Distributed Energy Management: The New Era of Demand Response

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Distributed Energy Management: The New Era of Demand Response

With rapid integration of renewables and distributed technologies onto the grid, utilities are increasingly upgrading their existing systems to address the challenges of maintaining power quality, balancing supply and demand in real time, and ensuring adequate distribution infrastructure capacity.

New technologies exist today which can address these challenges, allowing for decision making and load balancing at the grid edge. With the evolution of distributed intelligence and adequate processing power, the opportunity to solve key challenges exists with demand-side resources. These advancements will accelerate the growth and deployment of distributed energy resources (DERs) and demand response enablement.

The proliferation of DER's on the grid offers utilities a transformational opportunity to adopt clean, sustainable, de-centralized, and carbon reducing energy, where consumers can be generators and become vital partners in the future of the electric utility. To gain a better understanding of what utilities think about a holistic distributed energy management strategy, the role grid-edge computing and devices play, as well as what challenges they face and benefits they expect, Itron and Zpryme conducted a survey to electric utilities across North America.

Key Findings:

- 94% of utilities consider the conjunction of demand response and renewable generation a priority in the next 1 to 3 years
- 68% of utilities expect DERs to significantly impact their operations within the next 5 years
- AMI meters, line sensors, and smart thermostats are the most critical devices for utilities managing DERs

As part of our research, Zpryme surveyed over 170 utilities primarily across North America—with some international participation—to understand what distributed energy management means to them.

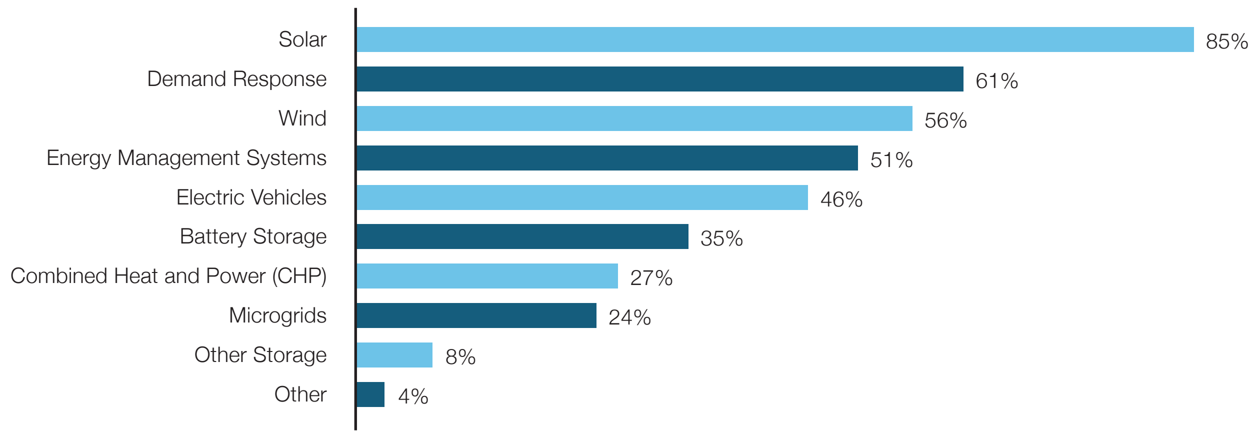
Here are the demographics of our respondents:

- **Utility type:** IOUs (40%), municipal (27%), cooperative (22%), and district/federal (5%)
- **Services:** Electric (95%), gas (33%), water (19%), wastewater (9%), and solid waste (2%)
- **Regions:** Northwest (27%), midwest (25%), southeast (24%), northeast (16%), southwest (12%), and international (16%)
- **Revenue in USD:** Over $1B (42%), $500M to $1B (6%), $100M to $500M (27%), and below $100M (25%)

The Demand Response Evolution

Demand response is a critical DER, and its interaction with other DERs—such as renewable generation, electric vehicles and energy storage—is giving utilities the opportunity to rethink their demand response strategies. To understand how utilities can evolve demand response, it is important to review which DERs already exist in utilities' service territories and their relationships with demand response.

FIGURE 1:
DERs currently used in service territories



Utilities already work with a large mix of DERs in their service territories. Over half of our respondents have solar, demand response, wind, and energy management systems impacting energy supply and demand. **(Figure 1)**

How important is demand response relative to these other DERs, and how do utilities expect that importance to change in the next few years? Figure 2 shows 76% of utilities consider demand response at least a moderate priority for their organizations relative to other DERs—with 36% reporting it as a high priority. Furthermore, 83% expect that importance to increase over the next 1 to 3 years. **(Figure 3)**

Demand response is a priority for utilities, but demand response used in conjunction with other DERs is also important. Overall, utilities say that demand response used in conjunction with renewable generation, for example, is a priority. **(Figure 4)** DERs are interdependent, and the interaction among them is important for utilities. What does this interdependency mean for demand response strategies? For utilities, 59% of them expect their demand response strategies to change in the next 1 to 3 years. **(Figure 5)**

76%

OF UTILITIES CONSIDER DEMAND RESPONSE AT LEAST A MODERATE PRIORITY

FIGURE 2:
Importance of demand response to compared to other DERs

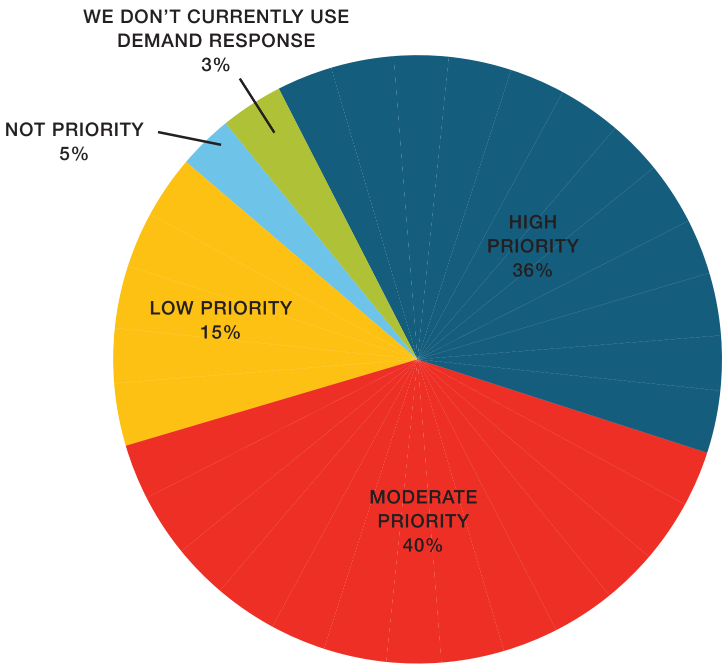


FIGURE 3:
Growth in importance of demand response and DERs over next 1 - 3 years

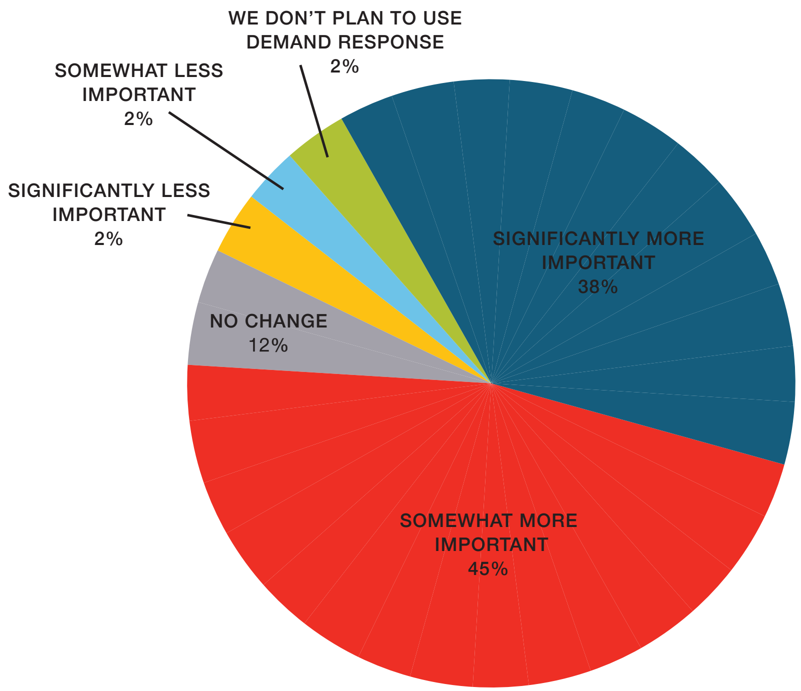


FIGURE 4:
Importance of demand response to compared to other DERs

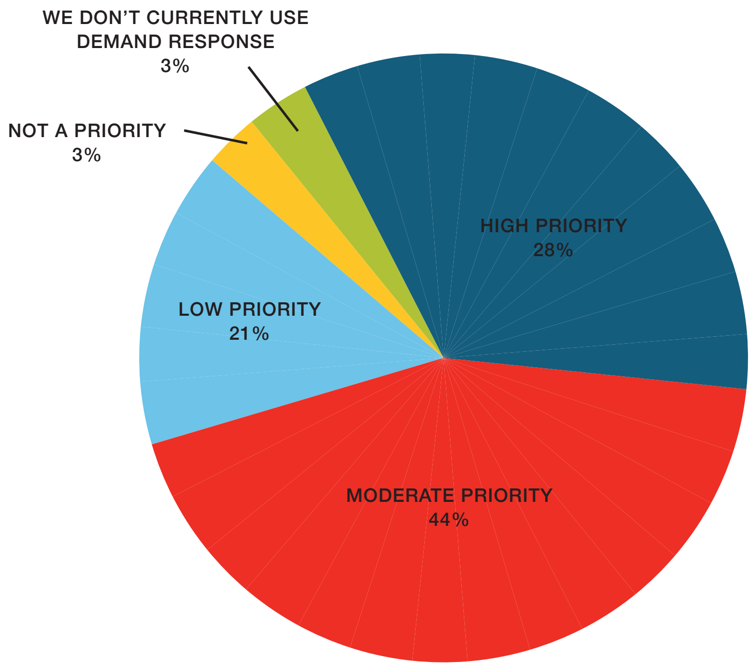
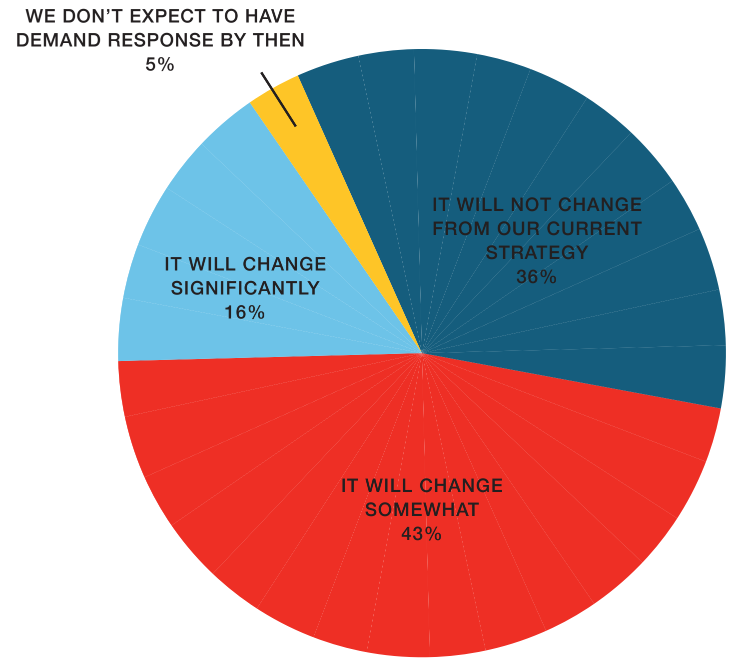


FIGURE 5:
Change in demand response strategy in next 1 to 3 years



Accelerating DER Deployment

Given the increased proliferation of DERs on the electric grid, the big question is: How much will DERs impact utility operations?

Over two-thirds of utilities expect DERs to impact their operations within the next 5 years. **(Figure 6)** Transmission and distributions operations, and planning will receive the brunt of the impact, but utilities also expect DERs to impact customer service. Examples of customer service impacts could include increased customer expectations and demands as customer-owned DERs continue to interact more with utilities' systems, or the need for upgrading customer service software and systems to handle new types of customer data and interactions. **(Figures 7 and 8)**

DERs offer significant opportunities for utilities to transform their operations, but maintaining power quality, balancing supply and demand in real time, and ensuring adequate distribution infrastructure capacity with their legacy systems are all operational challenges that come along with DERs.

FIGURE 6:
Expected time frame for significant impact of DERs on operations

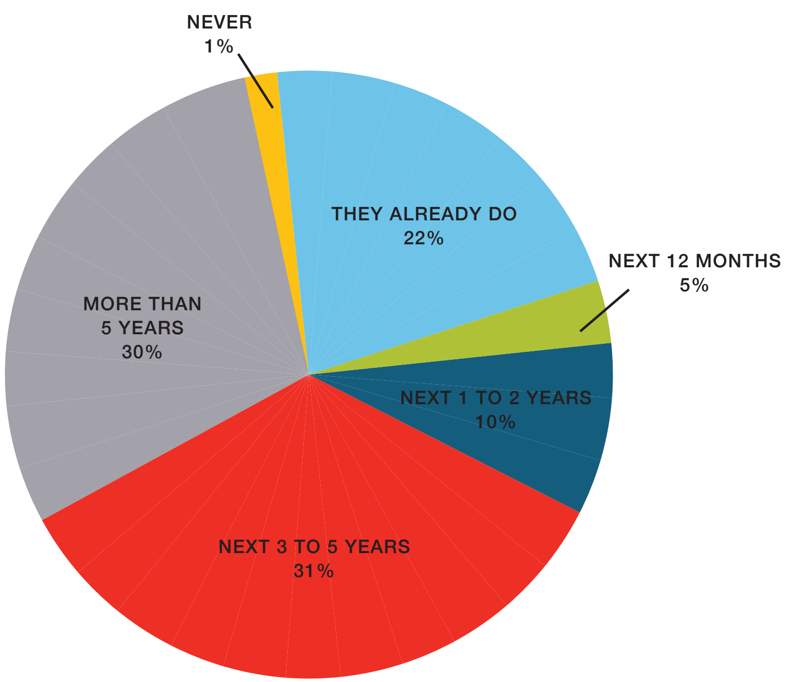


FIGURE 7:
Expected operational area first impacted by DERs

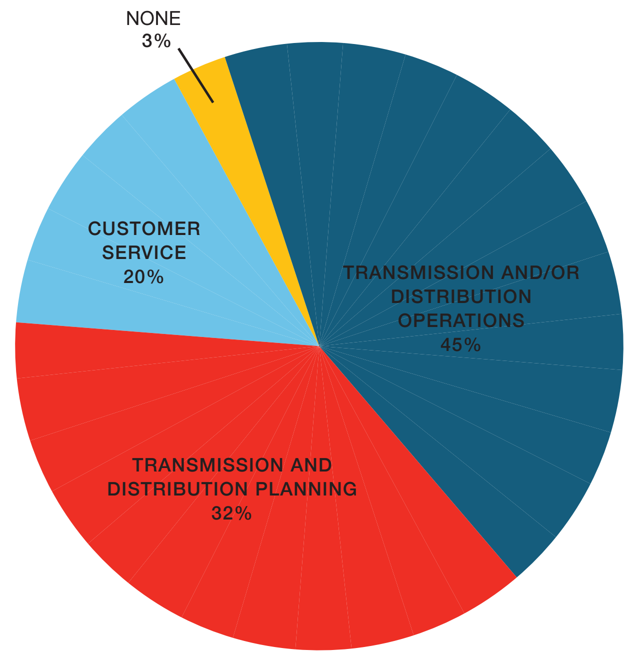
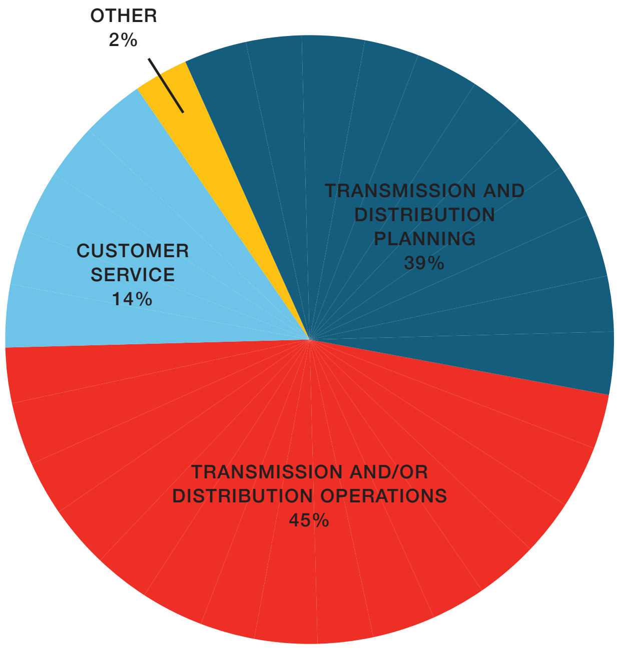
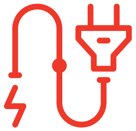


FIGURE 8:
Expected operational area most impacted by DERs in next 1 to 3 years



Some utilities are already facing these challenges, but others have yet to experience significant impacts. Half of utilities haven't seen an impact from DERs on power quality and reliability today, but they are already looking at how to address these challenges and embrace DERs. **(Figure 9)** They see distributed intelligence and computing power at the grid edge as a critical component to effectively manage DERs. **(Figure 10)**

Distributed intelligence is not only critical for managing DERs, but also enables utilities to deliver a host of new outcomes that traditional demand management could not provide. For example, imagine a local network of meters in an area with high electric vehicle (EV) penetration detects a potential overload on a transformer. With distributed intelligence, the network of meters can automatically modulate EV charging and issue the appropriate commands to local smart chargers at the grid's edge.



Furthermore, just over half of utilities believe they have good insight as to these assets' locations (51%). (Figure 11) The other half struggle to gain insight into where DERs are located in their territories, which is a crucial component of managing DERs. It's not enough to know DERs simply exist in a territory. Utilities also need to know where these resources are located on the grid to understand their true impact.

FIGURE 9:
The negative impact of DERs on power quality and reliability today

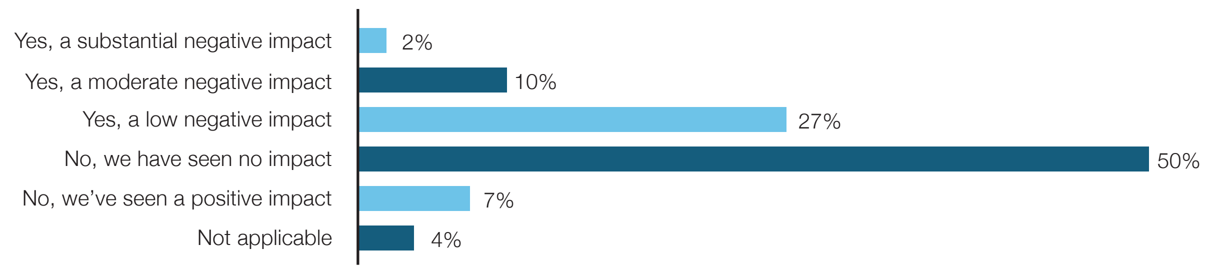
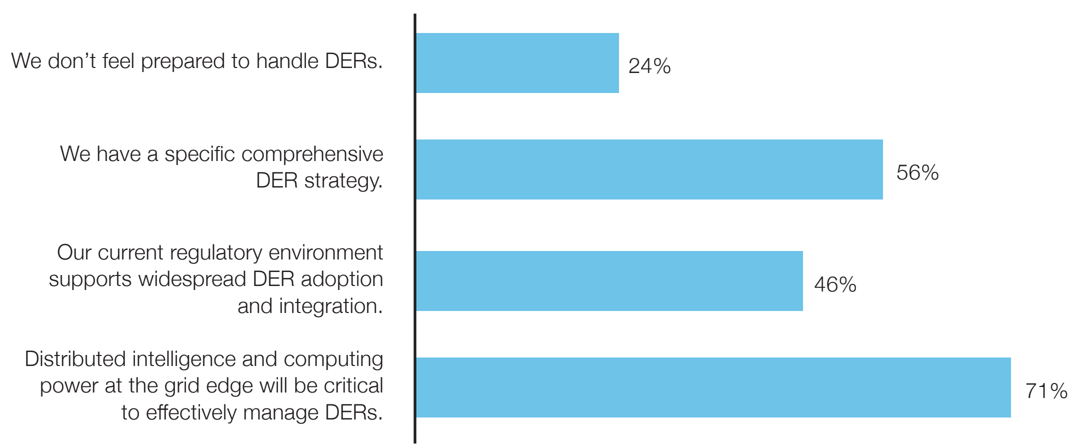


FIGURE 10:
Agreement on DER strategies (% of respondents who agree with each statement)



Leveraging "Edgy" Devices

Utilities expect to see the impacts of DERs in the next few years, and are planning now to address these issues. A holistic distributed energy management strategy involves the marriage of grid-edge computing and devices to address the successful integration of demand response, renewable generation, and other DER technologies. The EV charging example in the previous section is just one example of this marriage. Now, we will dive deeper into the devices critical for distributed energy management.

Which edge devices are critical components of a distributed energy management strategy? AMI meters, line sensors, and smart thermostats are the top three critical devices for managing the impacts of DERs. **(Figure 12)** Many utilities already use these technologies in their territories, but to fully leverage them for DERs, utilities need a distributed intelligence platform with grid-edge computing. First and foremost, utilities need AMI meters to have grid-edge computing capabilities. **(Figure 13)**

FIGURE 11:
Locational insight of DERs in service territories

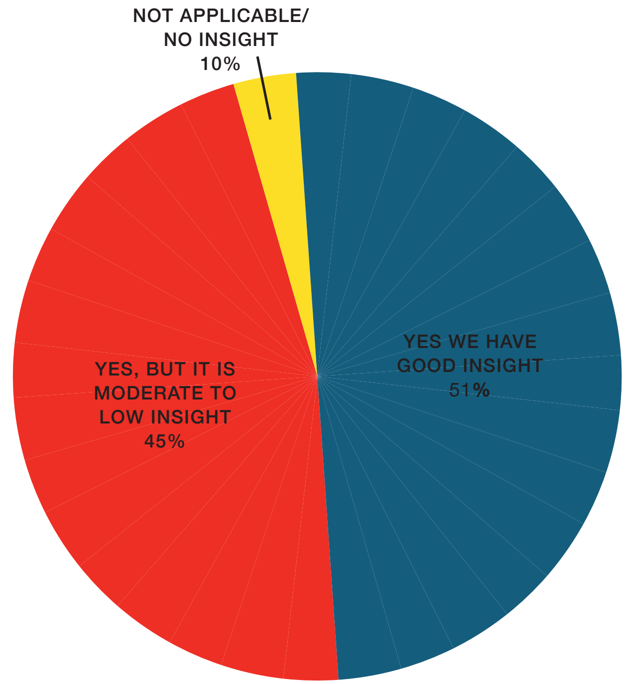
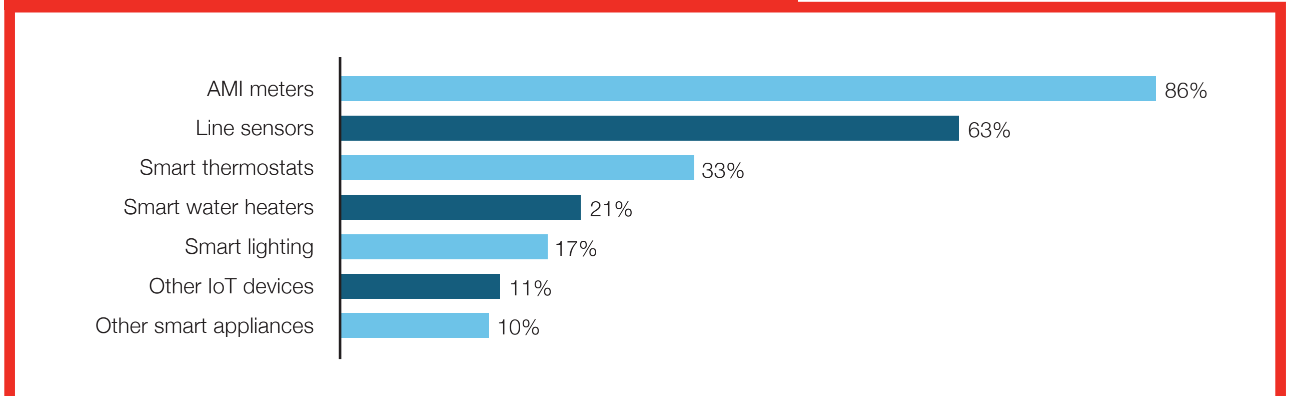


FIGURE 12:
The negative impact of DERs on power quality and reliability today



Even with this importance, utilities can't implement grid-edge computing capabilities into the devices listed in Figure 12 without demonstrating business ROI and securing the required budget. **(Figure 14)** Some regulatory environments remain difficult for utilities to navigate, and security continues to be another significant concern for devices on the grid edge.

Technology providers can work together with utilities to create cost-effective solutions that provide the ROI utilities need to make a business case for distributed energy management. For example, imagine real-time insights on a household's total load analyzed in conjunction with local price conditions. Then, an automated home energy management system uses this data to maximize the customer's participation in time-varying rates to achieve substantial savings on their energy bill. These types of solutions leverage vendors' technology expertise and utilities' grid management expertise to create a holistic approach of DER management using distributed intelligence.

FIGURE 13:
Devices requiring grid-edge computing to support DERs

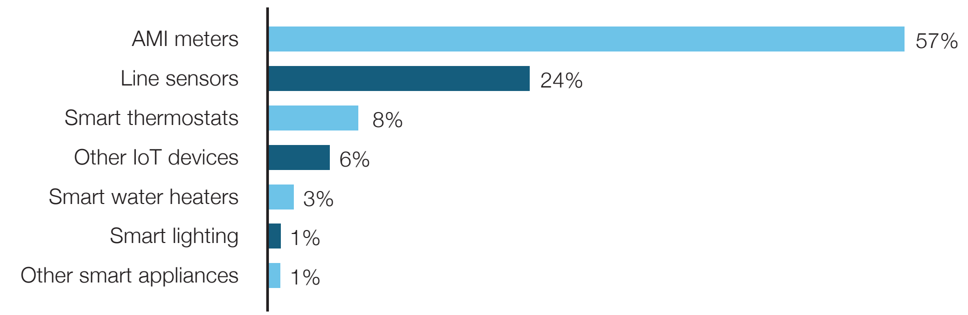
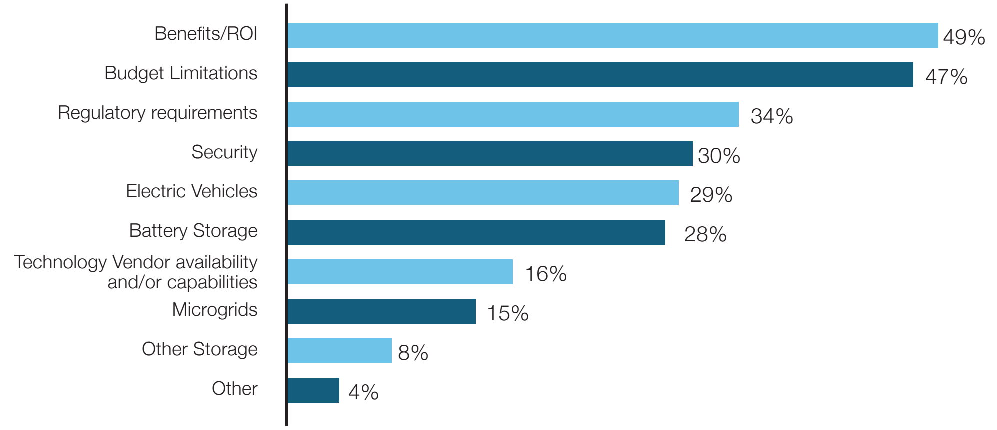


FIGURE 14:
Top challenges implementing grid-edge computing capabilities



Planning with Partners

Together, we're all moving into a future of renewables and distributed intelligence—utilities, technology providers, regulators, and customers. DERs continue to pop up on the grid, and utilities have the task of balancing this supply and demand in real-time. Demand response must adjust to these changes and work in conjunction with other DERs if utilities want to streamline operational efficiencies and create new revenue streams. What are some steps utilities can take to begin creating an effective distributed energy management strategy?

Our recommendations include:

- **Plan now.**
  Some utilities already face challenges with DERs, but varying regulatory environments have kept DERs from drastically impacting all utilities. However, renewable generation will continue to earn greater acceptance and grow. Now is the time for utilities to start planning for more renewable generation and other DERs. These strategies should include plans that don't just account for, but truly integrate the billions of devices that will build the future distributed energy platform—including line sensors, smart thermostats, and other IoT devices.

- **Don't plan in organizational silos.**
  As all aspects of the current utility business models continue to be challenged, utilities must completely rethink their energy supply chain. A linear approach to power delivery is no longer a viable solution. Many utilities have traditionally approached areas such as demand response, energy efficiency, and renewable generation as largely separate endeavors and programs. Utilities should consider how to better integrate these areas as they can all work together to deliver more effective distributed energy management platforms. It is also important to consider how these programs and services impact organizations across their business units, including customer service, IT, and transmission and distribution.

- **Leverage technology expertise.**
  Utilities' core competency is the delivery of critical services to communities, but not necessarily technology development. As the complexity of technologies grows, utilities should look to technology partners for expertise to create cost-effective solutions for today's increasingly digitalized and distributed grid.