

# POWER SURGE AHEAD

HOW DISTRIBUTION  
UTILITIES CAN GET SMART  
WITH DISTRIBUTED  
GENERATION



## **Distributed generation is playing an increasingly important role in energy systems across the world, driven by the sustainability agenda, energy independence concerns and increasingly favorable economics.**

There is overwhelming evidence that this trend will continue. We are seeing consumers showing growing interest in installing renewable generation—notably solar photovoltaic (PV)—in many markets around the world. Accenture’s New Energy Consumer research<sup>1</sup> shows that, globally, 45 percent of consumers plan to sign up for rooftop solar panels in the next five years. The result? Nearly six out of 10 utility executives believe small-scale and prosumer distributed generation will put greater stress on their networks’ future capacity than medium- or high-voltage connected distributed generation.

Strains on the network are not the only challenge facing distribution utilities. The rise of distributed generation is also eroding revenues and putting pressure on profitability, especially for vertically integrated utilities. Furthermore, integrating more distributed generation brings risks, as it could result in lower volumes being transported and higher network reinforcement costs.

However, given the criticality of distributed generation to facilitate the energy transition and the move toward more sustainable energy, this is not a movement utilities can afford to block or impede. Even if the political climate is temporarily changing to focus less on providing incentives for renewables in some markets, the momentum behind renewables remains powerful and building.

In short, the distribution business should be the catalyst for the integration of distributed generation and the progress toward the energy transition. Despite the challenges, the expansion of distributed generation also creates opportunities for distribution businesses to create services-based business models that could drive much-needed new revenue.

Overall, moving to smarter distributed generation integration is non-negotiable. The question is not if, but when. And we believe the time is now.

# DISTRIBUTED GENERATION IS **DISRUPTING THE DISTRIBUTION MODEL**

Utilities are well aware that the traditional distribution business model faces disruption on three key fronts:

## TECHNOLOGY DISRUPTION

**+300  
GW**

solar PV capacity now deployed worldwide

**-\$3**

2016 US costs of residential PV per watt from +\$6 in 2010

**+10  
MILLION**

three-person homes in Germany covered by PV capacity

## DEMAND DISRUPTION

**57%**

consumers considering investing to become power self-sufficient

**61%**

consumers interest in an online marketplace to sell the electricity they produce

## BUSINESS DISRUPTION

**59%**

utility executives expecting small-scale/prosumer distributed generation to place greater stress on network hosting capacity

**66%**

utility executives expecting their company's role to evolve toward DER integrator and DER services market facilitator

Sources: Accenture New Energy Consumer and Digitally Enabled Grid research programs; "Photovoltaic milestone: 300 gigawatts of global installed PV capacity," German Solar Association press release, January 26, 2017; "Solar Energy Supplies Power to 10 Million Households," German Solar Association press release, June 22, 2016; "NREL Report Shows U.S. Solar Photovoltaic Costs Continuing to Fall in 2016," National Renewable Energy Laboratory (NREL) press release, September 28, 2016.

# THE RAPID EVOLUTION OF **DISTRIBUTED GENERATION TECHNOLOGY,**

combined with its growing accessibility and more favorable economics, is moving it from a marginal to a mainstream factor in the grid.

In some countries, such as Australia, this move has already happened at daunting speed—utilities saw a hundred-fold rise in new, small-scale PV installations from 2007 to 2011, increasing from around 3,500 a year to 360,000 a year. Australian PV penetration has continued to grow, with 1.66 million, or around 15 percent of residential households owning a small-scale PV systems by early 2017. The United Kingdom has seen a similarly rapid growth in prosumer distributed generation, with PV capacity increasing from 1GW to 11GW in just over four years.<sup>2</sup>

# DEMAND DISRUPTION— CONSUMERS BECOME PROSUMERS

All the evidence shows that consumers have a growing appetite to move toward self-generation. Attracted by economic benefits, environmental sentiments, a desire for greater energy self-sufficiency and, in some cases, simply keeping up with neighbors' and friends' social dynamics, many consumers are preparing to take the step to become "prosumers." Accenture's New Energy Consumer research<sup>3</sup> shows that more than half (57 percent) of consumers would consider investing in becoming power self-sufficient. Close to the same proportion (45 percent) say that they are planning to sign up for rooftop solar in the next five years.

In addition, consumers believe their energy providers should be providing the services and support to fulfill these goals. Nearly six out of 10 consumers expect energy providers

to work with others to offer packages for distributed energy resources (DER) that can enable them to access more sustainable ways to generate and store electricity. And these are not just aspirations consumers expect to see met at some point in the future. In the markets where penetration of distributed generation is high, utility distribution businesses have already responded to this trend by offering new services to customers such as solar PV installation and maintenance. Other markets are fast catching up.

All this, of course, is not escaping the attention of distribution executives. They continue to voice considerable concern about the impact of rising rates of distributed generation penetration on their revenues (see Figure 1).

## SIGNIFICANT/MODERATE REVENUE REDUCTION REGIONAL HEATMAP



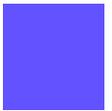
### EUROPE

Expected lower exposure to revenue reduction—likely due to many utilities having already gone through a first wave of distributed generation adoption



### NORTH AMERICA

Expected revenue reduction from distributed generation deployment—likely to be due to bundling of distribution and retail revenues



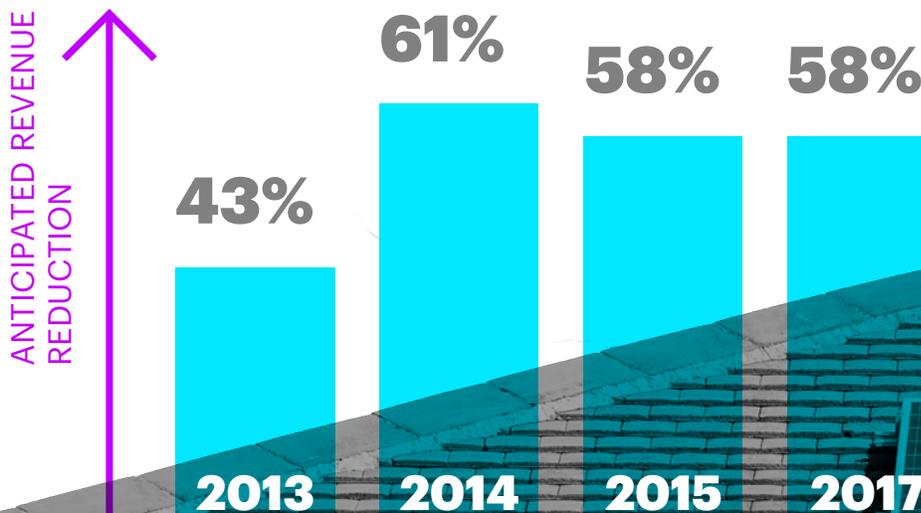
### ASIA PACIFIC

Expected revenue reduction from distributed generation deployment—likely to be due to bundling of distribution and retail revenues



**FIGURE 1.** Distribution generation is expected to cause revenue reduction.

## DISTRIBUTED GENERATION (E.G., PV, FUEL CELLS)



**Source:** Accenture's Digitally Enabled Grid program, 2017 executive survey.



# SMALL-SCALE DISTRIBUTED GENERATION— **LARGE BUSINESS** **DISRUPTION**

Distribution utility executives clearly understand the challenge integrating distributed generation presents. In fact, they see this as the single largest, fastest-growing source of business disruption. Nearly 60 percent of executives believe the proliferation of small-scale and prosumer distributed

generation will have an increasing impact on network reliability and quality up to 2020, caused by issues such as increased voltage issues and backflow of power into distribution substations. Accordingly, a similar proportion expect the role their company plays to evolve toward serving as an integrator of DER services and acting as a market facilitator for new consumer solutions and value realization.

## **ACCENTURE DIGITALLY ENABLED GRID (DEG) RESEARCH 2017**

Between October 2016 and January 2017, Accenture carried out interviews with more than 100 utility executives involved in the decision-making process for smart grid-related matters at their companies. The survey covered 23 countries.

Accenture's modeling assesses the costs of integrating small-scale distributed generation into the network, and the potential savings on network reinforcement capital costs.

# THE TIME TO SCALE SMARTER DISTRIBUTED GENERATION INTEGRATION IS NOW

While many distribution utilities have started to integrate distributed generation more effectively, their efforts to date have mostly been fragmented, focusing on only a part of the problem. For example, many utilities have streamlined their DER interconnection processes and shortened queue times for customers. But few have integrated those connection process improvements into a better forecasting approach for DER hosting capacity needs. The accelerating pace of distributed generation adoption calls for a more balanced, holistic and integrated approach. It is a proposition that is acknowledged by distribution executives, over half of whom say that the current distributed generation hosting capacity of portions of their current networks could be exhausted within 10 years (see Figure 2). In

the timeframes associated with grid improvements, that is a relatively near-term event. What's more, our estimates suggest that the costs of additional network reinforcement and automation required to facilitate the hosting of small-scale distributed generation integration by 2030 are in the range of \$20 billion in the United States and €58 billion in Europe.

Thanks to its ability to decrease loads on certain assets and reduce some network losses, small-to-moderate distributed generation penetration could initially benefit network performance, depending on the location of the distributed generation. But this is likely to be just a brief honeymoon period.

**FIGURE 2.** Distribution generation hosting capacity could be exhausted within 10 years.

WHEN DO YOU EXPECT TO  
**REACH THE HOSTING CAPACITY**  
FOR DISTRIBUTED GENERATION DEPLOYMENT IN  
YOUR NETWORK?

▶ **5%**

WE'VE ALREADY  
MET/PASSED IT

▶ **54%**

WITHIN THE NEXT  
10 YEARS

▶ **28%**

WITHIN THE NEXT 15  
YEARS AND BEYOND

▶ **13%**

WE DO NOT EXPECT TO  
EVER NEED TO EXCEED  
THIS THRESHOLD LEVEL

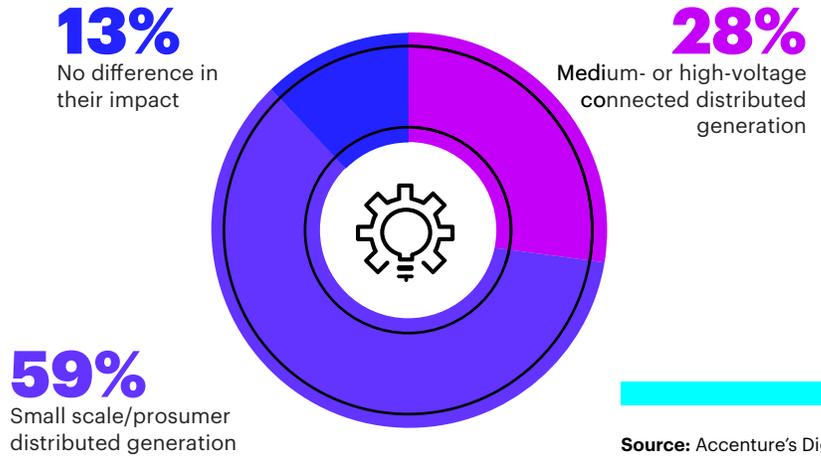
**Base:** Respondents who have a very/moderately clear forecast of the potential distribution generation hosting capacity of their network. Source: Accenture's Digitally Enabled Grid program, 2017 executive survey.

Over time, there will be a requirement for significant capital spend on network reinforcement to manage voltage excursions and peak load spikes that will be exacerbated by increased levels of distributed generation. And at current rates of adoption, this is a race that distribution utilities will struggle to win. The lead times we typically see for network reinforcement or to develop new smart grid-enabled capabilities at scale are generally much longer than the timeframes for new distributed generation capacity (three to five years). Uncertainty about where customers are going to put distributed generation on the grid—often in clusters—only compounds the issue. And it’s the ability to accommodate smaller-scale distributed generation—the fastest growing segment—that executives identify as likely to place the greatest stress on their networks (see Figure 3).

Utilities have low levels of visibility and control over their existing low-voltage networks when compared with medium- and high-voltage networks. Furthermore, in many cases distribution utilities have limited control or visibility over the deployment of small-scale distributed generation by prosumers, if the specific installation is smaller than a prescribed minimum. But the proliferation of smaller distributed generation is likely to mean that network reliability and quality issues will tend to be localized—and are going to need a different approach to address them efficiently and effectively. The requirement for a new approach is not yet showing through in the changes utilities are making to their operating models to address the challenges distributed generation presents. Smart grid deployments to date have focused more on technology deployment and piloting new grid innovations, but in the vast majority of cases have not ingrained new skills or processes into the distribution utility operating model. According to our Digitally Enabled Grid research, only a limited number of utilities have made significant changes in the development of new skills (26 percent), in process design (24 percent) and in governance (14 percent) (see Figure 4).

**FIGURE 3.** Small scale/prosumer distributed generation to place particular stress.

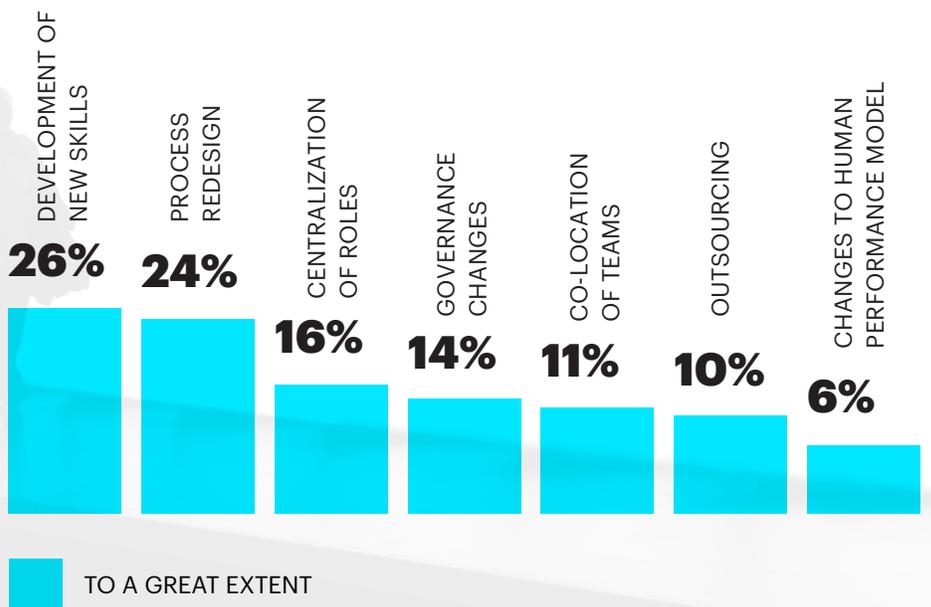
WHAT TYPE OF DISTRIBUTED GENERATION DO YOU EXPECT TO PLACE THE **GREATEST STRESS ON YOUR NETWORK** HOSTING CAPACITY?



**Source:** Accenture’s Digitally Enabled Grid program, 2017 executive survey.

**FIGURE 4.** Limited changes to operating models have been made to date.

TO WHAT EXTENT HAS YOUR COMPANY **IMPLEMENTED THE CHANGES** BELOW AS PART OF YOUR SMART GRID DEPLOYMENTS, TO DATE?



**Source:** Accenture’s Digitally Enabled Grid program, 2017 executive survey.

# FROM LOCAL TO NETWORK-WIDE: WHY DISTRIBUTION UTILITIES NEED A NEW APPROACH

**With most efforts currently focused on addressing local issues on a case-by-case basis, few utilities are taking the network-wide approach required to address (and benefit from) the increase in distributed generation.**

While every utility operates in a specific context that will ultimately determine the detailed approach it takes, all have to seek the appropriate balance between four key variables: increasing capital investments, optimizing operations and maintenance (O&M) spend, managing regulatory constraints on distributed generation deployment, and investing in smart solutions. The first two variables come with considerable risks and uncertainties that are likely to increase in the longer term. Increasing investment in capital assets presents some financial advantages if the basis for remuneration remains linked to asset value, as opposed to evolving toward an output-based model. However, the shifting tariff landscape raises questions about the long-term viability of current funding models. In addition, rising distributed generation adoption is likely to require ever-larger investments and operating sophistication to increase hosting capacity.

Relying on regulatory constraints to limit the deployment of distributed generation into the network may help in the short term to avoid some increases in network costs. But the overall direction of travel for consumer choice and policymakers' goals raises questions about the sustainability of a regulation-based strategy that seeks to prevent new forms of more renewable generation from connecting to the network. What's more, inherent in consumers' economic assessment is an assumption around the ability to export generation back to the grid. If consumers are not able to do this—either due to limited technical capacity or through reduced economic value—the result will be an acceleration in the deployment of storage, causing an even larger impact on total demand.



# SMART SOLUTIONS OPEN UP MAJOR OPPORTUNITIES

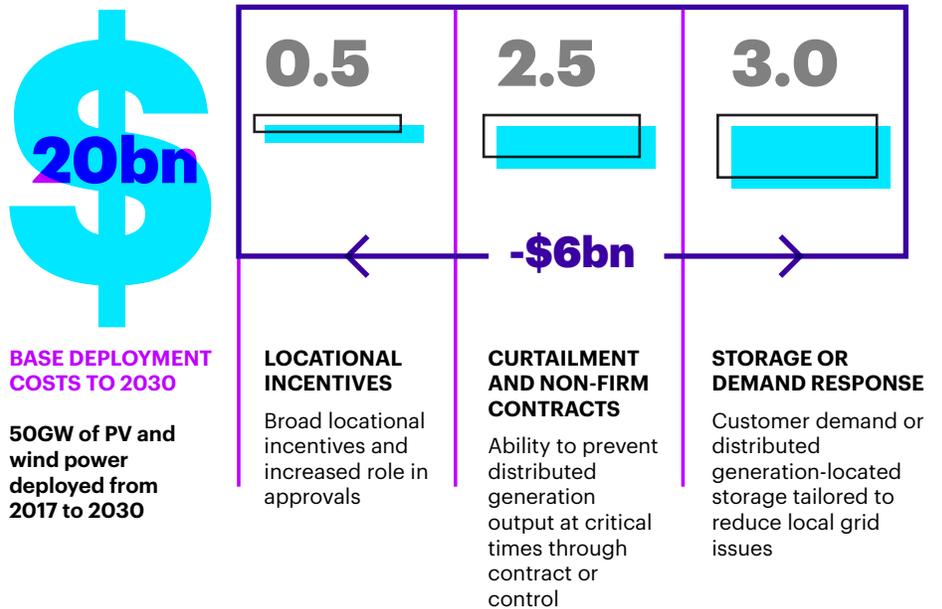
In contrast, investment in smart solutions offers the prospect of considerable advantages. One significant benefit is the potential substantial reduction in network reinforcement capital spend that customer-facing smart grid deployments could deliver.

**Our estimates suggest that this spend reduction could be as much as 30 percent of the projected €58 billion required in Europe and of the estimated US\$20 billion in the United States (see Figure 5).**

**FIGURE 5.** Distribution capital spend could be reduced by around 30 percent via customer-facing smart grid solutions.

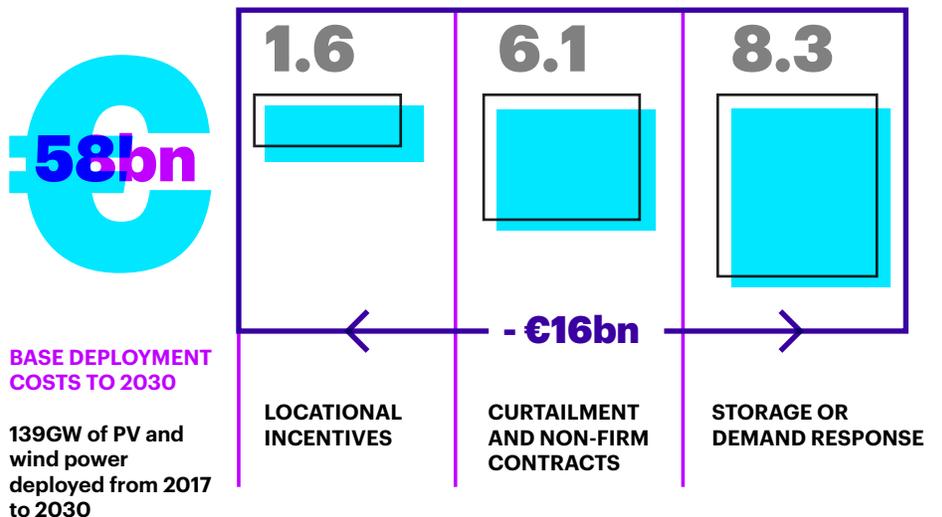
## REINFORCEMENT SPEND FOR SMALL-SCALE DISTRIBUTED GENERATION DEPLOYMENT TO 2030

UNITED STATES (\$BN)



## REINFORCEMENT SPEND FOR SMALL-SCALE DISTRIBUTED GENERATION DEPLOYMENT TO 2030

EUROPE (€BN)





# SMART SOLUTIONS

## **Harnessing smarter solutions to integrate distributed generation also opens many possibilities for effectively managing the increased complexity.**

In addition, steps taken to facilitate the ability of the grid to accommodate new forms of localized generation could prove foundational for the broader steps utilities should take to deliver the smarter, digitally enabled grid at scale.

Locational incentives could provide simple structures to help improve asset utilization by directing new distributed generation to appropriate locations on the network, depending on available capacity and other factors such as timing of peak demand. By making better use of smart meter and network sensor data, along with digital asset management and network modeling capabilities, distribution utilities would be able to undertake far more granular analyses to assess and optimize hosting capacity across the network. These same capabilities—together with the enhanced data and understanding of performance they provide—would also considerably enhance overall asset management. Many utility distribution assets are "fix on fail" today. In the future, more granular data on asset performance and on the specific risks from individual asset failure will drive improvements in operating costs to deliver network reliability. Using those improved asset management capabilities to drive network requirements could help steer

distributed generation toward areas of the network where it could have the greatest positive impact on network reliability. These could include a faster or cheaper approval process for specific locations, reinforcement cost charging and sharing benefits with distributed generation owners.

Smarter grid solutions could also enable the control and curtailment of distributed generation exports to the grid at critical times. This would facilitate the development of new commercial products and greater flexibility for network operators, with network monitoring and improved power forecasting enabling real-time controls. The resulting greater control could also enable the use of demand response to better manage grid performance, and encourage more storage capacity and smart inverters onto the grid to create new services and revenue.

A further benefit is that smarter grid solutions offer distribution businesses the opportunity to get in front of their customers in a new way, creating new value both for customers and the utility business. A new relationship could be formed through offering a range of distributed generation-related services such as payment for curtailment or integrated storage solutions.

# NEXT STEPS FOR **DISTRIBUTION BUSINESSES**

It is clear the distribution business cannot avoid the requirement to integrate distributed generation. Those that do this effectively will not only be able to play a leading role in the energy transition, but also could position themselves for regulated and unregulated opportunities.

However, as distribution businesses develop their strategies, there is no one-size-fits-all solution. Each utility will need to make a thorough assessment of its current context and capabilities; in particular, this will mean assessing the needs and behaviors of its customers. That will enable the business to plan the journey ahead and understand the appropriate mix of traditional reinforcement, O&M spend, regulated distributed generation approvals and smart solutions that its strategy needs to incorporate.

Developing a strategy will require utilities to assess the risks presented to their hosting capacity by the rise of distributed generation, considering its likely extent and timescales, along with deployment forecasts, regulatory constraints and degree of flexibility. That assessment should enable a degree of insight into the likely scope of disruption and whether solutions will be required on a local basis or network-wide. Such factors should dictate, for instance, whether solutions such as microgrids could be most effective at meeting the challenges created by distributed generation.

Of course, distributed generation integration is not isolated from other key distribution challenges. Issues such as reliability, and asset and outage management could also come into play. And distribution utilities need to understand the interplay between all these issues to gauge how new capabilities and regulatory models to support distributed generation integration could also address these other challenges.

The evolution of current regulatory models will, with variances depending on the specific market context, influence the array of new services required and the possibilities open to distribution utilities to develop new solutions and tap new sources of revenue. Accenture's Digitally Enabled Grid research indicates that distribution businesses anticipate a wide range of regulatory changes in the next 10 years, with changes in new tariff/pricing model topping the list (see Figure 6). Distribution utilities will need to undertake a careful analysis of the likely direction of developments, and particularly whether these will be market-enabled rather than regulatory- mandated. That analysis should also consider the extent to which consumers are likely to engage directly with new distributed generation services and how services for distribution optimization might be offered to consumers.

Accenture's Digitally Enabled Grid research indicates that distribution businesses anticipate a wide range of regulatory changes in the

# NEXT 10 YEARS

with changes in new tariff/pricing model topping the list (see Figure 7).

## HEATMAP: REGULATORY CHANGES NEEDED



**FIGURE 6.**

Anticipated regulatory changes expected in the next 10 years.

	EUROPE	NORTH AMERICA	ASIA PACIFIC
New tariff/pricing model	High	High	High
Greater role for the distribution business in the permitting and authorization of DER connections	Medium	Medium	Medium
Mandate to invest in distributed generation and/or storage to be used for network optimization	Low	Medium	Medium
Incentives for the deployment of innovative technologies in the network	Medium	Medium	Medium
Locational pricing for new distributed generation (medium-or low-voltage connection)	Medium	Medium	Medium
Mandate to use demand response to optimize the network/manage constraints	Medium	Low	Medium
Mandate to apply operational controls on third-party distributed generation and/or storage	Low	Medium	Medium
The implementation of an outcome-based/competitive revenue model	Low	Low	Medium

**Success in developing the new capabilities to operate in this fast-changing market hinges on seamlessly integrating technology that can enable advanced grid operations and new commercial models.**

And foundational to that technology is the harmonization of operational and business systems and data: IT/OT integration. Yet despite the acknowledged importance of IT/OT integration to delivering smart grid capabilities, most utilities have not yet moved to large-scale deployment.

In Accenture's IT/OT utility executives survey,<sup>4</sup>

**80%**

of respondents say they have not yet moved to a large-scale program to respond to IT/OT challenges,

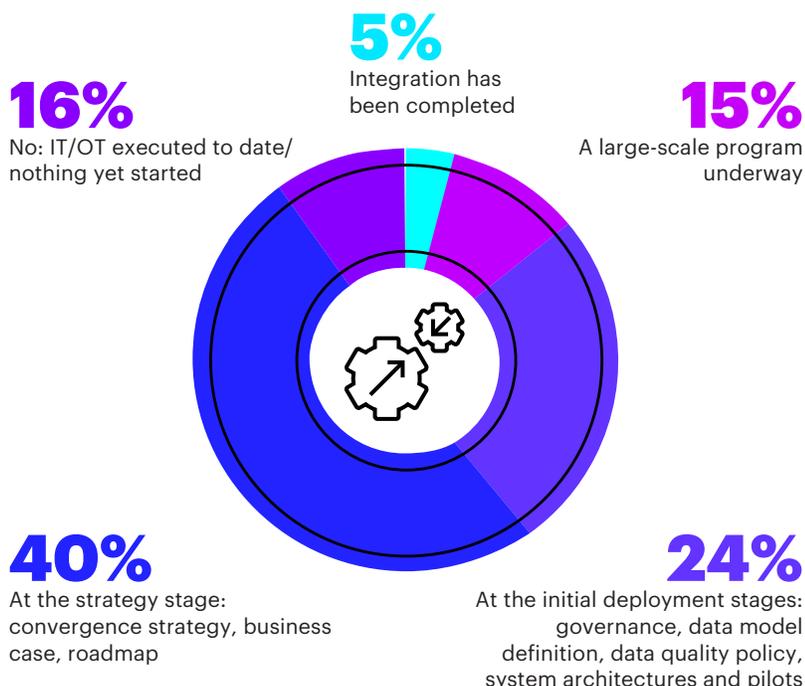
**AND**

**51%**

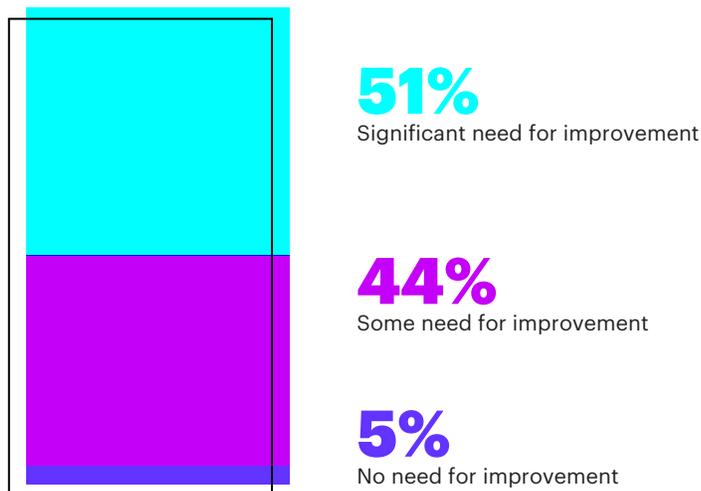
say that their IT/OT integration capabilities have significant need for improvement (see Figure 7).

**FIGURE 7.** Large-scale deployment of IT/OT integration is still to occur.

**WHAT STAGE OF IT/OT INTEGRATION BEST FITS YOUR CURRENT STATUS?**



**HOW WOULD YOU ASSESS THE MATURITY OF YOUR CURRENT IT/OT INTEGRATION CAPABILITIES?**



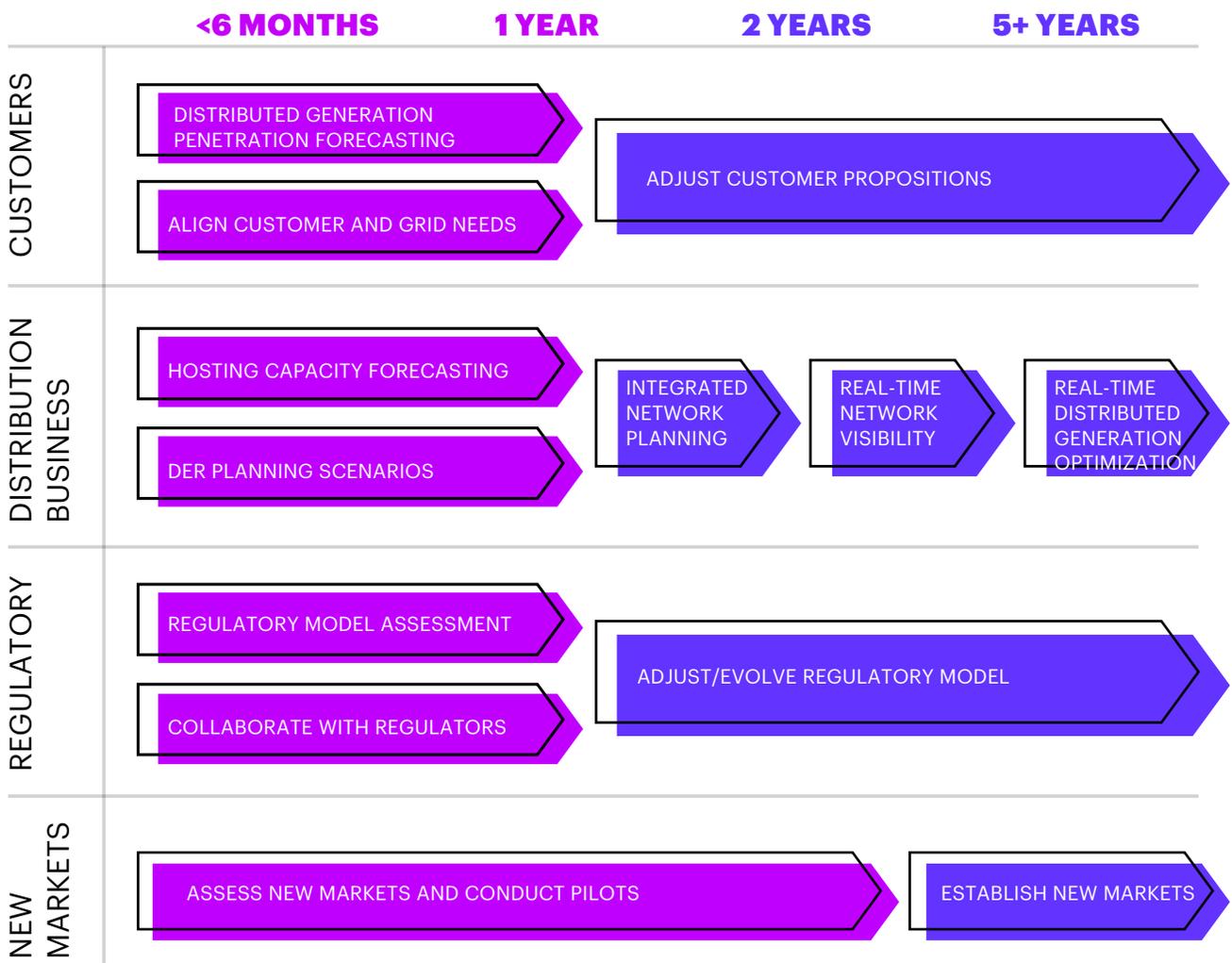
**Base:** All respondents.  
**Source:** Accenture's Digitally Enabled Grid research program, 2016 IT/OT survey.

## FOR DISTRIBUTION BUSINESSES, ACTIONS ON MULTIPLE FRONTS NEED TO BE UNDERTAKEN NOW (SEE FIGURE 8).

From a customer standpoint, utilities need to invest in forecasting capabilities. Depending on their regulatory context, utilities should focus on providing consumers with new distributed generation-related value propositions such as PV system design, locational incentives and financing services. From a network perspective, forecasting and grid operations will be key to moving toward real-time distributed generation optimization, including distributed

generation curtailment and the provision of ancillary services. These will require regulatory changes to provide an optimization mandate to utilities and realign the distribution business revenue model to become output-based. Timing is critical: building new capabilities is the long play—and those utilities who invest ahead of the curve will be those reaping the benefits of smarter distributed generation integration.

**FIGURE 8.** The future is now for distribution businesses.



## EXECUTIVE SPONSORSHIP AND CONTACT

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## ABOUT ACCENTURE'S DIGITALLY ENABLED GRID RESEARCH PROGRAM

Accenture's Digitally Enabled Grid program provides actionable insights and recommendations around the challenges and opportunities utilities face along the path to a smarter grid. Drawing upon primary research insights from utilities executives around the world as well as Accenture analysis, The Digitally Enabled Grid examines how utilities executives expect smart grid technologies and solutions to contribute to their future networks.

## ABOUT ACCENTURE

Accenture is a leading global professional services company, providing a broad range of services and solutions in strategy, consulting, digital, technology and operations. Combining unmatched experience and specialized skills across more than 40 industries and all business functions—underpinned by the world's largest delivery network—Accenture works at the intersection of business and technology to help clients improve their performance and create sustainable value for their stakeholders. With approximately 401,000 people serving clients in more than 120 countries, Accenture drives innovation to improve the way the world works and lives. Visit us at [www.accenture.com](http://www.accenture.com).

1. Accenture New Energy Consumer research program, 2016 consumer survey.
2. Postcode data for small-scale installations, The Clean Energy Regulator, Australian Government, [www.cleanenergyregulator.gov.au](http://www.cleanenergyregulator.gov.au); Accenture analysis.
3. Accenture New Energy Consumer research program, 2015-2016 consumer surveys.
4. Accenture Digitally Enabled Grid research program, 2016 IT-OT survey.

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