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Evolution is no longer optional for utility distribution companies

Mapping out the future of electricity distribution in the era of the digitally enabled grid: the "Distribution Platform Optimizer"

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Evolution is no longer optional for utility distribution companies

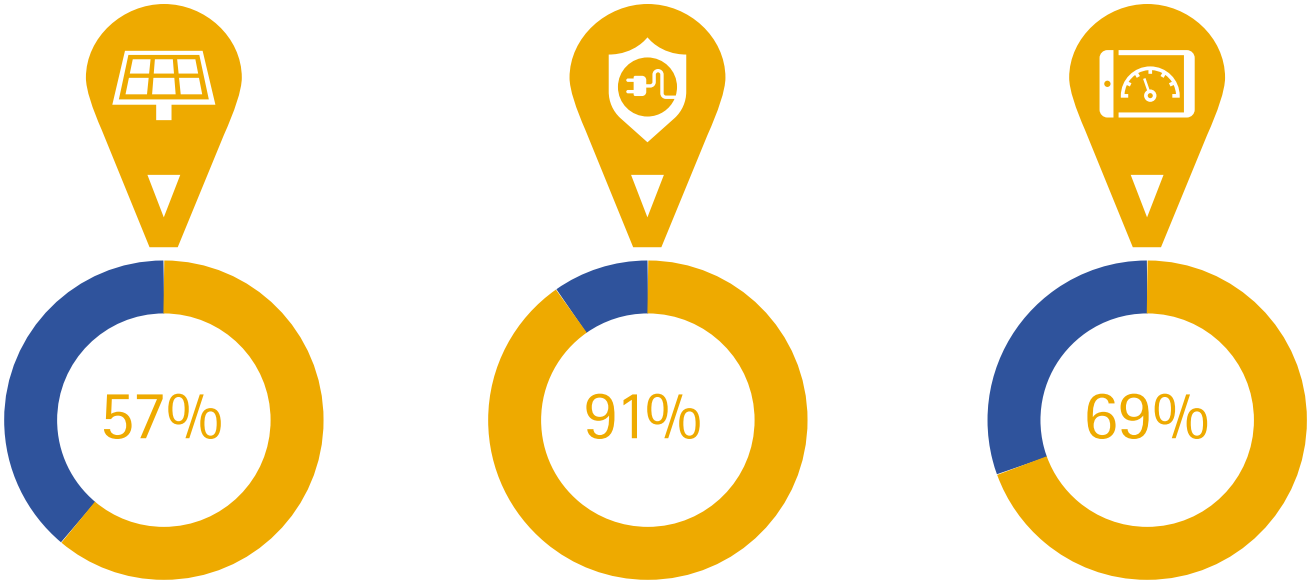
The utilities industry has had to weather some significant challenges over the past few years. While some utility companies have ridden out the turbulence better than others, it's clear that the disruption has much further to run. And changes required are substantial in the utility distribution business.

As a result, most of today's distribution businesses are experiencing profound strains on the traditional business model. In this paper, we examine the nature and some of the impacts of these pressures – and investigate a new model that we believe can be sustainable in the long term.

The distribution business is facing unprecedented challenges...

So, what stress factors are at play? Accenture's New Energy Consumer and Digitally Enabled Grid research programs among respectively consumers and utility executives tell the story. On the consumer side, expectations are increasing rapidly: some 71% of residential consumers[1] believe their utility could do more to help them reduce their energy costs – and 91% see reliability of supply as an important factor in building trust with their utility. Consumer behaviors are also changing, with well over half of consumers interested in deploying domestic energy generation and storage solutions, and most also interested in energy management programs (see Figure 1).

Figure 1. Consumer behaviors and expectations are changing



% of consumers who would consider investing in becoming power self-sufficient and not having to buy energy from their energy provider

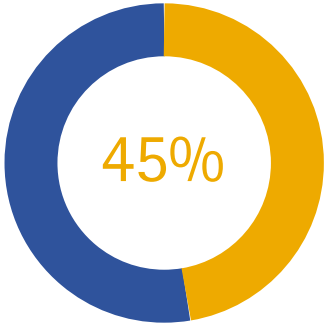
of consumers see reliable energy delivery as an important factor to build trust with their energy provider

of consumers are interested in energy management programs

Source: Accenture's New Energy Consumer research program.

[1] Source: Accenture's New Energy Consumer research program.

Figure 2. The traditional electricity distribution model is no longer fit-for-purpose



of utility executives report facing significant to major issues with a traditional transportation model for distribution to provide a sound foundation to meet their distribution's technical and financial challenges

Source: Accenture's Digitally Enabled Grid research program.

These profound shifts among consumers are mirrored on the utility side. Our latest industry research[2] among utility executives in 18 countries reveals a growing recognition that the current distribution model is nearing the end of its useful life. Some 45% of our respondent executives agree that the current distribution model is no longer providing a sound basis to meet their technical and financial challenges (see Figure 2). This concern is even more pressing in Europe, where 64% of industry executives think the current model has run out of road.

As if these strains weren't enough to deal with, distribution businesses are also facing pressures on the regulatory and policy front. Ongoing changes in regulation and the transition to a post-COP21 world means they're trying to play their part in delivering increasingly challenging policy and regulatory objectives, involving simultaneously driving further network efficiencies, integrating renewables, and implementing myriad new technologies in areas from the distribution network to back office to customer engagement (see Figure 3).

[2] Source: Accenture's Digitally Enabled Grid research program.

Figure 3. Targets and constraints from regulators continue to evolve (select examples)

Source: Accenture analysis, March 2016.

...causing fault-lines to emerge

So, as the stresses on the business model intensify, what fault lines are starting to emerge that require early action? Arguably the most urgent issue is that demand evolution is destabilizing the cost-revenue distribution model, as the combination of energy efficiency, distributed generation deployment and economic pressures take hold.

According to Accenture modeling based on our Digitally Enabled Grid research program, the resulting load reduction puts industry revenues at risk to the tune of US$48bn in the US and €61bn in Europe by 2025. And the challenges for distribution businesses could become even tougher because much of this reduction in overall load could come without a reduction in peak demand, whereby peak demand could be more resilient to energy efficiency and prosumer actions than total demand.

This decoupling of total and peak demand could drive a widening mismatch between the distribution network costs – which are largely driven by peak load – and total demand, resulting in increasing costs per kWh. Similarly, the deployment of small-scale distributed generation such as solar photovoltaics (PV) will tend to reduce the load factor by decreasing demand in the middle of the day, but will typically have little impact on peak demand. Evidences of decoupling of peak and total demand are already being seen in some geographies such as in the United States, Germany and Italy.

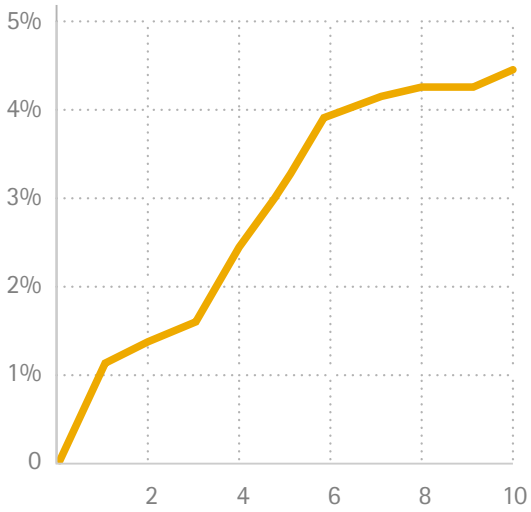
A key solution: demand response...

Faced with this squeeze between falling load factors and stubbornly high peak demand, what should distribution businesses do? In Accenture's view, distribution-optimized demand response tools will become key for enabling peak load management and to maintain grid reliability.

To date, these tools have not been widely used in distribution. But this now needs to change. Accenture modeling indicates clearly that demand response solutions can trigger significant changes to peak demand through programs that incentivize action on very few hours per month.

Experience in both generation and transmission shows demand response programs typically deliver an average change of about 5% from time-of-use programs and about 15% from critical peak pricing programs. This means demand response flexibility could be highly effective in managing distribution peak load (see Figure 4).

Figure 4. The effect of demand response programs on distribution peak load



Number of peak hours a month covered by the demand response program

Sources: Accenture's Digitally Enabled Grid research program; Accenture analysis.

...closely targeted at local optimization

However, to realize their full potential benefits, distribution-optimized demand response programs need to be much more tightly directed than they have in the past. This means distribution companies will need to add a high degree of location awareness to ensure that demand response is effective in supporting the optimization of the network. Examples of location awareness might include identifying specific circuits and assets that are at risk of exceeding tolerances from excessive demand, or incentivizing additional demand in selected areas to soak up spilled electricity from PV systems.

More generally, the use of demand response to support the management of the distribution network is part of a broader trend away from adding traditional assets, and towards making more effective use of the flexibility of existing network assets, generators and consumers. Crucially, the success of this approach depends on having a regulatory model that emphasizes performance over capital, together with the sophisticated understanding of the grid's operations and control that comes from deployment of a digitally enabled grid.

Storage: a new battleground for distributors...

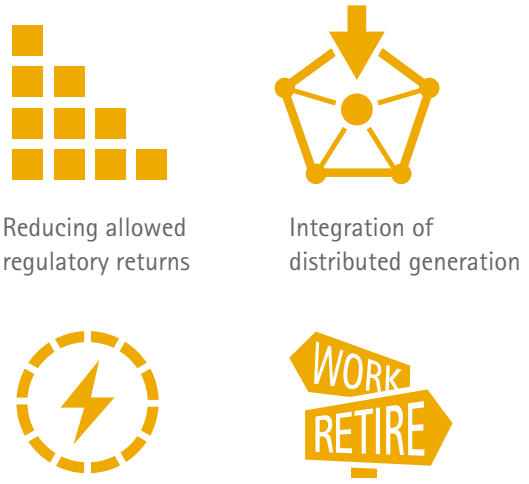
Alongside the widespread adoption of localized demand response programs, a further increasingly vital tool for utility distribution to manage peak load more effectively will be energy storage.

Why? The past ten years have seen enormous growth in small-scale distributed generation – particularly PV – in many countries. For example PV accounted for about 35TWh of electricity in Germany alone in 2015[3], with over 1.5 million plant[4]. Indeed, the shift to PV has been so rapid that policymakers in territories like the United Kingdom and Nevada (United States) are seeking to rein in PV deployments through measures such as reductions of feed-in tariffs.

Integrating large quantities of distributed generation (DG) has been testing for some utilities, as reflected by its ranking as one of the biggest challenges facing European distribution businesses in Accenture's latest Digitally Enabled Grid executive survey (see Figure 5). This largely reflects the challenges of managing the intermittent energy output from DG. However, Accenture believes that storage is now set to emerge as a new disruptive technology for distribution businesses to support integration of DG as well as playing a broader role in the management of the network.

Figure 5. Biggest challenges currently faced by European distribution business

Europe



Source: Accenture's Digitally Enabled Grid research program.

[3] "Germany adds 83 MW of solar in January", European Power Daily, March 01, 2016, (accessed March 28, 2016)

[4] Solar Bundesverband Solarwirtschaft e.V. (BSW-Solar), March 2016

While costs for residential storage still appear to be relatively high for most consumers, Accenture modeling indicates that for some customer sectors and locations the deployment of storage is already economic.

Figure 6 illustrates the shortening payback periods for situations where storage is deployed in a standalone fashion, and where used in conjunction with a photovoltaics system.

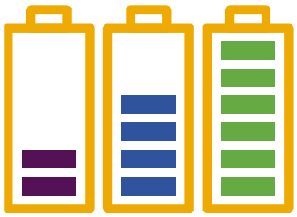
Figure 6. Internal rates of return (IRR) and payback periods for storage standalone and with PV

Storage system cost ($/kWh)	Peak pricing IRR/Payback for standalone storage	Peak pricing + low net metering prices IRR*/Payback for storage with PV
1000	15% 6 years	8% 8 years
750	23% 4 years	14% 6 years
500	37% 3 years	25% 4 years
250	76% 2 years	52% 2 years

~ Tesla Powerwall costs

2020 forecast

2030 forecast



Accenture analysis

3 kWh Storage system	3500 kWh Annual demand	200% Peak price premium	32 cents/kWh Electricity price
90% Efficiency	3 kW PV system size	12 years Technical life	75% of retail price Net metering price
12 years Technical life	Germany residential average Load shape	10% Minimum charge	
10% Minimum charge			

*IRR is for the storage investment only, not the PV system

Sources: Accenture's Digitally Enabled Grid research program; Accenture analysis.

...as falling prices encourage rising deployment...

Using relatively conservative assumptions, such as a peak price premium of 200% over off-peak and a feed-in tariff of 75% of the retail price, it's clear that storage is at – or close to – economic, especially given the likelihood of further falls in storage prices in the coming years. Countries such as Australia and Germany, and US states like Hawaii and California, are already experiencing growth in interest and deployment of storage.

And this rising interest is extending beyond the residential sector. In California, for example, Green Charge Networks is deploying 7.4 MWh of storage to fourteen educational sites, with an expected to reduction in electricity costs of US$6.4 million over the life of the project.[5]

What's more, as the costs of storage deployments continue to decline, the business case for them will keep improving. While the battery component of a Lithium Ion deployment is currently estimated to cost around US$500[6] depending on its characteristics, this figure is projected to fall by half within five years if manufacturing at scale takes off.

A further factor is that the non-battery costs of storage systems – such as the power convertors and installation – currently account for over half the total deployment costs. Experience with PV shows that when installation moves into the mainstream, these costs can fall significantly.

...heralding a surge in investment

All of this suggests that tariff structures and net metering pricing could drive a surge in customer-side "beyond-the-meter" deployments of storage, with storage also becoming a key investment area for distributors "in-front-of-the-meter". In fact, given the strong potential demand from electricity users for deployment of storage, the question arises as to whether distribution companies should deploy it themselves or just purchase storage services from third parties.

In Accenture's view, the answer is both. Where customers own distributed generation and storage resources, distributors will need to engage and encourage them to operate these resources in ways that enhance grid reliability. This may include providing grid services like generation curtailment, localized voltage support, and energy storage to support contingency load transfers.

Accenture's latest Digitally Enabled Grid research confirms that utility executives now recognize the need for grid-based storage – with 77% of our respondents either already investing or intending to invest in storage over the next ten years. The majority expect their organizations' use of storage to grow over the same time period, with "supporting renewable integration" the most commonly cited deployment driver (65%), followed by "improving network operations" (57%).

And 40% believe storage will be used to "allow deferment of network capital" – a strategy that could be particularly relevant to urban distribution networks where access to assets is difficult and expensive.

[5] "Green Charge Networks Announces California's Largest School Energy Storage Project with San Diego's Grossmont Union High School District." Energy Weekly News, March 11, 2016, (accessed March 28, 2016)

[6] "One good year deserves another: energy storage in 2016", Renewable Energy News, Jan 29, 2016, (accessed March 29, 2016)

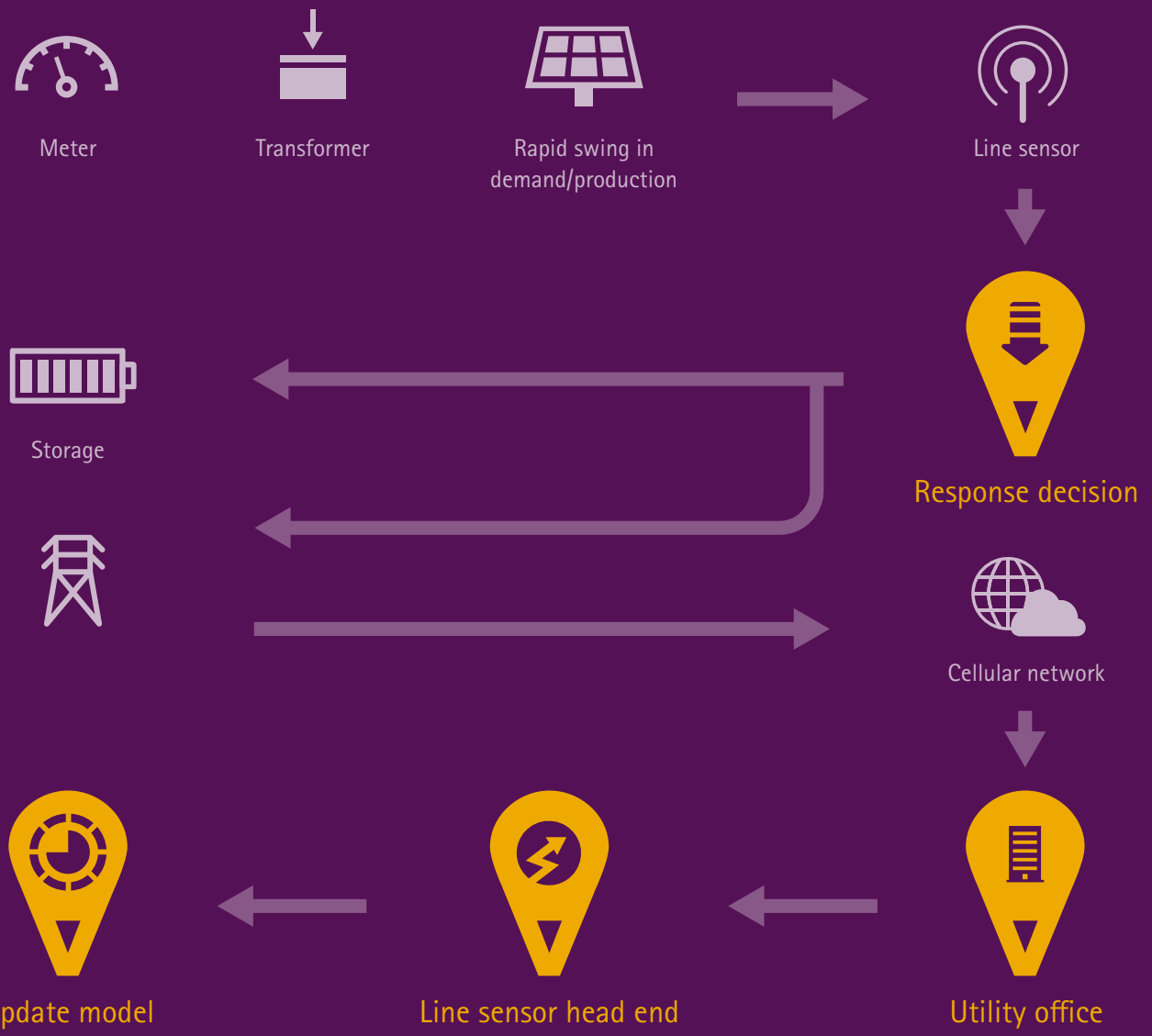
[7] "RES to install battery at 1.5-MW solar park in UK", SeeNews Renewables, January 7, 2016, (accessed March 29, 2016)

The rise in storage investments by distribution utilities is already happening – notably in the PJM area in the US, and by Western Power Distribution[7] in the UK, which is deploying a 640kWh storage system collocated with a large-scale PV generator. The Western Power Distribution solution will provide services both to the PV system to improve its revenues through load shifting, and to the distributor through a range of ancillary services

Experience to date confirms that in-front-of-the-meter storage brings greater flexibility and optionality to the distribution business than customer-owned and sited assets.

In Accenture's view, distribution-controlled storage will be a powerful tool for network optimization and – over time – will become integral to how most distributors run their networks and control costs (see Figure 7).

Figure 7. Using distribution-controlled storage for network optimization



Source: Accenture.

Towards a new model: the Distribution Platform Optimizer

So, given the change drivers and outlook we've described, what does Accenture believe the successful distribution business of the future will look like? We envision the emergence of a range of potential models, including:

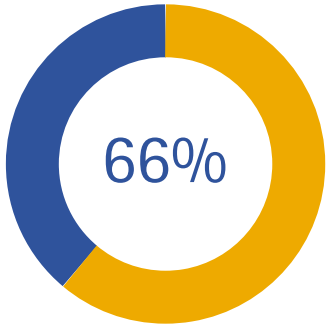
- The decoupled integrated utility – removing volume bias and the disincentive to optimize.
- The smart grid operator – leveraging new technology in the existing management paradigm.
- The platform access provider – providing equal access to the network to Independent players.
- The distribution platform optimizer – managing and coordinating all elements end-to-end, to provide the optimal outcome for the overall system.

In our view, the most sustainable model will be the distribution platform optimizer. This view is echoed by utility executives in our research, whereby 66 percent expect their company's role to evolve in the next 10 years towards one that integrates distributed energy resources (DER) and facilitates the market for DER services (see Figure 8). The deployment of storage and the utilization of demand flexibility are just two of the ways that further optimization of the distribution network can be achieved – with further opportunities being opened up by tools and strategies such as locational incentives, tariff changes, active grids, and more.

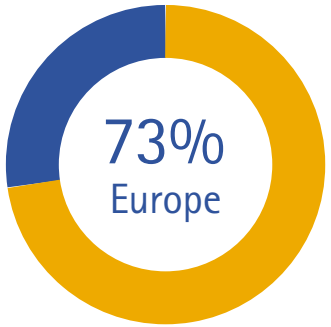
Figure 8. Mapping out the future of electricity distribution in the era of the digitally enabled grid: the "Distribution Platform Optimizer"

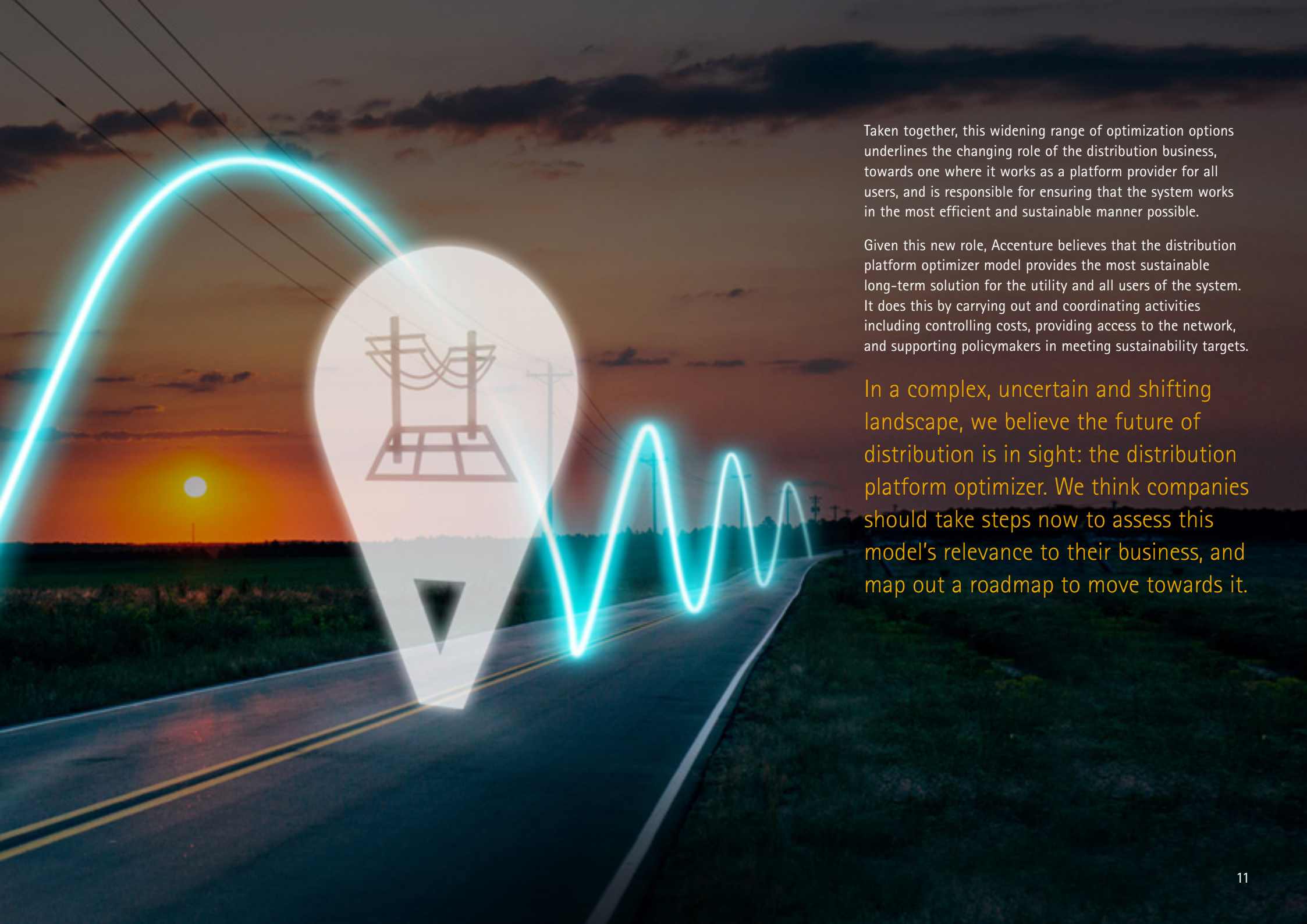
Source: Accenture's Digitally Enabled Grid research program.

Utility executives looking ahead in the next 10 years



expect their company's role to evolve towards one that integrates distributed energy resources (DER) and facilitates the market for DER services—
a distribution platform optimizer





Taken together, this widening range of optimization options underlines the changing role of the distribution business, towards one where it works as a platform provider for all users, and is responsible for ensuring that the system works in the most efficient and sustainable manner possible.

Given this new role, Accenture believes that the distribution platform optimizer model provides the most sustainable long-term solution for the utility and all users of the system. It does this by carrying out and coordinating activities including controlling costs, providing access to the network, and supporting policymakers in meeting sustainability targets.

In a complex, uncertain and shifting landscape, we believe the future of distribution is in sight: the distribution platform optimizer. We think companies should take steps now to assess this model's relevance to their business, and map out a roadmap to move towards it.

About the 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 more than 373,000 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.

About Accenture Smart Grid Services

Accenture Smart Grid Services focuses on delivering innovative business solutions supporting the modernization of electric, gas and water network infrastructures to improve capital efficiency and effectiveness, increase crew safety and productivity, optimize the operations of the grid and achieve the full value from advanced metering infrastructure (AMI) data and capabilities. It includes four offering areas: Digital Asset Management, Digital Field Worker, Intelligent Grid Operations and Advanced Metering Operations.

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