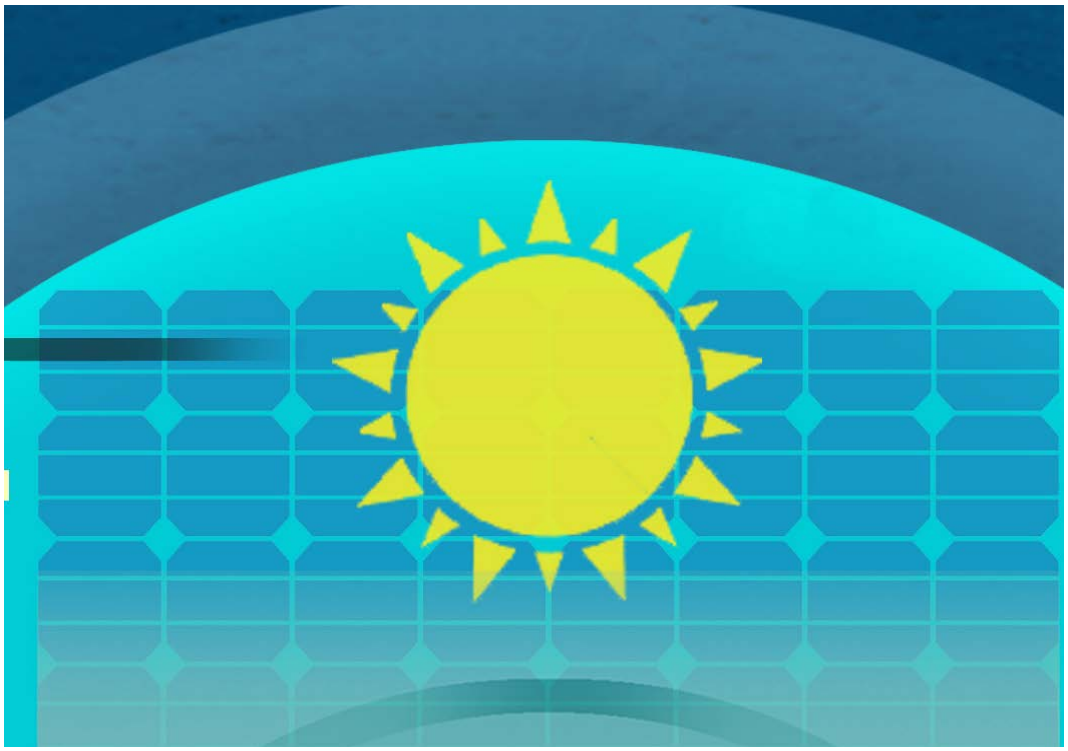
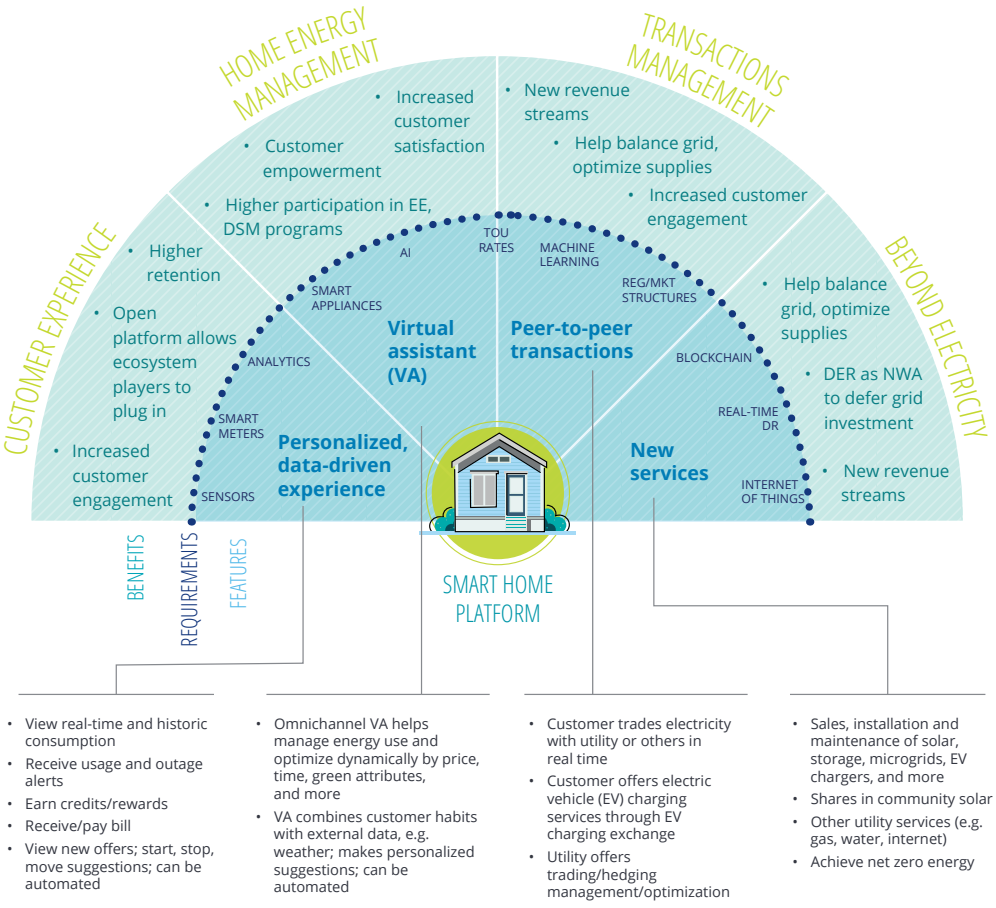


FIGURE 3

The future utility customer



Note: DER: Distributed energy resources such as rooftop solar, storage batteries, and EV chargers; NWA: Non-wires alternatives; DSM: Demand side management; EE: Energy efficiency; DR: Demand response. Requirements listed are not comprehensive.

Source: Deloitte analysis.

Employee

The power company employee of the future is a new-generation, tech-savvy professional who relies on connected yet independent systems, often collaborating with bots that integrate AI to accomplish tasks. Most processes are automated, freeing employees from routine, and sometimes dangerous, tasks and enabling them to focus on performing highly complex, customized, and unpredictable work.[8] From recruitment to succession planning, the employee's work is enabled by digital experiences, and their performance is measured in real time, as is learning and development. Through new approaches such as design thinking and employee journey maps, employee experiences are understood

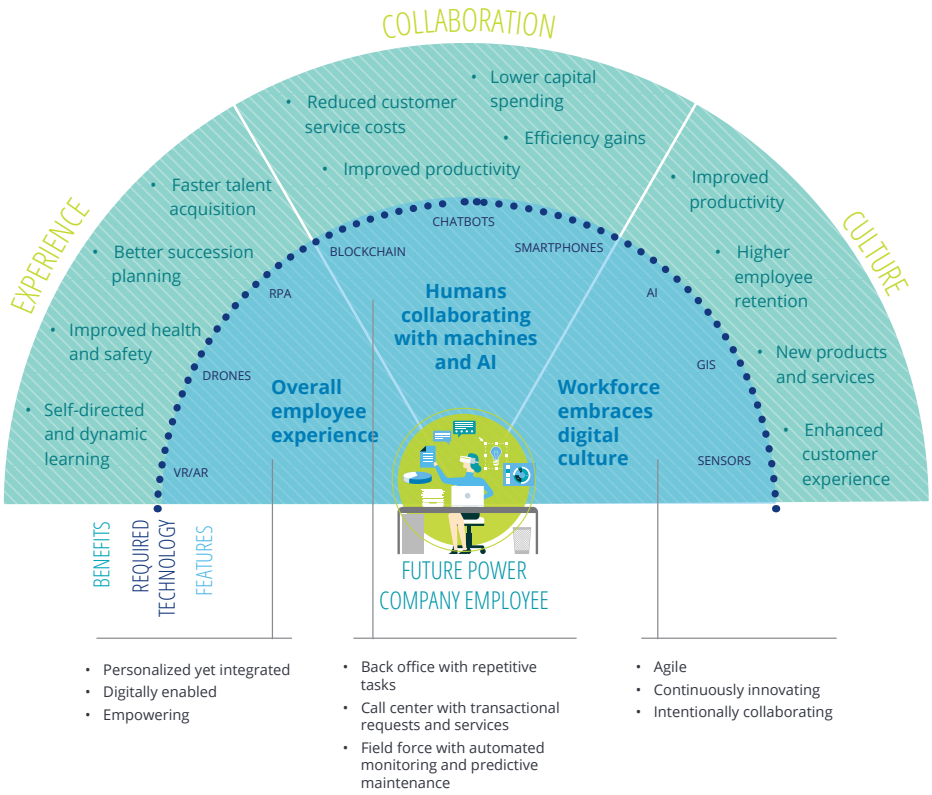
and improved, while tools such as employee net promoter scores measure employee satisfaction.[9] The digital DNA traits of agility, innovation, and higher collaboration levels are deeply embedded in the culture of the utility and evident in the way teams and employees interact.[10] (For more on Digital DNA, see pp 14–15.) This ingrained digital mindset impacts the way work is performed and improves productivity, generates cost savings, and provides opportunities for new revenue streams. Figure 4 illustrates a sampling of features and benefits of the future power company employee experience.

Assets

The future power company has real-time situational awareness of its generation, transmission, and distribution assets. Operational staff manages data as much as assets. A network of sensors, drones, cameras, and other devices provides a continuous stream of data on the status and performance of power plants, lines, towers, substations, transformers, poles, and other equipment. Dynamic visualizations display ambient temperature, air quality, moisture, voltage, current, fuel and water input, electricity and emissions output, load, vegetation growth, and other data on operations,

FIGURE 4

The power company employee of the future



Note: AR/VR: Virtual reality/augmented reality; RPA: Robotic process automation; AI: Artificial intelligence; GIS: Geographic information systems (mapping technology). Required technologies listed are not comprehensive.

Source: Deloitte analysis.

performance, or potential safety hazards. Analytics that use AI and machine learning combine this data with design limits of plants and equipment and external data such as weather forecasts and market pricing and process it to determine appropriate actions (see sidebar, "Automation and machine learning cut costs of asset inspections"). Some actions are automated through the company's automated distribution management system (ADMS) and other automation software (see sidebar, "Digital platform enables distribution system planning"). In addition, digital twins of the company's installed asset base, which duplicate physical asset specifications and operating parameters, apply real-time data to help predict and identify failures. The company also uses 3D printing to save costs by producing needed parts such as spare parts for turbines in house.

The digital DNA traits of agility, innovation, and higher collaboration levels are deeply embedded in the culture of the utility and evident in the way teams and employees interact.

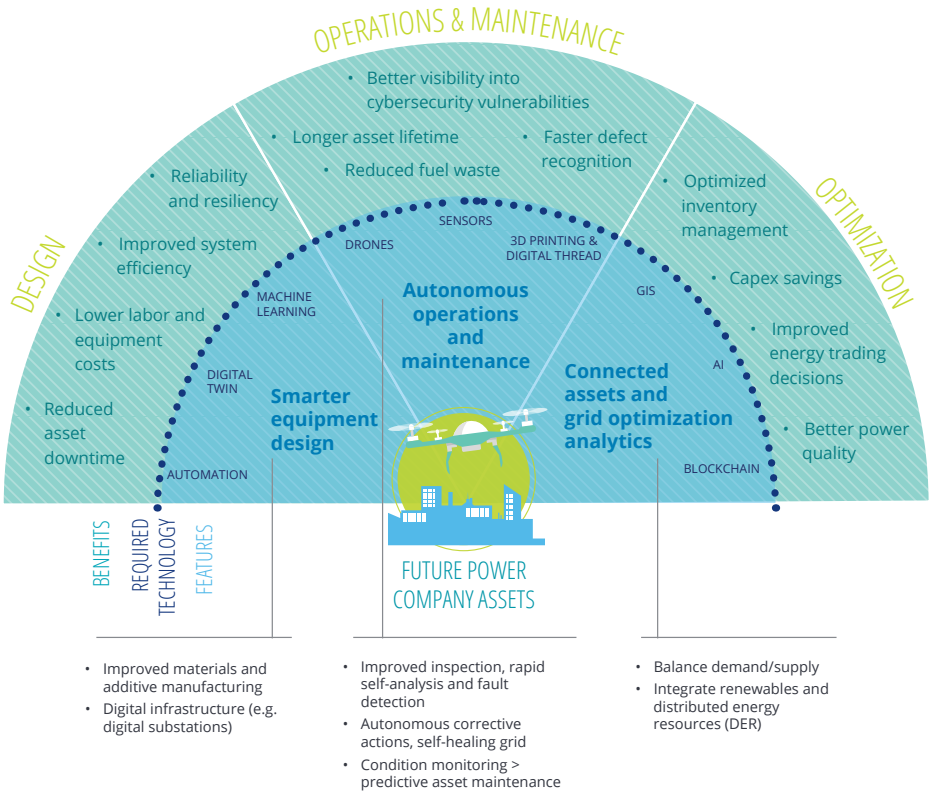
Generation assets are becoming more flexible, with the intelligence to self-ramp, self-balance, and self-diagnose. Plants have higher heat rates and availability, are more demand-responsive, and profitable. The company's distribution assets communicate with each other to self-balance, self-diagnose, and heal. As the system smoothly integrates rising volumes of variable wind and solar power and customer-sited energy resources, it seamlessly manages two-way power flows and complex demand management and response algorithms. Overall, the company sees reduced operations and maintenance costs; improved system efficiency, reliability, and resiliency; longer asset lifetimes; improved energy trading decisions; reduced fuel waste; lower carbon emissions; and better visibility into cybersecurity vulnerabilities (figure 5).

DIGITAL PLATFORM ENABLES DISTRIBUTION SYSTEM PLANNING

A distribution system operator (DSO) in Europe uses an asset analytics platform that enables risk-based asset management and investment planning. Using AI, visualization, and simulations incorporating data on voltage, load, grid topology, and more, the platform helps operators assess available capacity on the system and plan for future needs. It also helps them utilize assets more efficiently and prepare to manage the growing influx of distributed energy resources—all while keeping costs down and maintaining power quality. The DSO gained 50 percent efficiency and saved EUR 9.44 million over 10 years in capital expenditures.[11]

FIGURE 5

Power company assets of the future



Note: Required technologies listed are not comprehensive.
Source: Deloitte analysis.

AUTOMATION AND MACHINE LEARNING CUT COSTS OF ASSET INSPECTIONS

A European windfarm operator uses an application that deploys autonomous drones coupled with cognitive and weather forecasting services to inspect assets such as wind turbines and power lines.[12] Drones fly around the asset, sending images to the cloud for cognitive analysis, where any issues or anomalies are detected and reported. Inspections can be cut from 5 hours to 30 minutes, while reducing labor and equipment costs and eliminating the safety hazards associated with manual inspections at that height.[13] In addition, drone inspections can improve efficiency and reduce asset downtime and potential revenue loss.

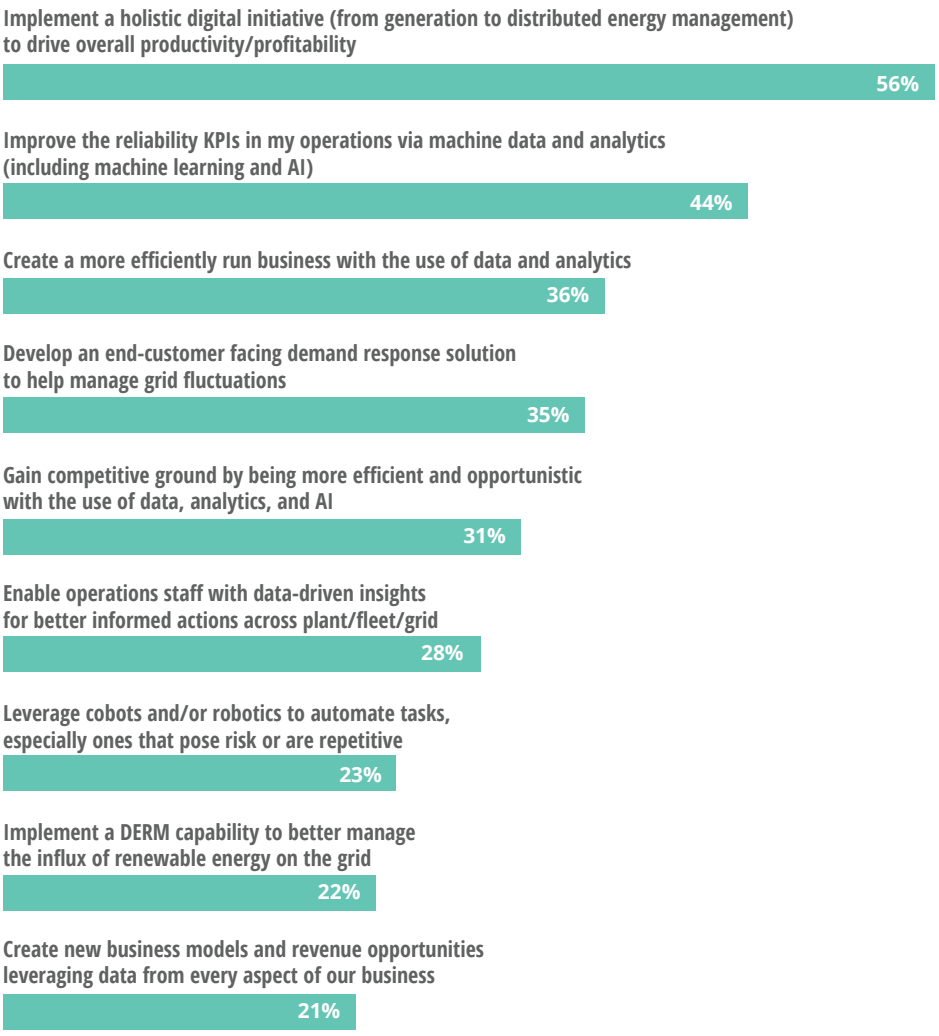
What are power companies seeking to achieve in the near future?

When executives were asked to indicate the top priorities for their business in the next 3–5 years, their responses were heavily weighted toward improving productivity, reliability, and operational efficiency, while they ranked "using insights from advanced analytics to better manage new resources" slightly below that (figure 6). Creating new business models and revenue opportunities ranked high for more than one in five respondents, but it was still at the bottom of the list.

FIGURE 6

Digital priorities of power companies

Select the top three digital priorities for your business over the next three to five years



Note: N=81.
Source: Deloitte global Industry 4.0 survey.

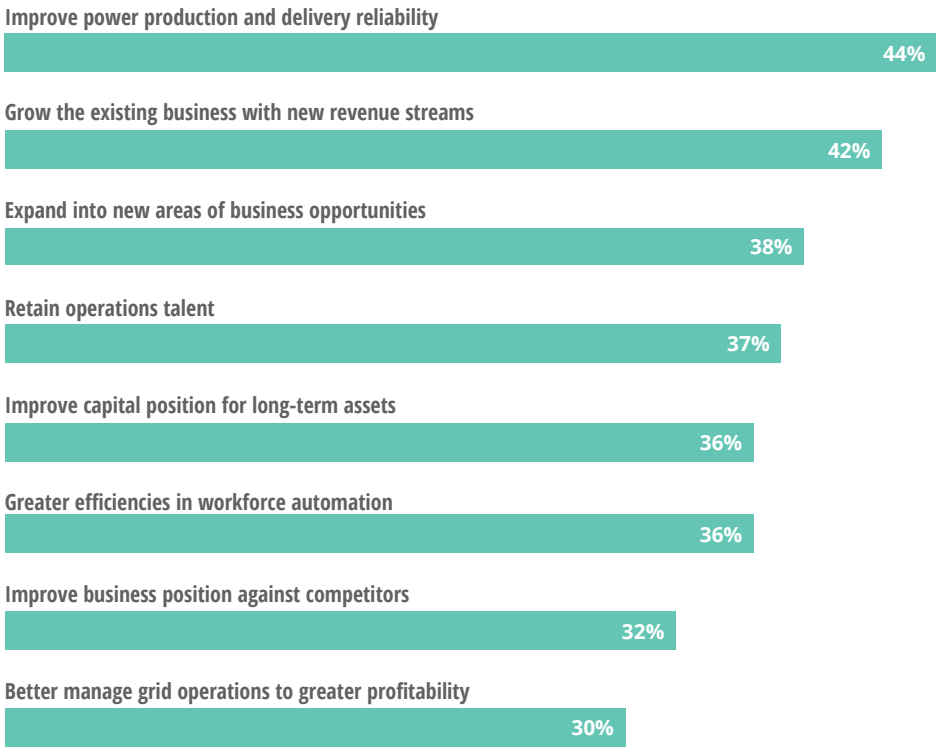
When asked about the outcomes they seek to achieve from digital transformation, respondents again put productivity and reliability on top (44 percent) but they also put growing the business with new revenue streams (42 percent) and expanding into new areas of business opportunities (38 percent) in the top three (figure 7). Ideally, both productivity and innovation goals would top the list of priorities (figure 6) and desired outcomes (figure 7).

Ideally, both productivity and innovation goals would top the list of priorities and desired outcomes.

FIGURE 7

Desired outcomes for power companies

What outcomes are you most interested in achieving with your digital transformation over the next three to five years? (Select up to three)



Note: N=81.
Source: Deloitte global Industry 4.0 survey.

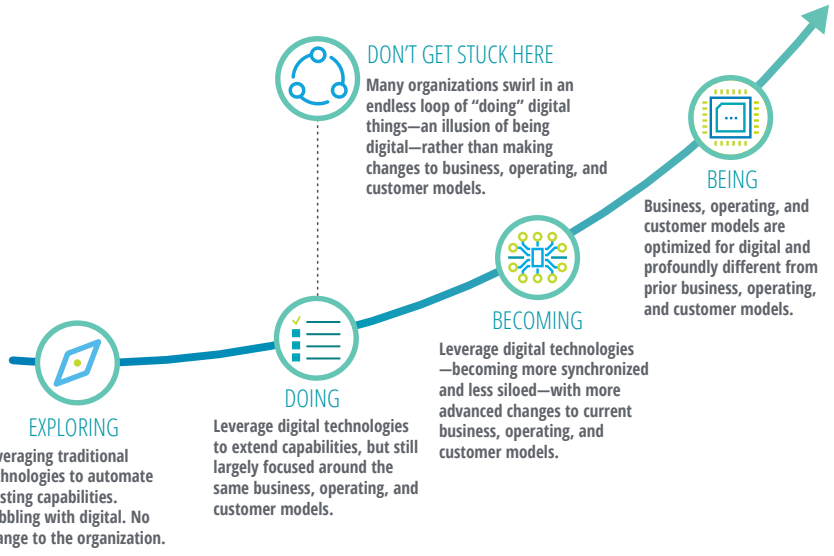
Digital pathway to the future

IN DELOITTE'S SURVEY, 95 percent of power sector respondents agreed with the statement "Digital transformation is a top strategic priority at my organization."[14] But how can they approach this transformation and what are the pitfalls to avoid? Figure 8 illustrates four phases of the digital transformation journey and highlights a common sticking point. On the left side of the continuum are organizations that are still dabbling with traditional technologies in the "exploring digital" phase. These companies may be vulnerable to new market entrants or other types of competition if they do not take steps to move forward. Companies in the next phase, "doing digital," are typically following others in adopting digital technologies on an "as needed" basis. It's easy to get stuck in this phase of continually implementing individual digital projects, rather than integrating digital capabilities enterprisewide. To break out of this phase and into the "becoming digital" phase, organizations should focus on creating formal and informal interstitial collaboration between departments and synchronizing changes across business, operating, and customer models. On the far right are companies that independently develop digital technologies and are already reaping the benefits of rapidly scalable capabilities. The "being digital" category is still quite small, populated by some of today's most recognized technology companies, industrial enterprises, and others. Most power and utility companies are currently still in the first two stages (exploring and doing).

To advance to the next level in their digital transformation journey, organizations should focus their efforts on three key areas:

FIGURE 8

Organizations can get stuck in the digital transformation journey



Note: N=81.
Source: Deloitte global Industry 4.0 survey.

Digital DNA is a catalyst for digital transformation. It enables the organization to become more outcome-focused, continuously innovating and iterating at a fast pace.

- **Innovation.** Important to becoming digital is to establish repeatable innovation capabilities to continuously supply the business with a robust pipeline of digital projects. Ideally, organizations should adopt an innovation process that enables them to rapidly design, test, and iterate each concept through to launch. Fostering a digital culture and standing up a digital foundry, as described below, can provide the foundation for a successful innovation process.
- **Culture.** A digital enterprise continuously redefines what it offers, how it delivers, and how it operates to drive competitive differentiation, maximize profitability, and minimize enterprise risk. This involves not only adopting exponential technologies but incorporating a "digital mindset" into the organization's DNA. Your organization's DNA defines how you:
  - Are organized (structure, physical space, geography, capabilities)
  - Operate (process, technology, governance, talent)
  - Behave (leadership, policies, rewards, performance management)
- **Digital foundry.** Many utilities are setting up internal digital foundries, which act as hubs or accelerators of digital projects. A foundry is a dedicated function with dedicated resources incorporating the skill sets required to carry concepts from ideation through implementation. Many of these skill sets involve new ways of thinking for the power sector, such as agile, as discussed earlier, and design thinking.[15] The foundry enables the company to create a more flexible, collaborative, self-organizing, and fast-changing environment, and deliver value more quickly and iteratively to its customers. Digital foundries should have leaders who understand how to best prioritize and allocate funding to implement digital projects. Below is a model for digital innovation being applied within a power company in its digital foundry.

DIGITAL INNOVATION MODEL

This is a model designed to triage and socialize ideas and proposed changes across an organization. Through a cadence of meetings and approval steps, concepts can flow to the right teams with a minimum of governance. Each concept has a champion to shepherd it through the process.

- **Phase 1:** In this phase, ideas and concepts are generated, inspired by external events, customer feedback, innovation pilot programs, or other sources.
- **Phase 2:** During this phase, the ideas are researched with customers and other stakeholders, and evaluated for feasibility; other dependencies are also identified. If accepted, the concepts are rapidly prototyped, tested with users, and either validated, invalidated, or revised and cycled through again.
- **Phase 3:** The teams complete an impact analysis, prioritize and plan the release, review cross dependencies, and address any barriers to release.
- **Phase 4:** The products are prioritized and usually implemented in a limited release, tested with customers, and the process is reiterated.

This model has generated and tested ideas to improve the customer experience, promote new services, and complete customer transactions through multiple channels, including smart phones and smart home speakers.

Digital DNA is a catalyst for digital transformation (see sidebar, "Digital DNA is a catalyst for digital transformation"). It enables the organization to become more outcome-focused, continuously innovating and iterating at a fast pace. Adopting these "agile" business practices means transforming the organization to deliver digitally by shifting the mentality away from linear, stage-gate activities, toward a more flexible, collaborative, self-organizing, and fast-changing environment. Instead of delivering one project at a time and not releasing it until all stages are complete, teams are scoping projects more fluidly, delivering smaller releases more frequently, and iterating in cycles and sprints.

This is a significant departure from the slow-moving culture for which most utilities are known. A key challenge is to adopt this approach not only within a specially trained "digital" team, but across the entire enterprise. Organizations cannot ultimately "be digital" if some departments have adopted a digital mindset while others have not. This involves an organizational transformation that introduces behavioral changes and instills them enterprisewide.

Many digital companies are transforming organizationally, operationally, and behaviorally to support the digital business environment. This could mean restructuring the organization to increase collaboration and decentralize decision-making. Or redesigning workspaces to enable more collaboration and fast iteration. Learning will likely play a key role, and will need to become more engaging, directly applicable, and available through multiple digital channels on-demand. Knowledge management will also evolve to enable fast access to customized, fit-for-purpose information from a rapidly growing trove of structured and unstructured data. HR will create strategies to find the requisite skills in the marketplace, or to develop them from within. Companies will roll out change management strategies and activities to shape this new culture—and those strategies will likely incorporate incentives, rewards, and performance milestones to encourage desired behaviors and practices.

DIGITAL DNA IS A CATALYST FOR DIGITAL TRANSFORMATION

To activate this catalyst, a company should determine:

- **How digital are we today?** Assess your company's overall digital maturity and determine if it possesses traits common to digital organizations, such as "continuously innovating," "intentionally collaborative," and "democratizing information."
- **How digital do we need to become?** Through a series of surveys, interviews, and working sessions, identify your company's digital ambitions and create a blueprint of the new DNA traits you need to achieve them.
- **How do we get there?**
  - Determine what is blocking or enabling the manifestation of the necessary digital traits in your organization.
  - Construct **minimum viable changes (MVCs)** that will help infuse the needed digital DNA into your organizational DNA. MVCs are a series of tactical, measurable change actions.
  - Develop a journey map that plots out the series of MVCs over a selected time horizon.
  - Manage the journey and expand or extend MVCs in key areas of the organization as necessary.

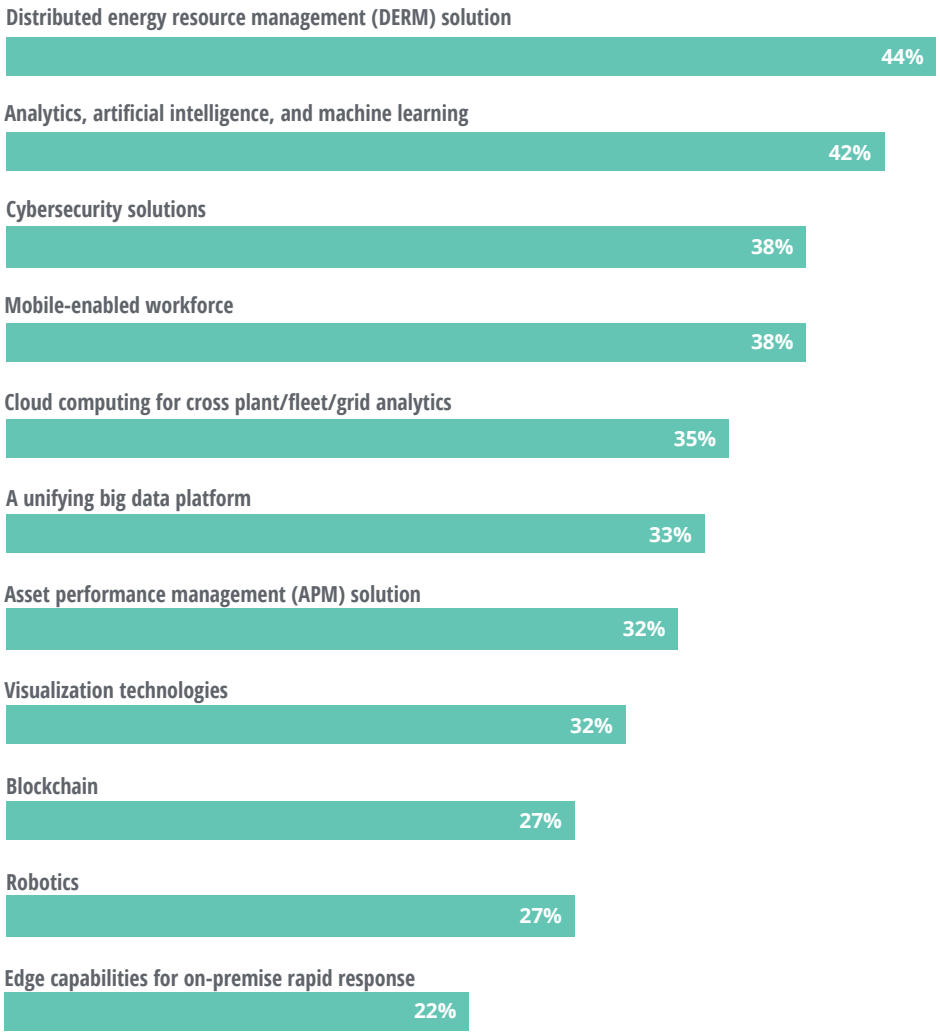
What capabilities are power companies exploring for the future?

Our survey respondents plan to explore many capabilities in the next 1–3 years as part of their digital strategies (figure 9). Many will likely involve new technologies that can help create value across the organizations using cloud computing, cybersecurity, robotics, machine learning/cognitive, IoT, blockchain, AI, digital twins, and augmented/virtual reality.

FIGURE 9

Digital technology capabilities that power companies plan to explore

What digital technology capabilities have you or will you be exploring as part of your digital strategy in the next one to two years? (Select all that apply)



Note: N=81.
Source: Deloitte global Industry 4.0 survey.

Getting started

THE POWER AND utilities sector is in an unprecedented period of disruption and transformation as a multitude of forces reshape it, and a wide array of new players appear to want in. Being already there, with assets in place, terabytes of customer information, and typically a high degree of brand permission,[16] incumbents may have an advantage from the starting gate—but likely not if they keep doing things the way they've always done them. Power and utility companies that seek to thrive as the future unfolds should start their digital journeys now or keep moving if they've already started. Here are some steps to consider:

- **Chart the path:** The first step is to recognize that the transformation to "being digital" will be a substantial, significant, and long-term undertaking. It's an ongoing process that won't end anytime soon. Start by defining your organization's ambitions and then chart a path to success by developing a road map to achieve those ambitions. A sequenced road map that is actively managed and well understood internally and by regulators is critical.
- **Develop innovation capabilities:** It's important to establish repeatable innovation capabilities to continuously supply the business with a robust pipeline of digital projects. Ideally, the innovation process will enable your organization to rapidly design, test, and iterate each concept through to launch.
- **Develop or acquire new technology:** Participate in a technology incubator, start a venture capital organization, or consider investing in or partnering with technology companies to develop innovative products, services, or business models and test use cases.
- **Transform culture:** Cultural transformation involves not only adopting new technologies but incorporating a digital mindset into the DNA of your organization. This requires developing processes to encourage experimentation and innovation in a continuous feedback loop. It will likely require an organizational transformation that introduces organizational, operational, and behavioral changes and instills them enterprisewide.
- **Invest in a digital foundry:** This will be the hub of your digital activities—a dedicated function that can continuously ideate and carry concepts through implementation. It will use new skill sets and new ways of thinking, such as agile and design thinking. And because of repeatable processes, it's less likely to require heavy governance.

Taking these steps can set your organization on a sound path to becoming, and one day being, digital. Enjoy the journey.

Endnotes

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2. Ibid.; Janet L. Sawin et al., *Renewables 2018: Global status report,* REN21, 2018.
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5. According to US Bureau of Economic Analysis data, annual US real Gross Domestic Product increased 19 percent from 2008 to 2018, averaging about 1.8 percent growth annually. For the same period, US Energy Information Administration data shows US retail electricity sales for all sectors increased just 1.8 percent, averaging about 0.2 percent annually. Sources: US Bureau of Economic Analysis, National Income and Product Accounts, accessed March 19, 2019; Table 1.1.6. Real Gross Domestic Product, Chained Dollars and U.S. Energy Information Administration, Electricity Data Browser, accessed March 18, 2019.
6. Capital expenditures for 59 of the largest US electric, gas and water utilities tracked by S&P Global have reached new highs every year since 2010, rising 116 percent from 2009 through 2018. Source: SNL Energy, accessed October 30, 2018. On the growing mandate for cleaner energy sources from customers, more than half of all residential respondents (53 percent) in Deloitte's 2018 annual Resources Study said that it is extremely or very important that part of their electricity supply comes from renewable sources, trending upward since 2013. Source: Marlene Motyka et al., *Deloitte Resources 2018 Study–Energy Management: Businesses drive and households strive*, Deloitte Insights, 2018.
7. For more on human-centered design, see Jim Guszcza, "Smarter together: Why artificial intelligence needs human-centered design," *Deloitte Review* 22, January 22, 2018. For more on agile business practices, see Amir Rahnema et al., "The Adaptable organization: Harnessing a networked enterprise of human resilience," Deloitte, 2018. For more on the Future of Work, see Deloitte's collection at https://www2.deloitte.com/insights/us/en/focus/technology-and-the-future-of-work.html. For more on ecosystems, see Mike Armstrong et al., *Business ecosystems come of age*, Deloitte University Press, 2015.
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13. Ibid.
14. Deloitte Industry 4.0 Investment Survey, 2018.
15. "Design thinking is an iterative process that seeks to understand the user, challenge assumptions, and redefine problems in an attempt to identify alternative strategies and solutions that might not be instantly apparent with the initial level of understanding." For more, see: Rikke Dam and Teo Siang, "What is design thinking and why is it so popular?," Interaction Design Foundation, February 2019.
16. In addition, unpublished survey results from *Deloitte Resources 2018 Study—Energy Management: Businesses drive and households strive* show that one quarter to one half of residential respondents said they would be willing to purchase additional services from their electricity provider, including internet service (49%), energy efficiency services (47%), cable television service (34%), and telephone service (25%).

About the authors

JIAN WEI is a principal leading digital transformation in Deloitte's Power and Utilities practice. For more than 20 years, Wei has directed high-impact engagements from strategy through execution, working at the intersection of innovation, digital technologies, operations, and organizational maturity. She is based in San Francisco.

SUZANNA SANBORN is a senior manager on Deloitte's Research & Insights team where she analyzes global energy trends, with a focus on the power and utilities and renewable energy sectors. She has more than 20 years of experience in research, analysis, marketing, communications, and program management in the power and utilities, oil and gas, and renewable energy sectors. Sanborn is based in McLean, Va.

ANDREW SLAUGHTER is an executive director of the Deloitte Energy, Resources & Industrials (ER&I) group. Slaughter works with ER&I leadership to define, implement, and manage the execution of ER&I research strategy; develop and drive energy research initiatives; and manage the development of ER&I thought leadership. Slaughter specializes in strategy, market fundamental analysis, organizational design, and policy advice. He is based in Houston.

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Contacts

US CONTACTS

Stanley Porter
Vice chairman
US Energy, Resources & Industrials leader
Deloitte Consulting LLP
+1 301 793 4170
sporter@deloitte.com

Scott Smith
Vice chairman
US Power & Utilities leader
Deloitte & Touche LLP
+1 619 237 6989
ssmith@deloitte.com

Reid Miller
Principal
US Power & Utilities Consulting leader
Deloitte Consulting LLP
+1 612 747 5474
remiller@deloitte.com

Brian Murrell
Partner
US Power and Utilities Risk and Financial Advisory leader
Deloitte & Touche LLP
+1 914 462 6113
bmurrell@deloitte.com

Dave Yankee
Managing director
US Power and Utilities Tax leader
Deloitte Tax LLP
+1 312 259 7875
dyankee@deloitte.com

Bill Graf
Partner
US Power and Utilities Audit leader
Deloitte & Touche LLP
+1 847 612 8940
wgraf@deloitte.com

Jian Wei
Principal
Deloitte Consulting LLP
+1 415 602 8672
jianwei@deloitte.com

Ian Wright
Principal
Deloitte Consulting LLP
+1 215 430 6271
iwright@deloitte.com

GLOBAL CONTACTS

Felipe Requejo
Global sector leader—Power & Utilities partner
Deloitte Touche Tohmatsu Limited
+34 91 438 1655
frequejo@deloitte.es

Rajeev Chopra
Global industry leader—Energy, Resources & Industrials partner
Deloitte Touche Tohmatsu Limited
+44 20 7007 2933
rchopra@deloitte.co.uk

Shamal Sivasanker
Sector leader—Power & Utilities partner
Deloitte Africa
+27 11 209 6592
ssivasanker@deloitte.co.za

Michael Rath
Sector leader—Power & Utilities partner
Deloitte Australia
+61 3 9671 6465
mrath@deloitte.com.au

David Morgan
Sector leader—Power & Utilities partner
Deloitte New Zealand
+64 4 470 3870
davidmorgan@deloitte.co.nz

Mark Lillie
Sector leader—Power & Utilities partner
Deloitte North West Europe: UK
+44 20 7007 2395
mlillie@deloitte.co.uk

Thomas Schlaak
Sector leader—Power & Utilities partner
Deloitte Germany
+49 403 2080 4894
tschlaak@deloitte.de

Veronique Laurent
Sector leader—Power & Utilities partner
Deloitte France
+33 1 55 61 61 09
VLaurent@deloitte.fr

Kappei Isomata
Sector leader—Power & Utilities partner
Deloitte Japan
+81 80 3469 2546
kappei.isomata@tohmatsu.co.jp

Guilherme Lockmann
Sector leader—Power & Utilities partner
Deloitte Brazil
+55 21 3981 0446
glockmann@deloitte.com

Anthony Hamer
Sector leader—Power & Utilities partner
Deloitte Canada
+1 416 643 8409
anhamer@deloitte.ca

Gerhard Marterbauer
Sector leader—Power & Utilities partner
Deloitte Austria
+43 153 700 4600
GMarterbauer@deloitte.at

Jukka Vattulainen
Sector leader—Power & Utilities partner
Deloitte North West Europe: Finland
+358 207 55 5549
jukka.vattulainen@deloitte.fi

Ragnar Nesdal
Sector leader—Power & Utilities partner
Deloitte North West Europe: Norway
+47 55 21 81 85
rnesdal@deloitte.no

Kevin Guo
Sector leader—Power & Utilities partner
Deloitte China
+86 10 8520 7379
kguo@deloitte.com.cn

Jong Woo Lee
Sector leader—Power & Utilities partner
Deloitte Korea
+82 2 6676 1399
jongwlee@deloitte.com

Shoaib Ghazi
Sector leader—Power & Utilities partner
Deloitte Pakistan
+92 213 4546494
sghazi@deloitte.com

Fredrik Johnson
Sector leader—Power & Utilities partner
Deloitte North West Europe: Sweden
+46 70 080 24 62
fjohnson@deloitte.se

Mikkel Boe
Sector leader—Power & Utilities partner
Deloitte North West Europe: Denmark
+45 22 20 24 94
mikboe@deloitte.dk

Arturo Garcia Bello
Sector leader—Power & Utilities partner
Deloitte Mexico
+52 55 50806274
argarciabello@deloittemx.com

Shubhranshu Patnaik
Sector leader—Power & Utilities partner
Deloitte India
+91 124 679 2333
spatnaik@deloitte.com

Vyacheslav Seronogov
Sector leader—Power & Utilities partner
Deloitte Russia
+7 495 787 0600
vseronogov@deloitte.ru

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Deloitte Insights contributors
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