JULY 2017 • SPECIAL REPORT

PUBLIC UTILITIES FORTNIGHTLY

"In the Public Interest"

Industry Leaders' Perspectives
Survey on Electricity's Future
Discussion About Electricity's Future

State & Future of the Power Industry

YEAR TWO

IN COLLABORATION WITH

NAVIGANT

PUBLIC UTILITIES FORTNIGHTLY
"In the Public Interest"
JULY 2017 • SPECIAL REPORT

Industry Leaders' Perspectives

What they really think about electricity's future

By Steve Mitnick, Editor-in-Chief,
Public Utilities Fortnightly,
with PUF's Pat McMurray

For the second year in a row, we talked with many leading thinkers from utilities (investor-owned and not), the regulatory and consumer advocacy communities, law, and trade associations. PUF's Pat McMurray asked them the following questions and summarizes their responses.

- What are the most disruptive trends facing utilities today? How will they change the status quo in the next five years?
- How can utilities manage the impact, the threats, and the opportunities presented by renewable resources of all kinds?
- How can utilities transition to a digital future? How can regulation support their goals? ❍

OFF THE RECORD

Leaders Across Our Industry Speak Out Frankly

The ground rules were simple. We promised the interviews would be completely off the record. We promised not to identify any of the prestigious fourteen-member interview panel. We asked them to say whatever they really felt in response to the questions.

The result? We garnered especially sincere perspectives on electricity's future from important industry leaders and thinkers. They represent a broad range of organizations. This made the resulting replies representative of our industry's approaches to the future.

Here's a brief introduction to the participants: Seven utility execs that are currently serving in different regions of the US. (The Midwest was well-represented, but we also talked with executives from the South and the West.) Three industry association executives. One former consumer advocate who is currently a consultant and one currently serving as a consumer advocate. We also talked with a state commissioner and a government energy executive.

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INSIDE

Most Disruptive Trends

What are the most disruptive trends facing utilities today? How will those trends change the status quo in the next five years?

Many panelists said distributed energy resources (DER) are the most disruptive trend; last year's respondents focused on DER as well. This is consistent with our related survey of PUF readership. Nearly half of respondents see DER as the most disruptive trend facing utilities today. One government executive in the energy space said, "Two words: rooftop solar."

There are other issues that accompany the DER disruption. A Midwestern utility executive who listed DER at the top of his list added, "Outdated rate design." Most respondents to the PUF readership survey think the regulatory model is the greatest legacy challenge facing utilities today.

Net metering and its impact on rate design were mentioned several times along with the disruptive nature of DER. And, away on the horizon, some envisioned another DER disruption from energy storage, although no one judged it as a top disrupter today. It's interesting that the PUF readership respondents viewed distributed energy storage as the most likely DER to be owned and operated by utilities.

There is much uncertainty about how much DER there will be. A utility executive from the South said that solar DER was not going to make big inroads in his service territory. Half the respondents to the PUF survey believe DER capacity will increase to as much as ten to twenty percent of total installed US generation by 2030.

However much new solar rooftop generation may grow, it's a destabilizing force.

One Western utility executive explained it would be harder to make twenty-to-thirty-year bets on the supply side of the business than ever before.

One government exec had a more sanguine view of the future. She believes that regulatory changes will allow for more integration of distributed renewables. Costs will come down and make renewables of all kinds more attractive for utilities. And, forty percent of PUF survey respondents believe a supportive regulatory environment is the most important tipping point for utilities to own and operate DER.

One Midwestern utility executive said, 'We could become just a platform for energy services.'

Other panelists focused on the rapid advent of new technologies and the fast pace of technological change. Not surprisingly, those close to the world of big data saw data analytics as the most important technology change of all.

However, the PUF readership did not see advanced data analytics and machine learning as drivers of utility revenue growth. Rather, the respondents saw them as middle or low priority opportunities. Similarly, just about five percent of the PUF readership respondents saw digital transformation as the key shift utilities must embrace to prepare for sustained growth.

One association executive said that data would be the key to the future, and that utilities should think strategically about how to use data. He warned, "Customers will be in charge." Another Western utility executive identified DER and the Internet of Things (IoT) as disruptors; they will converge, he said.

The PUF readership survey shows that "market[ing] new energy products and services" and "radically improving ability to innovate" were among the top-ranked transformations. Utilities should plan for them if they are to prepare for sustained growth through 2030.

In summary, the top two change agents mentioned by most panelists are DER and the rapid advance of new technology. But there were other interesting choices.

Several people highlighted the lack of load growth caused by energy efficiency as the most disruptive trend. In the PUF readership survey, one-quarter of respondents viewed declining load growth as

one of the legacy issues that poses the greatest challenge to utilities. Projections have gone from flat three or four years ago to negative, according to a Midwestern executive.

That's because utilities recover the fixed costs of the grid through variable charges. Energy efficiency itself was a top disruptor for more than one panelist, including a utility executive from the South.

2030. (New business models were the most important.)

Another panelist, also working in the advocacy space, said customer segmentation was the most disruptive trend. He said that the upcoming digital transition would create more customer segmentation.

Many respondents mentioned that consumers are becoming more educated and involved. Every panelist said that

Utilities will experience less load growth and will have to find new revenue sources.

One regulator said hydraulic fracturing was the most disruptive trend because it makes natural gas cheap, causing utilities to close coal plants and to decide against building nuclear plants.

This year, some respondents cast a broader net by mentioning consumers or customers as the most disruptive force. One panelist, a former consumer advocate, said the empowered energy consumer was the most disruptive agent utilities must deal with today. PUF survey respondents said improved customer engagement to anticipate changing needs was the second most important transformational shift utilities should prioritize to prepare for sustained growth through business-as-usual couldn't be taken for granted any more.

A Washington, DC-based attorney said politics are potentially a big disrupter, especially as different parties take control of the federal government's executive branch and Congress: watch upcoming elections. Energy politics are important to lawmakers as well as regulators; similarly, politics will play out on the state level, as well.

Almost all interview respondents emphasized the need to think creatively about new revenue sources. According to a Midwestern utility exec, utilities will experience less load growth and will have to find new revenue sources. Our revenue model does not match investment obligations, he said.

We need a change in the way we collect revenue, one association executive replied. Sales can't be volumetric any more. In the future, utilities need to be able to collect based on service, not volume of sales. A former consumer advocate said that might involve selling new services or new products to customers if utilities are permitted to do so.

Regulation will have to change to suit the new, disrupted utility world. More than one panelist said that regulation was key to making the new systems work smoothly.

Another association executive said, "Regulators need to decide what possible future states of the industry they are willing to consider. Some utilities may move away from the customer and be a wires company."

A couple of other respondents noted that third parties might become involved in the future utility, taking over some back-office work or responsibility for certain technologies, for example. One Midwestern utility executive said, "We could become just a platform for energy services." About one-third of respondents to the PUF survey believe utilities should pursue an energy platform provider business model to harness the full value (financial, operational, or otherwise) of DER.

A Western utility executive said to expect increasing penetration of DER: solar rooftop as well as storage and energy efficiency.

The association executive who is a data expert says that there are seven or eight different layers of sophistication with a robust advanced metering infrastructure (AMI) system. There is basic advanced meter reading, but there are also smart thermostat data and remote auditing data.

What does that mean for the future? The utility could be able to automatically predict and provide services of many kinds, including automated refrigeration, air conditioning, and light.

The attorney in Washington predicts there will be huge swings in the regulatory pendulum, again because of the uncertain political climate. Federal regulatory changes could lead to major disruption of state regulatory decisions. ❍

Renewables: Impacts, Threats, and Opportunities

How can utilities most effectively manage the impacts, opportunities, and threats caused by utility-scale and distributed renewables?

More than one respondent was quick to say that renewables are not a threat. Disruption may not equal threat in the minds of those panelists. A government executive said that as the smart grid is developed, any impact from the disruption would be ameliorated.

In the PUF readership survey, as many as forty percent believe wind and solar combined with storage to be the most viable resource alternative to backfill a widespread decline in baseload generation.

One Western executive who said renewables were not a threat added that utilities should look for opportunities in new technologies: for example, in storage and batteries. On the transmission system, he said, utility-scale batteries could help a grid operator manage the highs and lows of the electricity day.

Regulation is part of the problem, but also part of the potential solution.

One utility executive in the South says renewables are a challenge because of the way we have historically priced electricity. Load growth is declining across every customer class. If residential customers use less electricity because they are generating some of their own with solar rooftops, for example, we don't fully recover our fixed costs and other customers must pick them up.

When it comes to utility-scale renewables, one Midwestern utility executive said that the large-scale commercial and industrial customers are a key opportunity. Many are creating their own electricity market and, like the residential customers, are generating their own power. We need to get large-scale renewable power to them, he said. It's worth noting, however, that the PUF readership survey shows customer choice not to be a major driver for renewable energy adoption over the next decade.

The panelists who were concerned about recovering a utility's fixed costs were, of course, concerned about net metering. A couple of respondents said flatly that it is a mistake. Utilizing a time-of-use tariff is more equitable for the utility and for the solar developer.

Regulation is part of the problem, but also part of the potential solution.

The issue is finding a revenue model for a new technology platform; our product is still priced as though we are selling kilowatt-hours. More than one respondent said utilities are becoming service providers, not commodity sellers. Our single greatest threat is how we price our service. One association executive flatly declared, "The simple rate case is dead."

What is the answer to declining load growth? Utilities will need to encourage more electrification of our society. One panelist said, "Let's encourage more [electric vehicles (EVs)], more use of electricity in industrial processes. Let's encourage electricity replacing other forms of energy." The PUF survey responses support that point of view. Respondents identified electrification of transport as the number one technology that will offer the greatest revenue growth potential for utilities.

The consumer was mentioned more than once. One former advocate for consumers pointed out that the issue is how to design rates so that the appropriate costs are going to the appropriate consumers. He added that there are many places in the country where the renewable piece of an energy system is small.

A Western executive emphasized that it was important to look for future business opportunities in customer engagement, perhaps in automation of home devices. A consumer advocate said utilities should look to create certain products and services that might require regulatory changes.

Utilities can manage change adeptly. It's a matter of creating the right rate design.

A Midwestern utility strategist said that we need to understand what customers really want. And decouple revenue from sales volumes. An association executive added that until now, renewable additions have been driven more by policy than by economics. It's significant that an overwhelming majority, forty percent, of respondents to the PUF survey believe technology cost decline will be the greatest driver of renewable energy adoption over the next decade.

More than one panelist said that building good relationships with regulators is the key. Utilities can manage change adeptly, according to one utility executive in the West. It's a matter of creating the right rate design.

Not surprisingly, the association executive who is excited about the future of technology says the path to a bright future is in the data that utilities are gleaning from smart meters. How are utilities making use of that data? How can they use it strategically to offer new products to the consumer? A former regulator who is now a utility executive says, "Utilities have been adept at managing change."

A Midwestern utility executive said that we need to educate consumers better, help them really understand the electricity system. He added that we need to educate the regulators, too.

An attorney said that it all comes down to infrastructure. "We need the right policies in place for smarter infrastructure," she said. "That will give us the operational capacity to integrate renewables." ❍

The Digital Future

How should utilities embrace a digitized future? How can regulation support these goals?

Many panelists agree that the key to the digital future is the grid, both transmission and distribution. According to one government energy executive, no one cares more about the protection of the grid than the utilities. Utilities are already transitioning to the digital world. They are already moving to advanced technology.

A regulator said, "Getting smart meters in every home is the key to that digital future. And then identifying those customers who value technology and want to utilize it."

One respondent was rather puzzled by the question: he said the industry is already digitized. No one is putting new analog meters on their system. Everybody is moving to some variety of digital metering.

All regional transmission organization (RTO) dispatch systems for the country are run on computers. The real question, he said is, "How do we rebuild our distribution infrastructure to add the digital technology that will allow us to utilize mass distributed resources?"

He was not the only panelist to remark that the industry is already far down the digital path. An association executive said, "We are a heavily digital industry now. We have invested in AMI, down-line automation, and other digital tools. Everyone is getting a tremendous amount of data from their system."

If utilities don't plan the transition to the digital future, someone else will do it for them.

One of the Midwestern utility executives said that smart meter information gleaned by the utility can help the organization figure out how much DER to put on a circuit. That newly added DER might save the utility from having to build a new substation.

A former regulator said utilities should support research and development. They should deploy demonstration projects. And explore offering digital products to customers, such as cloud computing or software as a service.

A VP for corporate planning agreed; the utilities' digital transition should focus on the customer and on providing business value. Focus on that and not on what he called "shiny objects."

Similarly, most PUF readership survey respondents identify two key factors as the most important applications of machine learning innovation with the greatest potential impact on the utility business over the next decade. They are

load management and optimization as well as DER aggregation and integration.

A utility executive from the South said that digitizing would give customers more control. They will be able to manage multiple sources of generation on their own.

An attorney said that if utilities don't plan the transition to the digital future, someone else will do it for them. That someone else could be a third-party provider, or even a different utility. A regulatory executive at a utility said, "We need to quickly test things, pilot things, roll them out faster than we are used to as an industry." However, the PUF survey respondents see this as a lower priority. Only about ten percent believe adopting an agile management culture is a transformational shift utilities should prioritize.

Cybersecurity becomes an issue that is more and more important, according to a former consumer advocate and strategist. Improving cybersecurity is critical. And focusing on data privacy is part of that package. A Western utility executive said it's important to be aware that the more digital devices on the grid, the more risk to cybersecurity. The PUF survey reflects the importance of cybersecurity. One-third of respondents believe that physical and cyber attacks represent the biggest risk to safe, reliable power.

The Western utility executive also remarked, "Think about investments the utility needs to make as the IT system converges with the distribution system." A Midwestern utility executive echoed those comments, saying we need to invest in digital system architecture that will support DER. We need to invest in a digital framework that will allow customers to seamlessly engage in transactions.

The association data expert described the future from the thirty-thousand-foot level. He said, "The digitization of the industry means that distribution, not generation, will be the important space for the future utility."

The PUF readers who responded to the survey identified a supportive regulatory model as the most important tipping point for utilities to aggressively pursue owning and operating DER.

Be aware that the pace of technology change is very fast but typically, the pace of regulation is very slow, warned one Western utility executive. Regulators should explore rate design changes. A lot of technology changes are not possible without rate design changes.

Streamline the approval process for infrastructure, according to a government official.

Another association executive said, "Make sure regulators understand the revenue impacts of their decisions. Help them understand what the investment impacts of their decisions are. We need regulators to help us manage the grid effectively, and make sure revenue streams are available to pay for the costs that aren't recovered in an energy charge."

A former regulator urged his regulatory colleagues to help utilities plan for cost recovery for new technology. "How utilities recover costs in the future may not be in line with traditional ratemaking principles," he said. Typically, utilities recover costs based on kilowatt-hours sold; if those hours are decreasing, regulators need to look to the future.

A utility executive in the Midwest firmly declared that utilities need to educate regulators. "Regulators need to understand customers and what they want," he said. He doesn't think regulators understand that at all.

He added, "I think they take the combined input of stakeholders that appear before them in contested proceedings and think that somehow customer desires are being reflected in that process. Nothing could be further from the truth, as far as I'm concerned."

An attorney specified that the federal government should not be focused on moving every utility in the same direction. She said, "I think that ensuring that as much as possible happens on the state and local level is the key. That would help the transition because we'll have these mini labs throughout the country and we can see what has worked and what hasn't worked."

A VP for regulatory affairs who focuses on this topic every day echoed that sentiment. He said regulators should focus especially on regional and local preferences.

Some utilities may move away from the customer, leaving customer interaction and service to a third party, according to one association executive. Regulators in New York have already told utilities there that they must change their business model. So, regulators need to decide what possible future designs the utility business should utilize.

A sobering final thought from a consumer advocate: Most regulatory budgets across the country are very strained, at a time when those offices are dealing with very complex new questions. It's a bandwidth problem, according to more than one professional. ❍

One respondent was rather puzzled by the question: he said the industry is already digitized.

Survey on Electricity's Future

PUF conducted a fifteen-question online survey and received hundreds of responses to each question. In all, four hundred seven of you participated. Your responses are shown with graphical breakdowns and takeaways.

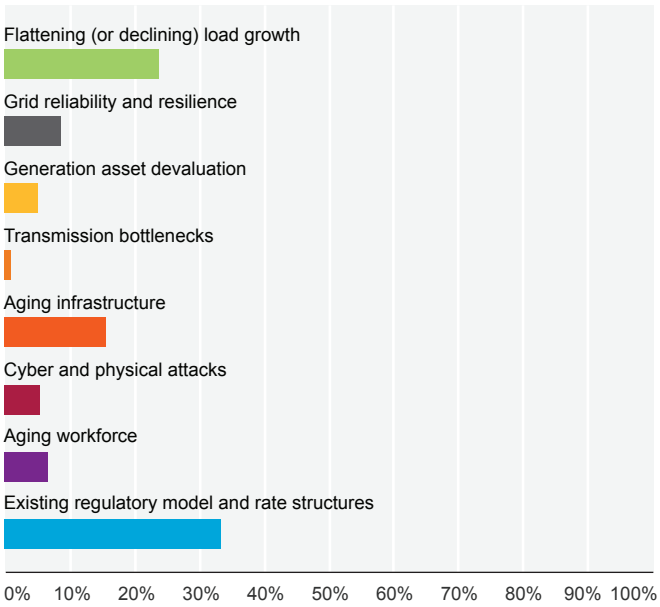
1. Which one of the following legacy issues is the greatest challenge for utilities today?

The greatest obstacle to innovation among utilities is the existing regulatory model and rate structures; this was last year's top choice as well. This reconfirms that regulation, in many cases, is trying to keep up with changing customer demands, new technology solutions, and business models.

In a more distributed energy ecosystem, where customers expect new energy solutions (like self-generation and storage, among many others), regulatory models and financial incentives will need to be aligned to maximize the value of the grid for all customers. At the same time, utilities will need to innovate in order to prosper in the face of industry transformation.

Regulators should take note. Just tweaking regulation and rules that were designed for the traditional centralized electricity delivery model will not be sufficient. A full overhaul and redesign of market structures and regulation is needed to support the new energy ecosystem. That includes the localized value of DER and pricing signals.

Nearly a quarter of respondents point to flattening or declining load growth as a key challenge for utilities. In mature markets, we see an accelerated decline in load growth, where usage per household or per commercial building is reducing steadily. While more energy consuming devices have been introduced behind the meter, energy efficiency and distributed generation are keeping demand growth for centralized power generation in check. This means less revenue for utilities, making it harder to invest in aging infrastructure—nearly sixteen percent of respondents cited this as the greatest challenge facing utilities.

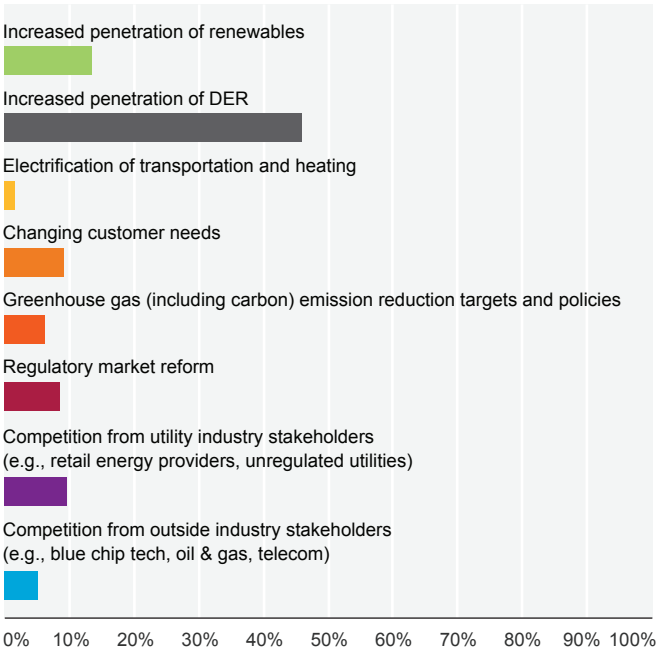


2. Which one of the following trends is the most disruptive to traditional utility business models over the next decade?

Nearly half of the respondents cite increased penetration of DER as the most disruptive threat to traditional utility business models over the coming decade. The result speaks for itself: the effects of DER are industry-wide and will have a deep impact on the existing market.

Navigant Research analysis shows that new installed DER capacity will grow three to five times faster than central station generation over the next decade.[1] Although solar PV still dominates the conversation with respect to which DER technology will have the most disruptive impact, energy storage, plug-in EVs, microgrids, demand response, energy efficiency, and other demand-side technologies each pose their own challenges for utilities.

DER was by far the dominant trend cited among respondents, with all other trends receiving only a small fraction of votes. Surprisingly, increased penetration of renewables didn't get more votes, since this is clearly disrupting utility operations as well. This trend is also disrupting most of the energy markets as utilities look for ways to successfully solve the challenge of managing intermittent resources without curtailment.



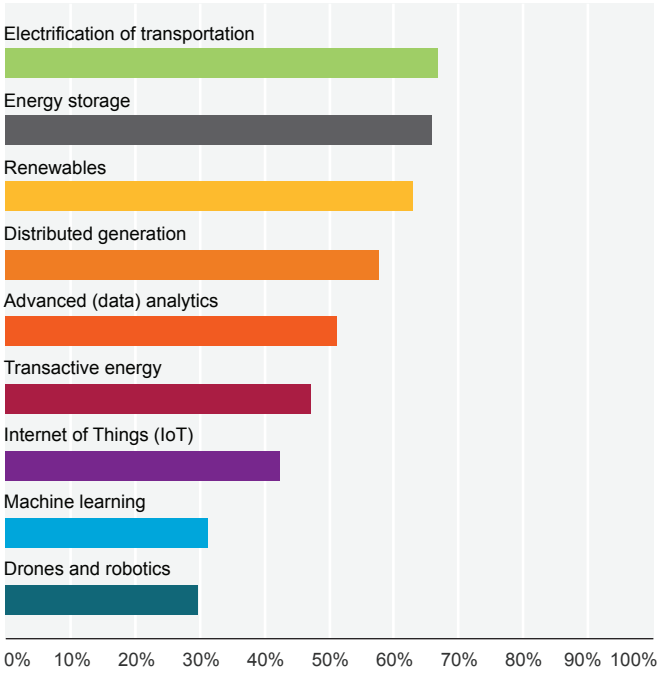
3. Please rank the following exponential technologies from the one that offers the most revenue growth potential for utilities to the one with least revenue growth potential for utilities.

Among the exponential technologies identified in this survey, most respondents (one-third) ranked electrification of transportation as offering the most revenue growth potential for utilities. Utilities see this trend (and in some regions, electrification of heating) as the most plausible pathway to slow down declining load growth. But when compared with question eight, where only fifteen percent of respondents believe vehicle electrification and charging services will be the most prevalent form of DER in terms of capacity by 2030, utilities are evidently questioning whether this will make up for the other forms of DER that are reducing overall load.

Surprisingly, as seen in the response to question nine, only sixteen percent of respondents believe vehicle electrification and charging services will be owned and operated by utilities.

Navigant Research analysis supports a bullish outlook for electrification of transportation in the utility industry.

Global electricity consumption by highway-capable road vehicles is expected to exceed 200 TWh by 2030, and the United States is projected to account for around one-fourth of this consumption.[2] Each charging station represents a new load, which could benefit utilities struggling with declining demand (a key challenge identified in the response to question one). Transportation-to-grid is one of the emerging Energy Cloud platforms[3] that offers significant potential for customers and utilities. Utilities should consider a transportation electrification strategy if they have not yet done so to capture their share of future revenue streams.

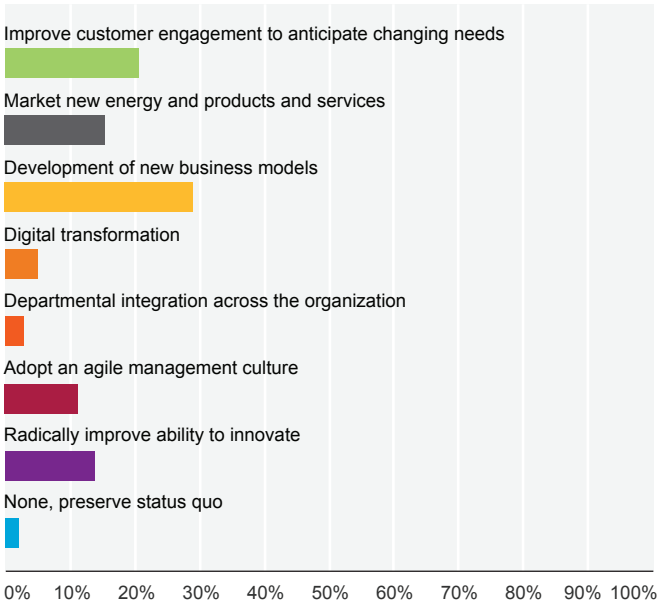


4. Which of the following transformational shifts must utilities prioritize to prepare their organizations for sustained growth through 2030?

As utilities wrestle with decarbonization, democratization, and digitization trends impacting the grid, it's perhaps no surprise that the development of new business models was cited by nearly thirty percent of respondents as the key transformational shift utilities need to embrace to prepare their organization for sustained growth. Navigant Research suggests that current distribution network operators will have transformed into distribution service orchestrators by 2030 and be responsible for far more than just network operations.[4]

Respondents see improving customer engagement to anticipate changing needs, marketing new energy and products and services, and radically improving the ability to innovate as secondary transformation shifts worth prioritizing. Although utilities are nearly unanimous in their recognition of the opportunity to redefine their relationships with their customers, identifying which channels to leverage and drawing a correlation between smart technologies and engagement remain key challenges.

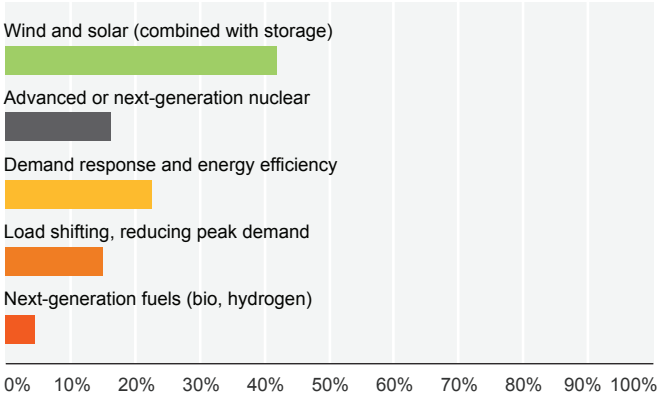
Only two percent of the respondents see value in preserving the status quo, which suggests that the industry is now mostly attuned to the sweeping changes that are taking place. Utilities have embraced innovation and are looking for pathways to successfully transform their organizations. However, balancing the performance of a legacy business with the exploration of new revenue streams and business models is a significant challenge. Time will tell who the winners and losers will be.



5. Which of the following is the most viable resource alternative to backfill a widespread decline in baseload generation?

Nearly forty-two percent of respondents agree that wind and solar, combined with storage, are the most viable resource alternatives to backfill for declining baseload generation. This accurately reflects growth trends today in which utility-scale renewables (mostly wind and solar) have represented sixty percent of total capacity additions to the US grid since 2014.[5] Coming in at a close second, thirty-seven percent of respondents believe that demand response and energy efficiency, along with load shifting and reducing peak demand (two related categories), are the most viable backfill resources.

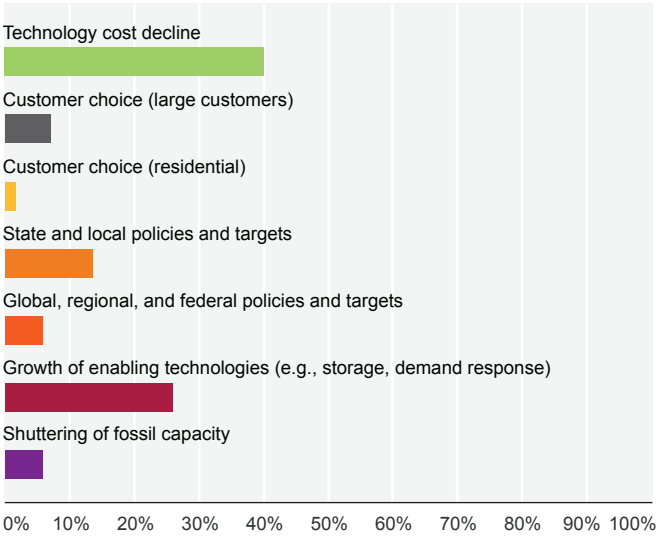
There is no silver bullet to replace fossil or nuclear baseload generation. A combination of multiple alternative solutions will be necessary. Besides those mentioned above, sixteen percent of respondents see next-generation (clean) fuels as the most viable resource alternative. That indicates a lingering preference for resources that share a close resemblance in function and operation to baseload fuels (available twenty-four-seven, able to store and transport). Hydrogen, produced from renewables (at zero marginal cost), is a strong candidate to fulfill this need.



6. Which will be the greatest driver of clean, renewable energy adoption over the next decade?

Most respondents believe technology cost decline will be the greatest driver of clean, renewable energy adoption over the next decade. Navigant Research analysis also views this trend as a key driver of adoption in the next ten years. According to its analysis, solar PV costs are expected to drop forty percent over the next decade across residential, commercial, and utility-scale market segments.[6] Wind energy has already seen a sixty-six percent reduction in levelized cost of energy over the past seven years.[7]

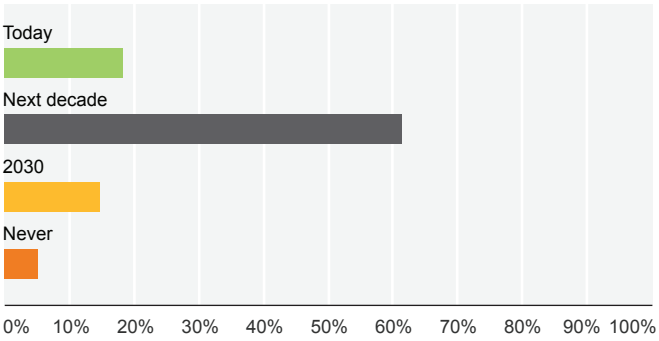
Meanwhile, twenty-six percent of respondents believe the growth of enabling technologies, such as storage and demand response, would be the greatest driver of clean, renewable energy adoption. Interestingly, almost two-thirds of respondents (sixty-six percent combined) believe that technology—whether through declining cost or growth in enabling technologies—would be the greatest driver of renewables adoption. Regulatory and policy drivers (twenty percent combined), customer choice of residential and large customers (nine percent combined), and shuttering of fossil capacity (six percent) were viewed as far less impactful drivers overall.



7. When will growth in DER force a major shift in utility business models?

DER will force a major shift in utility business models in the next decade, according to most respondents (sixty-one percent). Not surprisingly, only six percent feel DER will never force a major shift in utility business models, suggesting the industry is already acclimated to the reality of DER growth. But with only eighteen percent of respondents indicating the shift will occur today, industry expectation may lag behind reality.

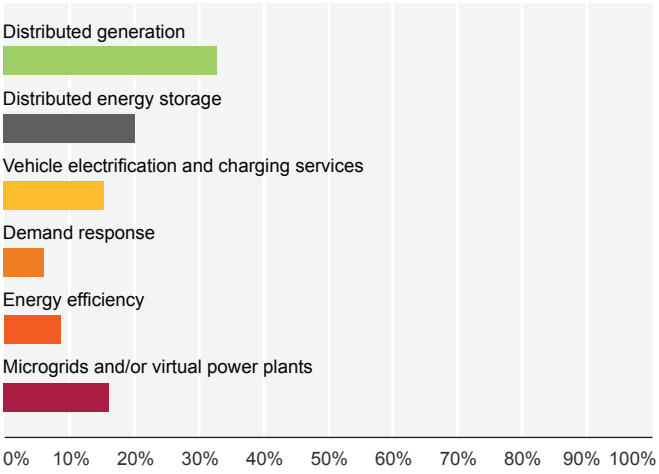
DER growth is accelerating and central station generation growth is slowing down. For example, Navigant Research analysis shows that new DER capacity deployments will surpass new centralized generation installments this year or next, and outpace new centralized generation deployments going forward. This signals a significant tipping point in the industry.[8] The impact of DER on load growth should not be underestimated by utilities. Especially important are energy efficiency and distributed generation. Long-term investments in central infrastructure assets are no longer without risk. Our advice to the industry is to adapt quickly to higher-level penetrations of DER.



8. Which will be the most prevalent form of DER in terms of capacity by 2030?

The DER landscape is comprised of several technology solutions that behave and perform quite differently. Among these, one-third of respondents (thirty-three percent) agreed that distributed generation—which includes distributed solar PV, small wind, generator sets, fuel cells, and microturbines—would be the most prevalent DER category in terms of capacity by 2030.

Navigant Research analysis supports this view, projecting that these technologies will account for fifty-two percent of cumulative DER capacity deployed over the next decade. Interestingly, distributed generation ranked fourth among exponential technologies that offered the most revenue growth for utilities (see question three).



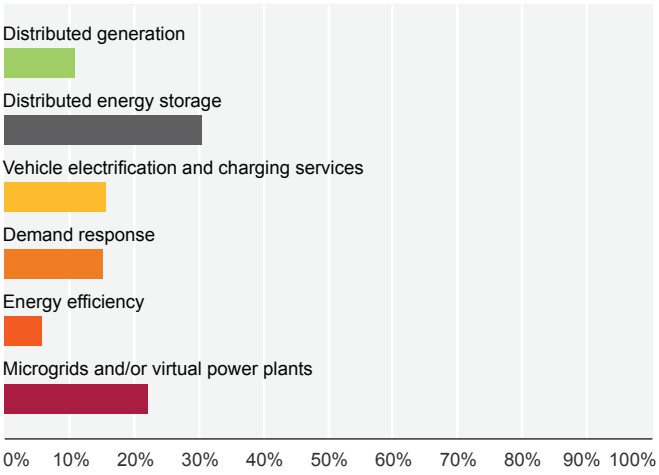
9. Which DER opportunity will be the most likely to be predominantly owned and operated by utilities in 2030?

Nearly a third of respondents (thirty percent) believe that distributed energy storage will be the most likely DER category to be owned and operated by utilities in 2030. Microgrids and/or virtual power plants followed closely with twenty-two percent of respondents, although vehicle electrification and charging services (sixteen percent) and demand response (fifteen percent) were also seen as likely opportunities for utilities to own and operate DER. To date, utilities have been challenged by distributed solar PV, with limited success in developing profitable business models and new revenue streams.

Views around vehicle electrification and charging services are surprising, as respondents said the opportunity offered utilities the most revenue growth potential in question three. This likely points to a market disconnect between an emerging technology opportunity in electrification of transportation and market barriers to its adoption.

One thing is certain, though: There will be more opportunities for utilities. The volume of technological innovation and adoption across the utility industry today is simply staggering. The Energy Cloud will usher in an era of combination technology platforms in which one-off technologies coalesce into highly distributed and networked energy ecosystems. [9] These are supported by rapidly evolving digitally enabled platforms, including integrated DER, Building2Grid, the transportation-grid-nexus, smart cities, IoT, and transactive energy, for example.

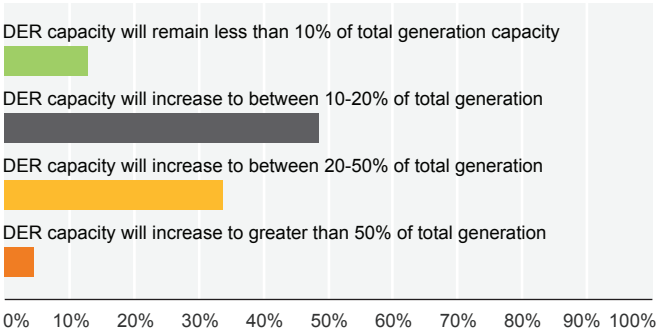
Navigant estimates that new products and services leveraging these emerging platforms could play a key role in driving $53 trillion in cumulative revenue across the global utility industry between 2016 and 2030. This means that utilities must build new business models around long-term customer needs and these adjacent emerging platforms.



10. By 2030, what percentage of total US installed generation capacity will DER represent?

Nearly half of respondents expect DER capacity to increase to ten to twenty percent of total generation by 2030. As this is a more aggressive view than last year's survey, it seems the industry recognizes the potential of DER.

It is important that the transition to higher DER penetration is carefully managed. The total volume (and with that, revenue) that flows through the core, centralized grid components will decrease over time. Balancing ongoing investments in existing infrastructure and new dynamic platforms along the grid's edge that support the integration of new technologies, products, and services will remain a challenge for the industry. This includes understanding and managing the risk of stranded assets that may become obsolete or financially unsustainable, as well as their cost to incumbent utilities, customers, and society.



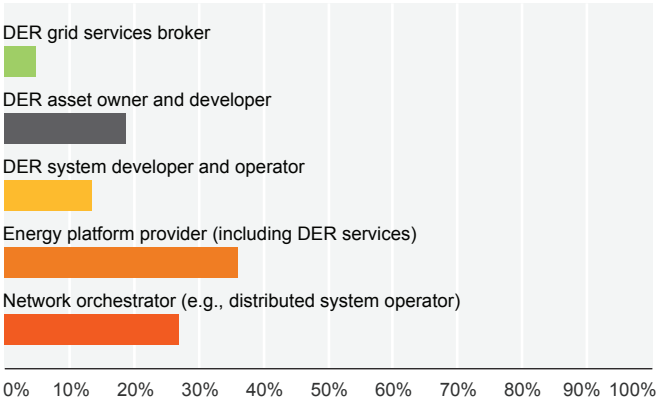
11. What business model should utilities pursue to harness the full value (financial, operational, or otherwise) of DER?

Business model innovation is an important focus for utilities in the face of DER trends (see question four). Increasingly, we see utilities advancing their thinking around business model innovation as they plan for a very different future with a customer-facing value chain, increasing competition around DER-related services, and data rising in importance as a commodity.[10] More than a third of respondents (thirty-six percent) see energy platform provider as the role to pursue, while just over a quarter (twenty-seven percent) think the utility should play the role of network orchestrator.

Whether connecting DER or developing, owning, and operating DER, we see more and more utilities embracing platform provider and orchestrator roles for their business.

This development is significant and aligns with the thinking that utilities must play a key role in fully leveraging the potential and capturing the value of DER by completely integrating these resources in long-term resource plans, midterm energy markets, and short-term grid management.

Navigant Research predicts that the current energy supply business—already transitioning to a service-based model—will be fully transformed into an energy service provider (ESP) model. Companies will offer end-to-end energy services that have little in common with today's volume-based approach to revenue generation. With these trends in mind, not surprisingly, just one in five respondents think utilities should remain an asset owner and developer.

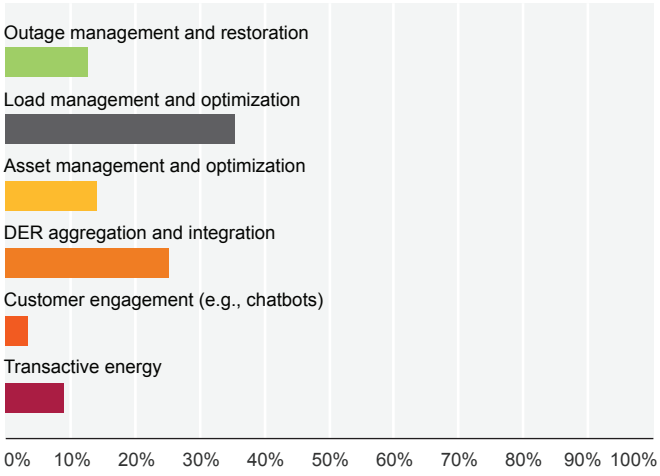


12. Which application for machine learning will have the greatest impact on the utility business over the next decade?

Machine learning is a subcategory of artificial intelligence (AI) that provides computers with the ability to learn without being explicitly programmed. Machine learning is increasingly seen as a critical component of utility digitization and automation efforts. Its potential applications are quickly growing in number across the utility industry.

Among the range of potential applications for machine learning within the utility business, more than one-third of respondents believe its greatest impact will be around load management and optimization (thirty-six percent). A quarter of respondents see DER aggregation and integration having the greatest impact. Navigant Research analysis aligns with these views, which show expanding utility investment in demand response management systems, DER management systems, and virtual power plants as key emerging trends.[11]

As these systems become increasingly sophisticated, these investments are likely to drive greater automation throughout grid operations and routine processes. For utilities concerned about aging infrastructure and optimizing existing assets, such breakthroughs may help extend the useful life of existing assets and mitigate replacement costs as utilities transition to a more distributed landscape.

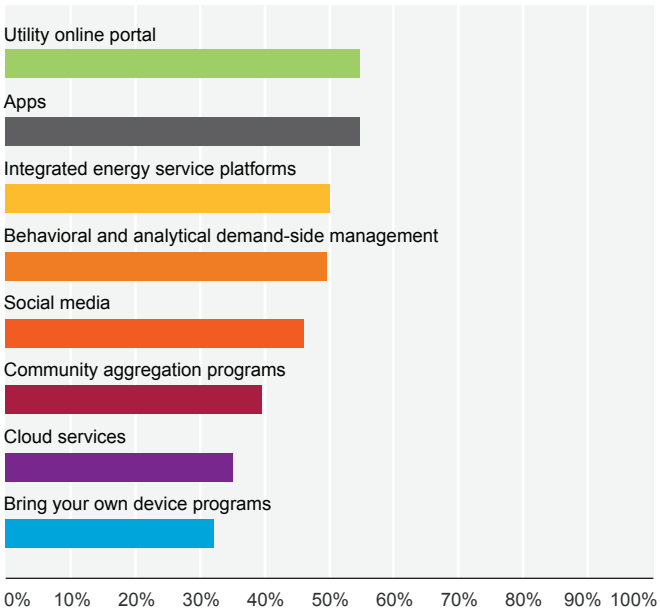


13. Which emerging customer engagement channels should utilities adopt to improve their relationship with customers from highest priority to lowest priority?

Customers want more choice and control beyond basic electricity service; utilities need customers to participate in demand-side management programs to reduce load and avoid the construction of new expensive centralized transmission and distribution infrastructure. As a result, customer engagement has fast emerged as a critical area of focus for utilities. However, no single strategy has emerged around how best to engage customers.

Underscoring this reality, very little consensus was reached among respondents when asked to rank which customer engagement channel utilities should adopt to improve their relationship with customers. Utility online portals, apps, and integrated energy service platforms each commanded the most instances of number one rankings. These results are consistent with responses from last year's survey, in which more than half of the respondents saw apps as the most likely customer engagement channel to be widely used to deliver value to customers from utilities by 2025. It is important to note that respondents were not asked to rank opportunities in last year's survey.

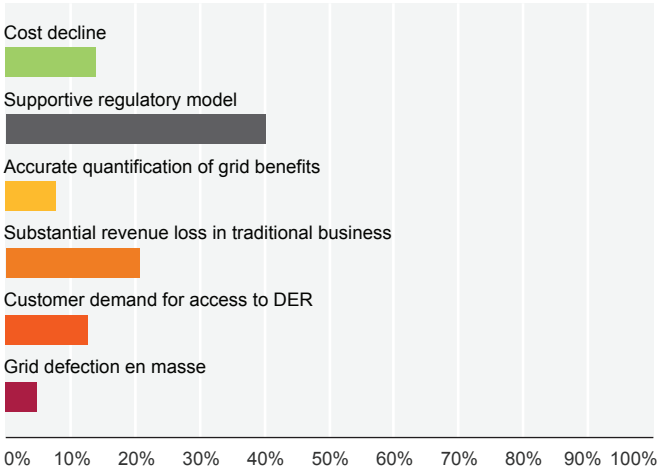
Community choice programs, cloud services, and bring your own device programs were most frequently ranked last. Interestingly, no consensus emerged around social media, which was ranked among the highest and lowest priorities in equal proportion. This bucks trends around customer engagement through social media observed throughout the broader economy.



14. What is the most important tipping point for utilities to aggressively pursue owning and operating DER?

Regulatory challenges remain a dominant theme amidst utility industry transformation. Four in ten respondents point to a supportive regulatory model as the most important tipping point for utilities to aggressively pursue owning and operating DER. This is consistent with findings in question one, in which one-third of respondents pointed to the existing regulatory model and rate structures as the most important legacy challenge facing utilities today. Nearly half of respondents to last year's survey felt that the existing regulatory model would remain a key legacy challenge for utilities by 2025, so it seems that progress is being made.

In this past year, many states have reviewed and, in some cases, revised regulation and rate structures to manage increasing levels of DER. While New York and California are early leaders, Arizona, Colorado, Massachusetts, Minnesota, and Vermont, among others, also incorporated market rules and mechanisms to support DER.



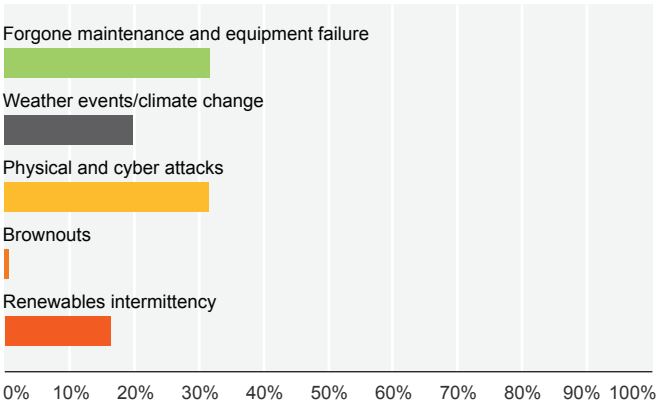
15. Which of the following represents the biggest risk to safe, reliable power?

Aging infrastructure and grid digitization are two of the most important trends shaping the utility industry today. Not surprisingly, nearly two out of every three respondents saw either forgone maintenance and equipment failure, as well as physical and cyber attacks, as two of the biggest risks to safe, reliable power.

Of these two risks, forgone maintenance and equipment failure is perhaps easier for utilities to address. Greater use of analytics to optimize asset performance and integration of DER offer some protections. Physical and cyber attacks present a much more pernicious threat due to the potential for impact across large regions and the open-ended nature of the threat.

In summary, the responses to this year's survey, compared to last year's, show an advancement in thinking around the trends and technologies that are impacting utilities. DER are making their mark, impacting load growth, and changing the physical and financial flows of the electric power system.

This is a slow transformation, but utilities are experimenting with new business models and going after non-traditional revenue streams that will continue to grow and possibly erode their traditional business. Some utilities have moved beyond experimentation and have dedicated organizations focused on the new energy business, aggressively playing offense. Others are in a more defensive, wait-and-see posture. Our recommendation to utilities is to play defense as well as offense, as focusing solely on defensive strategies will set an organization back with the risk of losing customer and shareholder value. ❍



1. *Distributed Energy Resources Global Forecast* (2015).
2. *Global Fuels Consumption* (2016).
3. *Navigating the Energy Transformation, Building a Competitive Advantage for Energy Cloud 2.0* (2016)
4. *Defining the Digital Future of Utilities* (2017).
5. *U.S. Energy Information Administration, Electric Generators Report* (2017).
6. *Distributed Solar PV* (2017).
7. *Wind World Market Update* (2017).
8. *Distributed Energy Resources Global Forecast* (2015).
9. *Navigating the Energy Transformation: Building a Competitive Advantage for Energy Cloud 2.0* (2016).
10. *Defining the Utility Digital Future* (2017).
11. *Demand Response Management Systems* (2016); *DER Management Systems* (2016); and *Virtual Power Plants* (2016).

Discussion About Electricity's Future

Steve Mitnick talks with Karin Corfee, Rob Wilhite, Ted Walker, Todd Williams, Mike Rutkowski, David O'Brien, Trina Horner, Kathleen Gaffney, Jay Paidipati, Mackinnon Lawrence, and Jan Vrins of Navigant.

PUF's Steve Mitnick: You have just one elevator ride alone with the chief executive of a major utility. What would you want to tell him or her?

Karin Corfee: The pace of the industry transformation—driven by changing policies and regulations, increasing customer choice, and technology innovation—is a threat, but also an opportunity for utilities.

Load growth is no longer a given, and long-term asset investments face greater risk. Customers are becoming prosumers, and new energy products and services are in demand. The future grid will be cleaner, more decentralized, and increasingly intelligent.

Picture a highly distributed, networked, and dynamic grid in which emerging technology-rich platforms, such as integrated DER (iDER), connected buildings, transportation-to-grid, smart cities, communications superhighway, IoT and transactive energy platforms, are managed by network orchestrators. At Navigant, we call this the Energy Cloud.

As utilities navigate the impacts of the emerging Energy Cloud, they must explore different strategic pathways to sustain growth in customer and shareholder value. Your organization must learn to test new platforms, business models, products, and services quickly. Agility and innovation will be key to survival. The future will demand a sprint just to maintain existing market share.

In Navigant's view of the 2030 energy landscape, the balance of power and revenue will shift to the edge of the grid:

- **Utility-scale and distributed renewables account for fifty to one hundred percent of generation.** DER uptake is widespread, accounting for most of the new build capacity.
- **Prosumers trade self-generated power on the open market.** Electricity is bought and sold at market rates through peer-to-peer transactions supported by blockchain and settlement processes.
- **The smart grid of 2017 has transitioned to a neural network of networks.** The new grid is nearly autonomous and self-healing, leveraging innovations in AI and cyber-physical systems (e.g., IoT, self-driving EVs, intelligent buildings, and smart communities).
- **The industry has undergone significant digital transformation.** Data analytics and AI-based algorithms have become important competitive

The future will demand a sprint just to maintain existing market share.

Karin Corfee is a managing director in Navigant's global Energy practice and the global lead for Customers, Markets, Products, & Services. She specializes in strategic planning, energy efficiency, renewable energy, distributed generation, and climate planning initiatives for utilities. With more than thirty years of industry experience, Karin has conducted numerous studies examining the impacts of DER on the grid. She helped develop the California Energy Efficiency Strategic Plan and the California Independent System Operator five-year strategic plan.

Robert Wilhite is a managing director in Navigant's global Energy practice. He directs business strategy and regulatory advisory services for utilities in North America, Europe, and the Middle East. As a frequent industry speaker and writer, Rob advises energy clients seeking new revenue growth and business expansion, as well as master planning for smart investments for countries, regions, and cities. He is coauthor of the book *Utility of the Future: Directions for Enhancing Sustainability, Reliability and Profitability*, and was recognized as one of the Top 25 Consultants in the US by Consulting Magazine in 2009 and as one of the Networked Grid 100 Movers and Shakers of the Smart Grid by Greentech Media in 2012.

differentiators. Data offers visibility into each prosumer's electricity exports and imports.

■ **Utility business models have transformed from supply-based to service- and platform-based.** Rather than focus purely on the delivery of grid-sourced power, ESPs orchestrate adjacent platforms, and offer individualized products and services to suit their customers' specific needs. These services will include DER sales, maintenance, and aggregation.

Customers sit at the heart of the Energy Cloud. A new market of DER, digital energy products, and services will develop, adding at least $1.3 trillion in new revenue opportunities globally in 2030 alone.

Are you exploring business models to develop new revenue streams? Have you embraced a customer-centric model? Are you building collaborative partnerships? Are you exploring bundled solutions and Energy Cloud platforms? Most importantly, do you have a strategic roadmap to address market transformation designed to capture long-term value?

PUF's Steve Mitnick: What will the utility of the future look like in 2030? How will it be different from today's utility? How will it provide value to its customers?

Rob Wilhite: The utility of the future in 2030 will no longer function as an electricity supplier or regulated service provider only. Nor is it likely to be called a utility at all. Operating in a dynamic and rapidly changing competitive environment, agility and adaptation to new technologies, distribution channels and partners, platforms, and business models will be core to the utility of the future's sustained success. Altogether, the successful utility of the future will operate

A new market of DER, digital energy products, and services will add at least $1.3 trillion in new revenue opportunities globally in 2030 alone.

in an environment that includes rapid technology change, dynamic business models, and a constantly evolving and ambiguous set of supplier, competitor, and partner relationships.

The utility of the future will include those utilities that embrace this transformation early and commit to innovation before disruptive business models capture significant market share. Greater emphasis will be placed on services, infrastructure optimization, and network orchestration versus commodity supply. This includes an ongoing focus on product diversification as well as customer intimacy. Ultimately, there is a transition from the regulator as the ultimate customer to one where the customer is the ultimate regulator.

One emerging utility of the future business model that parallels fast-growing, high-profit approaches in other industries (e.g., transportation, lodging, and entertainment, among others) leverages the concept of a platform service provider. In this role, the utility of the future orchestrates digitally networked assets, like distributed energy storage, EV charging stations, and community- and privately held solar PV systems, to provide highly responsive grid support services that maximize value for the end customer. This requires considerable innovation in areas such as real-time information processing and communications technologies, AI, and transactive energy systems. It will also require pricing strategies that reward innovation and customer value, in contrast to today's regulated model that depends on increased capital spending to achieve revenue growth. Accordingly, the utility of the future will have embraced a greater risk profile with strategic planning horizons measured in months or years, rather than decades.

PUF's Steve Mitnick: How does industry transformation – DER growth, digital transformation, etc. – threaten current utility organizational culture and management? How can utilities address these issues and prepare their organizations to thrive in an uncertain future?

Ted Walker: The utility operating model of today is focused around two predominant business models: 1) the asset owner/operator and 2) the service provider. With functional names like "asset management" and "transmission and distribution (T&D) operations," significantly sized asset owner and operator functions are focused on building infrastructure, keeping the lights on, and amortizing large capital expenditures over time horizons of thirty-plus years. Service provider functions like customer care and billing are also very large sub-organizations within the current utility model focused on the aggregation of energy demand and financials in the centralized energy delivery model.

Both operating models are under threat from nimbler, customer-centric, and more capital-efficient approaches that leverage DER and digitally enabled

Ted Walker is a managing director in Navigant's global Energy practice and a key leader in the areas of strategy, policy, and regulation. Ted uses his expertise to hone in on energy company growth opportunities and help clients thrive alongside the changing role of the utility in an evolving energy ecosystem. Throughout his career, Ted has worked across the utility value chain, with particular concentrations in energy retail, T&D, customer front and back-office, and shared services. He has significant experience working with medium and large electric and gas utilities to develop and plan strategies that extend beyond the business-as-usual mindset.

solutions. Many of the disruptors bringing these models to market are from outside the power industry, borrowing proven strategies that have succeeded in other highly regulated environments.

Emerging utility models are gaining traction in the industry.

- **Technology creators** bridge the gap across the operations and customer silos, often harnessing existing and newly available digital technologies combined with data to identify utility-side, customer-side, and joint opportunities. The technology creator moves the focus past the commodity to meet additional, broader customer needs beyond energy. The focus is on innovation as a core competency, adding value across the energy value chain by combining emerging technologies to unlock capabilities not yet available today.
- **The network orchestrator** business model leverages digital connectivity to deliver value through relationships (network capital) across a platform that participants use to interact or transact. Including high-growth ventures like Uber, Airbnb, and Spotify, these companies may sell products, build relationships, share advice, give reviews, collaborate, and more. While it has proven to be the most universally profitable and scalable business model, we have not seen network orchestrators at scale within the utilities industry.

Culture shift within utility organizations can greatly improve the chances of sustaining value through business model transition. Utility executives should consider the following:

- **Be intellectually curious**. For example, if you, as a utility executive, have not test-driven and charged a plug-in EV, then get behind the wheel. Understand the shifting demand patterns for vehicle charging infrastructure within your community and service territory.
- **Make innovation a holistic endeavor across your organization's mission, values, and culture**. It is safer to innovate than to preserve the status quo.
- **Be collaborative.** New business models will require breaking down silos across your organization and the vendor ecosystem (e.g., crowd-sourcing innovation within the organization and technology platforms with industry partners).
- **Embrace and own the transition to the Energy Cloud**. Articulate a vision for the future and don't be afraid if the path forward involves cannibalizing the existing business.

PUF's Steve Mitnick: What lessons can be learned from European utilities with respect to transitioning utility business models in a time of industry change?

Todd Williams: European utilities and energy companies have made significant moves to position themselves for what Europe calls the energy transition. For example, RWE split off its renewable, network, and retail businesses into innogy. E.ON made a similar move, but spun off its traditional generation business into what is now called Uniper. ENGIE is investing heavily in its new energy business and has recently acquired EV-Box, a Netherlands-based EV charging infrastructure provider, and ninety-five percent of Solairedirect, a solar PV developer and owner. National Grid, Centrica, and EDF Energy are making significant investments in new energy businesses and DER in a search for growth to replace lost revenue in traditional businesses. In terms of innovation and business model evolution, the European utilities are several years ahead of most of their North American counterparts.

European utilities are seeking to build highly integrated and digital energy platforms and service offerings. The most significant strategic acquisitions have focused on DER technology providers across the energy storage, solar PV, energy management, combined heat and power, and EV charging infrastructure markets. Each acquisition represents a single brick in the diversified portfolio of businesses utilities across the region are building. As evidence, joint offerings combining multiple assets—such as E.ON Solar and Storage, which targets the UK residential sector—are increasing in frequency.

What's generally absent from emerging business models among European utilities is the long-term vision, operating model, processes, and software (or

Todd Williams is a managing director in Navigant's global Energy practice and the utilities and energy company lead for Europe and the Middle East. For more than two decades, Todd has served as a trusted strategic advisor to utilities, ESPs, and generation developers in developing innovative business models and launching new businesses to take advantage of emerging energy technologies and transformative market changes. He has also advised governments and regulators on effective policies and regulations to reflect market and technology changes. In addition, Todd has served as an expert witness on generation valuation and various regulatory matters.

Michael Rutkowski is a managing director in Navigant's global Energy practice, providing expertise in emerging technologies and business strategy. Mike has over twenty-five years of experience in the energy industry, with significant knowledge in the areas of strategy development, business planning, asset management, and operational performance improvement for the power generation and electric/gas utility sectors. Also a registered Professional Engineer, Mike's work links corporate and business unit strategy to operational plant floor considerations, providing sound operational improvement and investment decision-making support to his clients.

As energy becomes increasingly democratized, utility incumbents and new market entrants will need to personalize products and services much more so than today.

connective tissue) for integrating increasingly diverse assets into dynamic Energy Cloud platforms. This would enable capabilities such as dispatching connected resources as virtual power plants (VPPs) or as transactive energy arrangements within communities and peer platforms.

Going forward, European and North American utilities alike will need to focus on building a shared mission and agile culture across a portfolio of acquired capabilities. They will need to do so by leveraging integrated operating models, processes, and emerging communications and networking technologies. These capabilities will help utilities integrate and optimally dispatch highly distributed and diverse platforms to maximize value among stakeholders.

PUF's Steve Mitnick: It is argued that we're living in a time of exponential technology innovation. What immediate changes can utilities make to embrace technology innovation more proactively and position their business to fully realize the potential disruptions to the status quo?

Mike Rutkowski: Contrary to general belief, utilities have innovated significantly over the years to prepare themselves to manage emerging challenges, and we are seeing some great examples of this. But while they realize they need to look for ways to create additional value for their customers, the stakes in their traditional businesses are high. Navigant recommends utilities sharpen their strategic planning around four priority areas to embrace innovation more fully across their organizations:

- **Technology profiling**. Establish the capability to quickly understand the potential impacts of technology innovations on the ability to deliver customer value, and proactively take steps to deliver that value to customers.
- **Infrastructure planning**. Make informed judgments around how much and how soon customers will adopt each emerging technology (e.g., solar PV, storage, EVs, etc.). This will provide the utility with a basis to understand how to invest in technical infrastructure.
- **Operations**. Evolve operations to deliver maximum value to utility customers. For example, as energy becomes increasingly democratized, utility incumbents and new market entrants will need to personalize products and services much more so than today.
- **Customer engagement**. Understand the customer experience though journey mapping as well as sophisticated modeling techniques to translate the customer needs into new products and services and distribution system requirements.

Utilities must reconsider traditional roles and business models in terms of delivering customer value. In many cases, utilities are uniquely situated to deliver the technology to the customer in the most valuable way. And in other cases, utilities may need to make innovative technology investments in distribution systems so that other market participants (customers and third parties) can deliver and extract maximum value.

PUF's Steve Mitnick: What will the role of the regulator be in 2030, especially in establishing and monitoring the grid platform to accommodate more dynamic and networked energy systems? What legacy assumptions should regulators reconsider?

David O'Brien: Utility regulation can best be described today as an analog system trying to serve a digital world. This framework is ill-equipped for the scale of transformation taking place and the realities of technology innovation coming down the pike. We are entering the era of the Energy Cloud in which the distribution utility will operate as an enabling platform. Its role will be more of a facilitator of diverse business models and resource interconnections than a volume purveyor of electrons.

To adapt and deliver on ambitious public policy goals and customer demand, regulation will need to evolve rapidly. As one example, traditional verification (and often litigation) of prudent spending and operations based on an assessment of inputs in administrative rate cases needs to pivot more to a market monitor role informed by dashboard indicators measuring utility outcomes. Along these lines, increasingly, we see performance based regulation (PBR 2.0) emerging. PBR 2.0 is composed of flexible plans that allow clear line of sight to value for customers and ongoing performance evaluation based on metrics tied to policy and customer objectives.

David O'Brien is a director specializing in strategy and operations within Navigant's global Energy practice. He advises clients on how to prepare for and optimize the transformative change taking place in the energy industry. David helps clients examine the changing physical and financial domains of the distribution grid and consider the business models and regulatory frameworks that will sustain their business. He is an industry thought leader with numerous published articles that focus on opportunities to leverage grid modernization capabilities and advance policy goals to meet the increasing expectations of customers and foster an emerging twenty-first century energy marketplace.

Relevant examples are under way in the United Kingdom with the RIIO (Revenue = Incentives + Innovation + Outputs) framework and in New York under REV (Reforming the Energy Vision). In both cases, regulators are collaborating around the formation of grid development plans engineered to deliver a dynamic market ecosystem. These frameworks introduce new metrics to monitor results and drive iterative improvements. One might characterize these efforts as monopoly regulation with a market overlay.

PUF's Steve Mitnick: Utilities and utility regulators have a reasonable concern that current trends could change in the next five or ten years, rendering some new initiatives and investments imprudent. What is the range of near-term (one to five years) steps states and regulators should take to embrace industry transformation? How should utilities and regulators think about these risks?

Trina Horner: The pace of transformation is misaligned along the power industry value chain, which impedes the ability of utilities to keep pace with emerging technologies and their impacts across the rate base:

- Technology innovation is accelerating and leading to a **sprint** in the value chain, which increases the likelihood of disruption from more nimble players.
- Operational models are adapting and will **jog** along while risk is evaluated.
- Regulatory and ratemaking models are **walking** and must play catch up immediately to deliver maximum customer value.

A collaborative utility/regulator approach that provides a clear line of sight into the needs, costs, and benefits of new technology investments is crucial for managing industry transformation risk. This collaborative conversation does not begin with technologies; rather, it starts with a clear understanding of the value to customers, the utility's role, and the regulator's objectives. Next, there must be a robust functionality and need assessment. Finally, it ends with specific and proactive technology decisions.

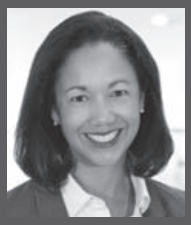
Market innovation is occurring so rapidly that states and regulators must focus less on individual, one-off technologies. Instead, states and regulators should focus on the operational and financial implications of emerging Energy Cloud platforms and the roles they want utilities to play in this landscape. Are utilities investment vehicles? Traditional service providers? Technology innovators? Network orchestrators? Finally, and most importantly, what kinds of regulatory structures need to be established to enable success in those roles?

By identifying expectations up front for the utility's role, states establish appropriate incentives and accountability for utilities. For their part, utilities must critically examine the functionality of new investments and initiatives in the context of individual system needs. What technologies can be leveraged to provide multiple system benefits? What operational competencies are they lacking that pose a risk to realizing investment benefits? And what levels of risk are they prepared to take for non-traditional investments?

PUF's Steve Mitnick: What does the future relationship between utilities and customers look like? What engagement tools will have the greatest impact?

Kathleen Gaffney: As the value shifts to the edge of the grid and beyond the meter, customer engagement is fast becoming one of the most critical aspects of grid transformation within the Energy Cloud. Customers want more control and choice beyond basic electricity service; utilities need customers to participate in demand-side management programs to reduce load and avoid the construction of new infrastructure. In other words, utilities must meet an exponentially growing set of customer choices and changing demand while continuing to serve their core customer base.

As customer engagement has become a more proactive process for utilities, more innovative solutions are appearing across multiple channels and for multiple purposes. The use of mobile apps, social



Trina Horner is a director in Navigant's global Energy practice. As a former regulator and business leader for both municipal and investor-owned utilities, she brings broad experience navigating regulatory, strategic, governance, and policy challenges in today's changing energy environment. Her work encompasses revenue requirement, rate design, cost of service and rate case development, as well as strategic assessment of regulatory, operational, and policy initiatives. Trina has cultivated credibility across a diverse spectrum of energy industry stakeholders for her understanding of these issues, as well as her ability to drive effective solutions for them.

Kathleen Gaffney is a managing director in Navigant's global Energy practice. With more than two decades of experience in managing large-scale, multiyear engagements and overseeing the work of large interdisciplinary research teams, Kathleen plays an integral role in advising energy clients on demand-side policies, markets, and programs. Her work centers on directing targeted market research that incorporates robust data analytics, customer segmentation, and behavior modeling to help clients better understand evolving customer expectations and strengthen their competitive position in a rapidly changing environment.

media, and other communication channels are important prerequisites to a more dynamic exchange between utilities and their customers. Greater attention to two-way engagement will be needed, such as increased data sharing and improved opportunities for customer interaction directly with the utility.

Utility customer engagement solutions likely to have the greatest impact in the market are those that demonstrate the following best practices:

- They personalize engagement to go beyond a better customer experience, such as providing user-specific information that drives willingness to engage.
- They are targeted to find the right customer to engage at the desired level of participation, technology capability, and commitment.
- They are interactive, self-service oriented, and accessible anytime, anywhere.
- They package or bundle services. For example, the utility acts as a gateway, optimizer, or orchestrator for a variety of services and technologies.

PUF's Steve Mitnick: How would you reconcile the following arguments: 'utilities should become leaders in DER at every scale' and 'utilities should stay out of DER to foster greater competition'?

Jay Paidipati: We advise utilities to be flexible. The environment in which utilities operate will differ from one service territory to the next—whether differing policy and regulatory regimes, existing resource portfolios, rates and rate structures, or varied customer demographics. While there is no one-size-fits-all blueprint, there are several leading roles utilities can play with respect to DER:

- **Universal DER access.** Currently DER program dollars mostly benefit higher-income customers. At the same time, most DER vendors target higher-income customers due to their access to financing and availability of discretionary funds. To reach a high penetration of DER, this is not a sustainable reality. Regulators, ratepayer advocates, and customers will not accept this market imbalance. Utilities have an opportunity to take a lead role in developing programs that cater to lower- and middle-income customers, enabling them to maintain or even broaden and diversify their rate base. Such models in the energy efficiency space are common in the United States. By doing so, utilities can directly support expansion of DER while fulfilling a market need where there is likely to be little to no direct competition.
- **DER market optimizer.** In places where utilities cannot develop or own DER projects, they can still lead in signaling where DER is needed to maximize locational benefits. This benefits all ratepayers. For example, typically, only utilities have access to feeder-level information that can be used to find where DER can provide the most value. If aggregated, this data can provide both a public good (i.e., increasing access to DER across the utility's territory) and potentially evolve into a new revenue opportunity for the utility (i.e., sale of data). To foster competition, utilities could provide this data openly, thus stimulating investment in innovative new products and services across their territory. This last point, however, should be approached with caution as it could cannibalize or obviate the need for the utility's core business.
- **DER system operator.** In areas where the utility controls dispatch and optimization of generation, utilities can play a similar role for controlling and optimizing DER to provide the most value to the grid. Taking the above example into account, utilities are uniquely positioned to leverage feeder-level data to harness the full potential value of DER.

All in all, utilities are in the best position to enable DER innovation and investment.

Jay Paidipati is a director specializing in emerging technologies and business strategy in Navigant's global Energy practice. His work is focused on helping Navigant's clients manage and make decisions regarding emerging energy technologies, including DER. He has worked with utilities and federal, state, and local governments, as well as manufacturers and investors. In response to client needs, Jay has developed and delivered technology evaluation and screening services, cost studies, market penetration analysis, employment impact studies, cost and benefit studies, technology due diligence, and program evaluation.

Mackinnon Lawrence is a senior research director, leading Navigant Research's syndicated products and content management across the group's portfolio. With more than a decade of experience as an analyst and attorney serving the international energy sector, he has played a lead role in guiding the Energy practice's global research agenda. His work has focused on the Energy Cloud and emerging technologies that are transforming the power grid. He is a frequent speaker at industry events and is often quoted in major media outlets including *The New York Times*, *Forbes*, and *Scientific American*.

PUF's Steve Mitnick: It's 2030. Which of today's disruptive technologies will have the greatest impact on the traditional utility business model?

Mackinnon Lawrence: By 2030, we expect to see a combination of successive technology and communications innovations enabling greater concentration of value across the edge of the grid. Deployed with physical assets like DER across Energy Cloud platforms, these technology combinations will breach outdated regulatory models within the decade while unlocking new distributed, transactional structures and relationships.

As these examples show, technologies capitalizing on the twin forces of digitization and democratization will have the most disruptive impact on traditional utility business models. The proliferation of VPPs illustrate that when multiple digital innovations, such as distributed sensors, communications, distributed computing, machine learning, distributed generation, and advanced networking are combined into a networked system, they become a viable alternative to centralized power generation and delivery.

In the near term, these closed VPP networks will give rise to larger IoT networks operated or enabled by human or machine-based network orchestrators, especially in more progressive utility jurisdictions. The next major shift will be when these closed systems move to a completely open, AI-powered transactive network not limited by geography or a single commodity (e.g., electricity). This is the tipping point where we could see the role of traditional utility business rapidly diminish.

The power industry is somewhat unique in that it is one of the few industries today that has yet to undergo a widespread digital transformation. Other industries are much further along in the process—media, telecom, and consumer finance—and many incumbent players bear the scars from disruptive business models that have upended traditional value exchanges. As these examples have shown, two factors are typically present when technology disruption takes hold. First, low barriers to entry lead to more agile competition able to exploit inefficiencies. Secondly, large legacy business models often generate most of their revenue and impede their ability to pursue new opportunities. For utilities, their legacy business remains a major vulnerability. At the same time, a heavy reliance on expensive infrastructure and tangible assets with long amortization schedules have partially insulated them from less capitalized upstarts. This is shifting rapidly.

Jan Vrins is a managing director and Navigant's global Energy practice leader. He advises utility executives on developing strategies for ensuring long-term operational and financial success in a rapidly changing landscape. Jan developed the Utility of the Future Framework to help clients understand how the trends in the market and evolving business models can improve commercial and operational performance. His utilities industry experience includes investor- and government-owned utilities in North America, Europe, and Latin America. Jan has authored various publications and presented at leading industry conferences. With extensive consulting experience (twenty-five-plus years) in the energy sector and a history of growing businesses in diverse international markets, Jan is a global leader in today's energy consulting industry.

PUF's Steve Mitnick: What are the existential opportunities and threats confronting utilities, if any? What does Navigant see as some of the initial steps in preparing for energy transformation? What are clients' major blind spots in strategic planning?

Jan Vrins: As the power industry transformation increasingly goes the way of clean, digital, and distributed, the disruption facing the industry will proliferate and become increasingly complex. DER technologies are the focus of planning today, but their value and impact will expand exponentially when paired with connectivity, data analytics, and machine learning. Rate-basing investments in centralized assets will increasingly give way to a portfolio of investments in mass-produced technologies with ever-shorter lifecycles. Scale will be achieved (or maintained) through aggregation and hedging of risk.

Utilities must begin rethinking many of the time horizons and approaches that have anchored strategic planning in the past. Long-term integrated resource plans and five-year strategic plans are not sufficient; an Energy Cloud playbook is needed. In this playbook, utilities play both defense and offense.

An updated defensive strategy entails:

- Engaging with customers and regulators to understand customer choices vis-à-vis price and reliability.
- Continuing to upgrade the grid and redesign operations to be more flexible and facilitate the integration of DER.
- Finding equitable ways to charge DER customers for T&D services ("the value of the grid").
- Developing utility-owned renewable and DER assets to appeal to environmentally conscious customers, as well as prosumer customers, while also diversifying the asset base.

Decide in which Energy Cloud technology platforms you want to play: iDER, connected buildings, transportation-to-grid, smart cities, energy communications superhighway, IoT, and transactive energy.

Playing offense is even more important. Utilities must:

- Decide in which Energy Cloud technology platforms they want to play: iDER, connected buildings, transportation-to-grid, smart cities, energy communications superhighway, IoT, and transactive energy.
- Create new revenue streams through the development of new business models, products, and services.
- Implement a holistic approach to planning that accounts for both current and future interdependence across technology, regulation, policy, economics, and customer demands.

The starting point is a holistic, but agile planning process that seeks to outmaneuver disruption. Utilities must:

- **Sponsor** a cross-functional team across their organization that will spearhead a strategy with a view toward a robust, integrated Energy Cloud plan. What barriers maintain silos across your organization? What cultural predispositions are prevalent across your organization?
- **Assess** how the Energy Cloud is evolving across markets in which the utility operates or has targeted for expansion. What are the forecasted penetration levels of DER? Are customers inclined to invest in smart behind-the-meter solutions or do they prefer the status quo?
- **Identify** inefficiencies in the current value chains and business models. Where does your organization have a competitive advantage? Where are you most vulnerable to more efficient and cost-competitive solutions?
- **Develop** more efficient and cost-effective solutions. How can you further drive efficiency in your core business where service levels are aligned with customer needs? What investments are needed to pursue Energy Cloud platforms with new tools and capabilities?
- **Innovate** relentlessly across the organization. How can you test new business models and revenue, margin, and risk profiles? What can you improve in the next iteration? ❍

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