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Utilities

A Platform Approach to Advanced Distribution Grid Management

Addressing unprecedented challenges in an evolving utility landscape requires an enterprise-wide, platform based approach focusing on both effective grid management techniques while supporting customers to take control over their energy usage

ORACLE WHITE PAPER

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INTRODUCTION

Driven in major part by widespread growth of distributed generation - including 27.0GW of installed rooftop solar capacity globally in 2017[1] - along with other forms of Distributed Energy Resources (DERs), electric utilities around the world today face significant changes to the traditional energy delivery model. Once considered passive ratepayers at residential, commercial or industrial levels, customers now have the capability of supporting their own generation and load control to exhibit direct influence over power production and consumption. On the grid side, however, intermittency in distributed generation and variations in consumption patterns create the need for information, which is vital to the efficient control of the network, usually residing outside the reach of utility supervisory control and data acquisition (SCADA) and traditional distribution management systems (DMS).

With traditional approaches, it's difficult for utilities to predict and accurately forecast granular intermittent renewable generation, their aggregated impact on the grid connection points, and overall energy supply. Because solar and wind are not dispatchable, utility operators can't choose when to

[1] Global Market Outlook for Solar Power 2018-2022, SolarPower Europe, June 2018, Available: http://solarpowereurope.org/reports/global-market-outlook-2018/

use the electricity from these resources. Instead, they must analyze and mitigate any impacts of its inherent intermittency. In order to continue to provide safe, reliable, and affordable grid services, utilities must transform the view of distribution to safely connect, model, operate and optimize customer DERs as part of the distribution platform.

Electric utilities recognize the need for new distribution network technologies to accommodate sustainable growth and customers' growing interest in grid-connected, customer-owned energy technologies. As policies that concern these technologies—customer choice, emissions reductions, weather-related outage response—begin to unfold around the world, a fundamentally different approach to the electricity distribution infrastructure is needed. The distribution grid of the future comes to fruition with a customer-centric platform approach - supporting data collection, curation and visualization in a flexible, integrated and scalable manner delivering effective utility business transformation.

BALANCING THE PACE OF CHANGE

The dynamic between the customer and their electric utility has shifted significantly. Those individuals and businesses that own DER want to be digitally connected with their suppliers just as they are in many other aspects of their life. Energy has become another impactful data source utilized to make meaningful improvements within their own lives, their community, and society as a whole. Today's energy customers want information, control, and options, and they want access and control from wherever they may be.

In particular, two different categories of consumer-driven technologies are playing an enormous role in pushing transformation of the electricity distribution grid. These are:

- **Dispatchable and non-dispatchable DERs** including energy storage (batteries), rooftop solar, microgrids, and combined heat and power installed with the capability to supply power to the grid. While regulations vary, the global trend is toward requirements that utilities connect this class of DERs to the grid and use the electricity they intermittently produce as part of their regular power supply to balance load.
- **Smart, grid-connected equipment** including home appliances, building-level energy management systems, smart thermostats, electric vehicles, and the like—that can play a role improving energy efficiency, demand-side management (DSM) and overall grid reliability. DSM, in particular, has proven to be an integral component of the utility portfolio in the form of demand response (DR) programs. DR programs increasingly encompass both large and small customers, and regulators clearly favor programs that use grid-connected equipment to embrace sustainable growth, meet peak demand, decrease supply costs, reduce air pollution, and lower customer bills.

These consumer-owned, consumer-driven technologies are growing faster, and being adopted more widely, than expected. Fewer than one in six global utility survey respondents in 2013 anticipated

distributed generation to supply more than a 10% share of electricity demand by 2025[2]. With expectations now at 12% global generating capacity being distributed (65% of which is solar PV) [3], utilities today are generally wondering when, not if, this will impact the business.

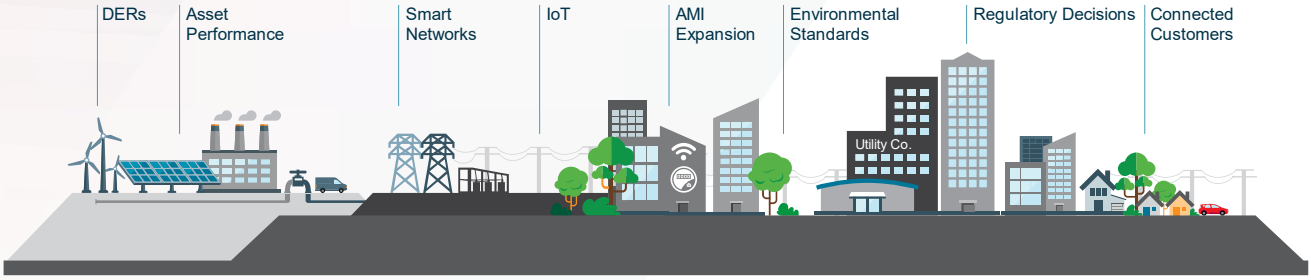

Figure 1. The Evolving Utility Landscape- an unpresented amount and pace of change pushing business transformation

To resolve this dilemma, utilities must re-examine near-term and long-term plans for DER technology integration and whether their current enterprise systems are able to support the needed changes. Utilities need an integrated approach to address DER planning that includes future customer demands, grid operations, asset management, and workforce enablement.

Five years ago, it might have been difficult to find technologies that can be unified to accommodate both current and future needs. That is no longer the case. Following are four pertinent examples to leverage within a common, platform-based approach.

Advanced Distribution Network Modeling

Most regulators assume distribution grid-side resource benefits in the DER rates, and thus it is up to utilities to fully leverage their value in planning and operating models. Distribution network modeling—the ability to see and to profile all utility-scale as well as each customer's granular grid-connected sources of supply (including beyond-the-meter customer DER) and demand, no matter how small—is one obvious example of how utilities can gain that value. Planning functions will need to aggregate these granular resource models to their connected points in the planning models in order to fully accommodate their impacts and leverage them as the grid-side resource for which they are typically compensated.

Outage Management

A solid outage management system has clear benefits. It increases customer and regulator satisfaction by shortening outage times and improving reliability metrics used around the globe. It gives accurate restoration times to help customers plan around the outage. It quickly integrates mutual aid crews. And, with the addition of advanced distribution management functions, it can automatically isolate an outage and temporarily restore power to surrounding areas.

Smart Field Device Management

Traditional asset management systems handle a relatively limited number of specifications: manufacturer, serial number, and maintenance schedule. Smart equipment, however, requires a far greater number of specifications: tables to support configuration compatibility, calibration measurements, firmware versions and patches applied to each device module (e.g., metrology or

[2] PwC; 12th PWC Annual Global Power & Utilities Survey, Smarter Energy – Distributed Generation; page 22, Dec. 2013

[3] Frost & Sullivan, Future of Energy, page 5, Dec. 2017, Available: https://ww2.frost.com/files/6615/1619/3733/Future_of_Energy_Value_Proposition_-_Dec_2017.pdf

telecommunications), scheduled battery replacements, and audit compliance that can grow to support millions of devices for large utilities. Utilities need a device registry and lifecycle management process and systems in order to engage customers and fully leverage these grid-connected resources.

Demand-Side Management (DSM)

DSM has become an increasingly important application in an evolving landscape that values DERs alongside more traditional assets. With traditional options of addressing anticipated increases in demand focused on supply adjustments, utilities today are realizing the tremendous potential in connecting grid-side and customer-side resources to leverage demand reduction with effective DSM programs. Time and scale are paramount as utilities look to deploy everything from blanket efficiency reductions to complex load shaping in order to deliver energy action whenever and wherever it's needed. Utilities are in a central position to be the trusted energy advisor to customers; however, it will take considerable effort and the right approach – developing the vision and roadmap today in order to drive more customer value moving forward.

Simplifying the journey towards a customer-centric grid

Typically seen as the "grid edge", it is clear with the higher penetration of distributed energy resources, the model is shifting to one that is customer centric. The importance of grid operations remains, but now this complexity must be solved with an integrated customer and utility perspective.

UNDERSTANDING THE DER LIFECYCLE

To meet the challenges of a more distributed model, utilities have to rapidly develop new processes to manage DER assets and maintain them over time. It is important to note that the DER lifecycle management process starts with the customer and ensures that they remain engaged throughout the entire lifecycle.

Figure 2. The DER Lifecycle Map- begins and centers around the customer

Start with customer engagement and enrollment. Utilities will identify customers with DER and qualify them into the right programs. Utilities may have specific programs with specific prices tailored for customers with DER assets. Utilities need an integrated Customer Information System (CIS) with a customer engagement solution, and Service Order Management (SOM), to manage these procedures.

- Integrate distribution network planning. Utility professionals need to perform a comprehensive network planning and modeling exercise to integrate DER assets. It starts with a network model and inventory of assets. Capacity and impact planning on the existing systems with an integrated Distribution Management System and Outage Management System enables utilities to perform capacity and impact planning.

- Make use of the granular load forecasting and analytics. Grid operators have to account for load models from the customer to the system level. Any reverse feedback on the feeders and circuits can have a negative impact on the distribution system. Utilities are looking for an integrated network model that combines device-level data and advanced analytics to develop a much-improved forecast.
- Validate customer connection points. Asset registration and connection is an important step to ensure an ongoing record of each DER device. Utility professionals need to be able to take care of the whole process associated with asset commissioning and decommissioning.
- Prepare your asset operations for ongoing DER management and maintenance. Utility professionals will need to keep tabs on the health of DER devices, manage configurations and upgrades. An integrated mobile workforce management system with asset management can identify, fix, and restore a DER device much faster. Utilities can offer new services with integrated mobile workforce solutions that constantly track equipment as well as keep the network model up to date.
- Review your billing systems and settlement processes. Customers need accurate billing based on the granular metering and device data to settle DER consumption. For instance, utilities need accurate data for setting net metering, critical peak, and time-of-use prices. Customer operations and IT require an integrated view of billing, metering, and customer engagement solutions.
- Equip your IT operations to support ongoing customer experience. Utilities can use multi-channel tools to keep customers updated on their consumption, targeted programs, and events. Utilities can improve customer satisfaction when they're able to present unique information tailored for each customer based on their consumption, market participation, rate changes, programs, equipment maintenance, and outages.

Grid Management for the Next Generation Utility

The platform approach combines the scalability with flexibility to meet today's needs while streamlining future investment to gain:

- Enhanced grid visibility down to the low-voltage, distributed generation, and customer networks
- Reduced number and impact of customer outages with end-to-end system automation
- Improved power network quality by avoiding customer hazards due to voltage fluctuations
- Operationalized bottom-line savings by reducing unplanned truck rolls in half
- Increased customer satisfaction by reducing customer interruption minutes

THE PATH MOVING FORWARD

As utilities move from supplying energy to providing new layers of differentiated services based on customer needs, long-term technology plan for distribution grid management is critical. Utilities need to ensure that current technology investments and upgrades act as stepping stones to support the programs they want to offer and the expectations of future customers. A decision today to invest in a one-off, limited-use technology, or to contract with third-party service companies, could significantly increase the technology costs to offer new programs or support new business models in the future.

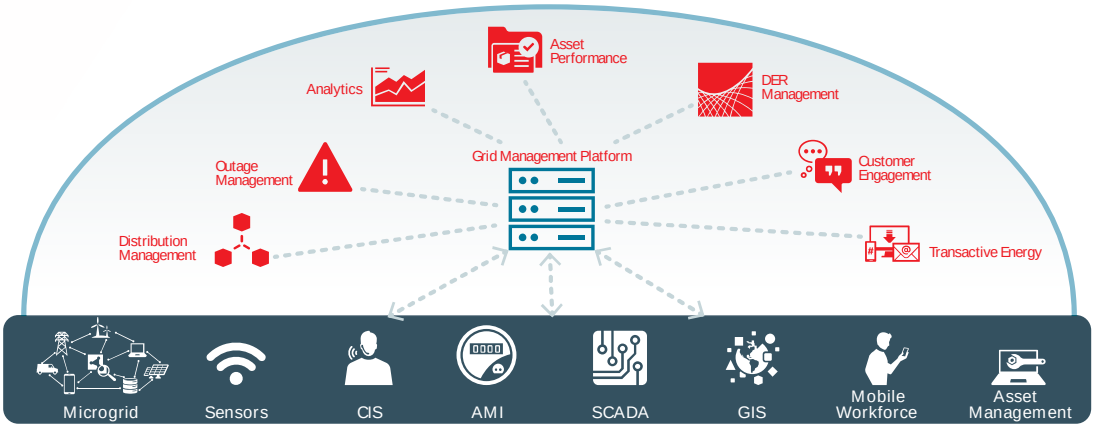

Figure 3. The Grid Management Platform- Maintaining a reliable foundation while supporting agile innovation

In contrast, investments in technologies that align with a strategic vision of the future utility with a customer-centric perspective will provide current and future benefits, including:

- **Executing on long-term business planning including transformation.** Prevent dead-end investments in applications that will clearly need to be changed out in the future. Focus instead on the strategic vision and aligning use cases for business planning around the engaged prosumer. This enables incremental responses to growing customer demands.
- **Performing while undertaking digital transformation.** Give staff time to drive digital transformation by gaining experience with new procedures and business processes while there is still a relatively small amount of customer-owned energy technologies on a system.
- **Analyzing risk carefully and early on.** Lower the cost and risk of pilot programs. Planners can have a fully tested, real-life technology structure within which to design, offer, and evaluate the results of a wide variety of possible offerings. They can gain experience not only with the technology itself, but also business process changes necessary to support the scale accompanied by widespread adoption of DER. As the most successful pilots transition smoothly into permanent programs, there is no loss of momentum while staff members struggle to scale up technologies that work well only when the number of program participants is small.

There are, as well, technology characteristics that can go a long way to ensuring the future value of today's investments. For applications, these include the ability to provide:

- **Visibility**— understand at the granular level to individual distributed resources and their operational context within the network model. The volume of customer-owned equipment with 339 million devices (83% growth) in smart homes and 518 million in smart buildings (42% growth) in addition to 314 million grid edge-connected devices (21% growth) do not show signs of decreasing[4]. Utilities will inevitably need to plan for and manage DER impact on reliability and create business models to capitalize on the new revenue and demand response opportunities.
- **Scalability**— handle not just more customers and more devices but also steeply escalating amounts of detailed data about each customer and each asset generated at higher velocity and with greater complexity.
- **Prioritization**— separate activities and processes that must take place in real time from those that can have less rigorous scheduling requirements. Utility staff and other resources are not increasing at the same rate as utility data, devices and processes. Applications that treat equally every alarm, every device reading, or every transaction all but ensure that resources will be wasted and real emergencies will receive short shrift.
- **Integration**— enable utilities to architect a system of systems to meet new requirements leveraging as much existing investment as possible. Applications must relate to each other in logical ways so that business processes to manage data can flow seamlessly from one to the next given a wide range of possible scenarios.
- **Recovery**— guard against data loss no matter the severity of security breaches or equipment breakdown. The volume of smart metering data – with over 70 million smart meters installed in the US alone since 2012[5] - will likely, in the future, seem almost trivial compared with data volumes associated with DER management and grid-connected customer equipment. And grid efficiency

[4] Gartner, 2016 worldwide estimates and yearly growth rates, Dec 2015

[5] Smith, Scott, 2018 Outlook on Power and Utilities, Deloitte Center for Energy Solutions, page 6, Available: https://www2.deloitte.com/us/en/pages/energy-and-resources/articles/power-and-utilities-industry-outlook.html

will require extensive historical analysis of this data. Once lost, such data cannot be reconstructed.

It is without question today that the global energy industry is facing unprecedented challenges in a rapidly evolving landscape. Increasing adoption of DERs combined with rising regulatory, operational efficiency and customer expectations are rendering obsolete the traditional model of energy delivery. In addition, the proliferation of smart meters, IoT sensors, electric vehicles, energy storage and smart home devices are all pushing utilities to the precipice of becoming data-driven organizations in order to thrive amid this disruption.

Using this platform-based approach to advanced distribution grid management, utilities have the tools to address the dynamics of a 21st-century grid with a holistic, enterprise-wide approach. Rather than the traditional, specific operations unit-based efforts, an integrated approach to achieve scale while cost-effectively integrating future customer demands, grid operations, asset management and workforce optimization is the necessary journey forward. The roadmap to success is not one size fits all, but it begins with executing on a strategy that puts all the pieces together and unlocks opportunities not just for one group, but across the entire enterprise.

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