DERMS: Maximizing the Value of Distributed Resources

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Introduction

The role of a utility is becoming increasingly complex. For most of the last century, energy flowed in one direction—from large, centrally-located generators to homes, businesses and commercial industry through a grid managed and operated by Generation, Transmission and Distribution utilities. These utilities are tasked with providing reliable, safe power by ensuring generation supply balances to end-consumer load on a minute-by-minute, day-by-day basis.

In recent years, however, this balancing act has grown considerably more complex. While large generation plants still form the backbone of the system, operators must now account for bi-directional power flows and variable output from grid-scale renewable resources. Further complicating the picture is less predictable consumer demand due to the increased adoption of distributed energy resources (DER) like rooftop solar, energy storage, electric vehicles and in-home smart devices. When unseen and unquantified, these distributed energy resources can create operational problems on the grid.

However, adopting DERs on the grid also represents a significant opportunity. Once visible, forecasted and controllable, distributed energy resources provide significant value to the grid, often in ways that legacy generation plants cannot. To manage DERs, many utilities have started to utilize DERMS, or Distributed Energy Resource Management Systems. These enterprise-wide software solutions enable all utility stakeholders—operations, consumer engagement, marketing bidding and more—to monitor and intelligently control DERs in an orchestrated fashion from the distribution transformer to market integration.

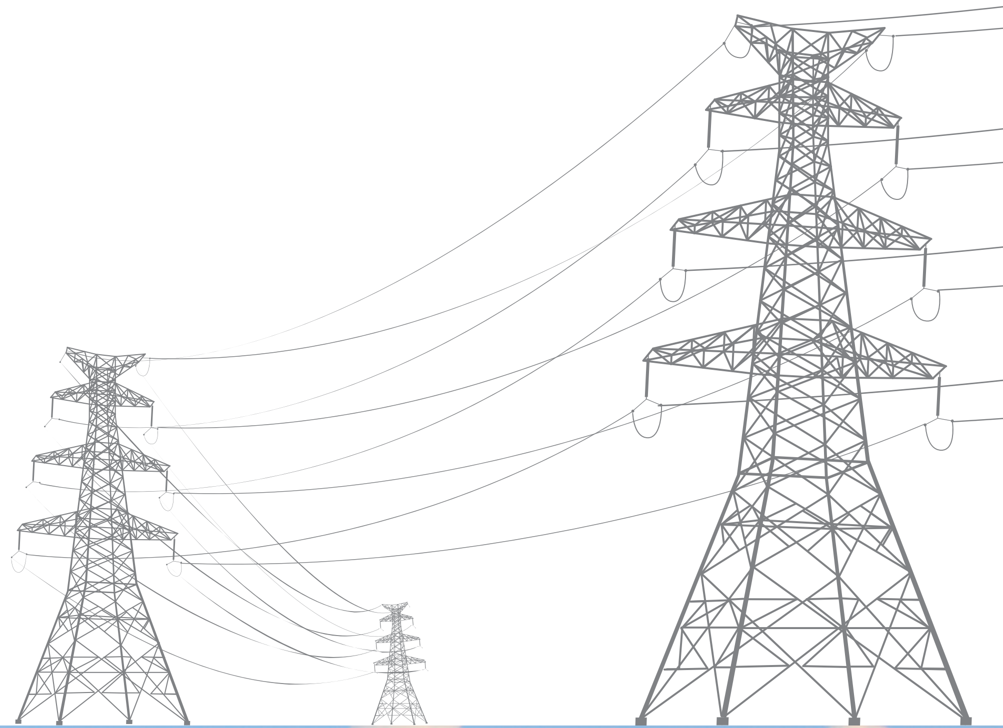
As the industry continues through a period of unprecedented changes, solutions like DERMS are quickly becoming indispensable tools, allowing utility operators to optimize their operations today by making better, more informed decisions. Not only can they maximize the value of their DER assets by delivering reliable power to consumers, but with DERMS they can plan for the "next-generation" systems of the future.

Significant Changes—and Challenges

Electrification

Since 2000, global demand for power increased by more than 70 percent with a large part of that increase being fulfilled by renewable sources, like wind and solar, which now represents nearly a third of all power generation. In 2013 the installation of residential solar alone in the United States was 792 megawatts, representing a 60% increase over 2012. Fast forward to the present and almost six gigawatts of residential solar was installed last year with the U.S. Energy Information Administration estimating that another 63 gigawatts of solar will be implemented by the end of 2024, much of it added to the distribution grid.

While a host of factors are behind the increase in demand, two of the largest are the growing number of industrial companies turning to electrification – particularly renewable power – to help reduce their carbon footprint, and the widespread adoption of electric vehicles. Globally, the



International Energy Agency forecasts a 35 percent increase in EV sales this year, enough to account for 20 percent of all vehicle sales. It is fore-casted that over 50% of all vehicles sold will be EV/s by 2030.

Meeting those growing needs, however, isn't as simple as pouring more electricity into existing systems. In many areas, the electric grid is already at capacity, so adding more power to the system could lead to brownouts or cause equipment breakdowns.

Variable Renewable Generation

Further complicating things are the specific challenges—like intermittent generation and frequency regulation—that come with renewable power.

While it offers great promise for decarbonization and helps the world meet net-zero emissions goals, the intermittent nature of renewable power—wind turbines only turn when the wind blows, and solar panels only produce electricity when the sun shines—creates a significant hurdle. To understand how to integrate renewables into the grid, operators must be able to reliably forecast when and how much electricity they generate and what impact it will have on the grid.

An additional challenge for incorporating renewable power into the grid is its lack of inertia, which plays a key role in dealing with breakdowns across the grid. The spinning turbines in traditional generation sources provide inertia and ensure power flows at a steady frequency (60 Hz in the U.S., 50 Hz in Europe). That inertia acts like cruise control for the grid—should a generator break down; the turbines' inertia provides power to keep the system running for the few seconds it takes for other generators to speed up and ensure power supply remains constant.

With renewable power, that inertia is nonexistent. The system must react much faster, so many operators rely on smart inverters to make sure renewable power enters the grid at the right frequency, and to curtail load as conditions across the grid change. While the increase in the use of renewable power is forcing utilities to contemplate how to modernize the grid, it's far from the only change the industry faces.

Bi-Directional Power Flows

As DERs become increasingly abundant, the demands of managing thousands of grid-connected devices and their impact on system operations are forcing many utility operators to consider a paradigm shift in how they do business.

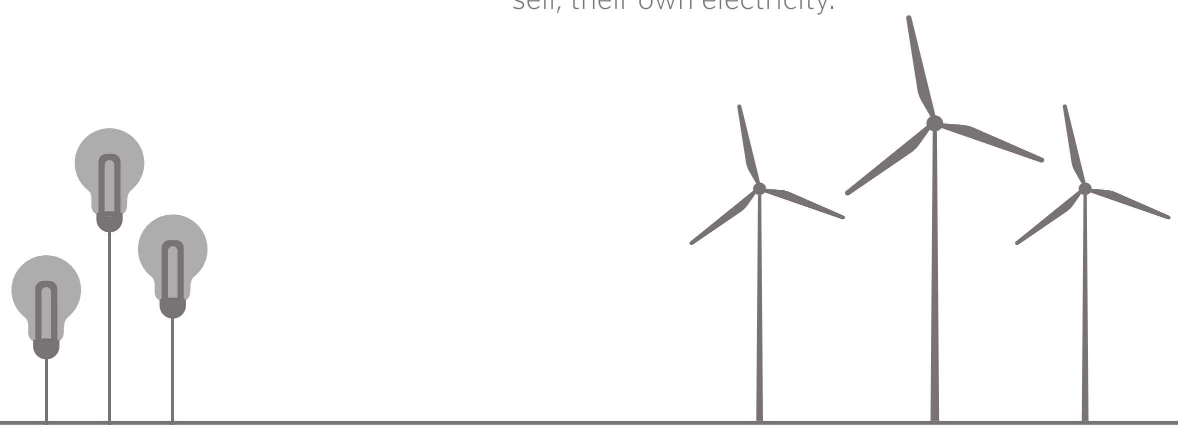
Historically, that business flowed in only one direction—large, centralized power plants generated electricity, which was then transmitted to substations, and from there it was distributed to homes and businesses. Today, that one-way road is being transformed into a two-way highway that carries not just electricity in both directions, but also a broad range of data from millions of DERs. Utilities need to engage consumers with new business models and programs to encourage adoption and optimal time-of-use of the many DER's available.

Situational Awareness

For utility operators, deriving actionable information from this data is critical—without it, they have only a partial picture of what is happening on the grid at any one moment. Having visibility into what devices are connected to the grid, where they're located and how much power they are generating or consuming allows operators to make real-time decisions about how to balance load on the grid and optimize performance for customers.

Industry Regulation

For customers, the rise of DERs—particularly devices like residential solar and other renewables—can not only translate into significant savings as they generate their own power, but new regulations in both the U.S. and Europe are opening the door to a new class of "prosumers," customers who produce, and then sell, their own electricity.

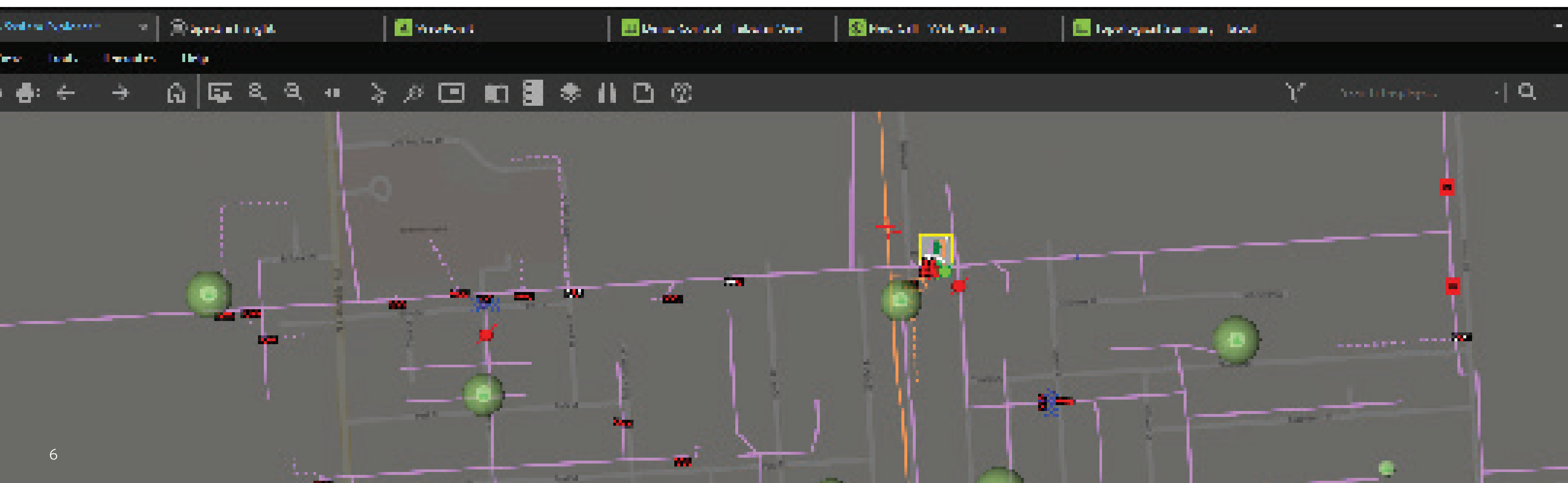


In the U.S., Federal Energy Regulatory Commissions (FERC) Order 2222 allows customers and other companies to aggregate DERs into Virtual Power Plants, large groups of individual DERs which—due to their aggregate size—have significant impact on grid operations and more economic value to grid markets than individual DERs. Approved in 2020, the rule—and similar regulations enacted in Europe—marks a fundamental shift away from a centralized generation business model for utilities, and many are still working to understand the mechanics of how aggregated DERs can be integrated into the wholesale energy markets.

How an Enterprise DERMS Delivers Value

While many companies are offering some form of DERMS software, the reality is that most are relatively limited and manage only a single or very few DER types. To be considered a fully encompassing enterprise-wide DERMS solution, the software must provide:

- A system of systems approach allowing management of all DER, including aggregator DER in a single platform
- Multiple personas for control room and non-control room that enable operational flexibility, promotes collaboration, and enables visibility and reporting across stakeholders
- Dynamic resource management allowing operators to schedule and dispatch resources by device type, location, and more
- Resource value maximization and market participation capabilities across all types of DERs
- Securely operate within the utility control room while fully integrated to real-time control systems
- Provide full visibility and awareness of DER behavior to the utility
- Forecast and optimize DER for safe grid operations
- Advance sustainability goals by maximizing DER usage and quantifying impacts



Improved Grid-Reliability and Situational Awareness

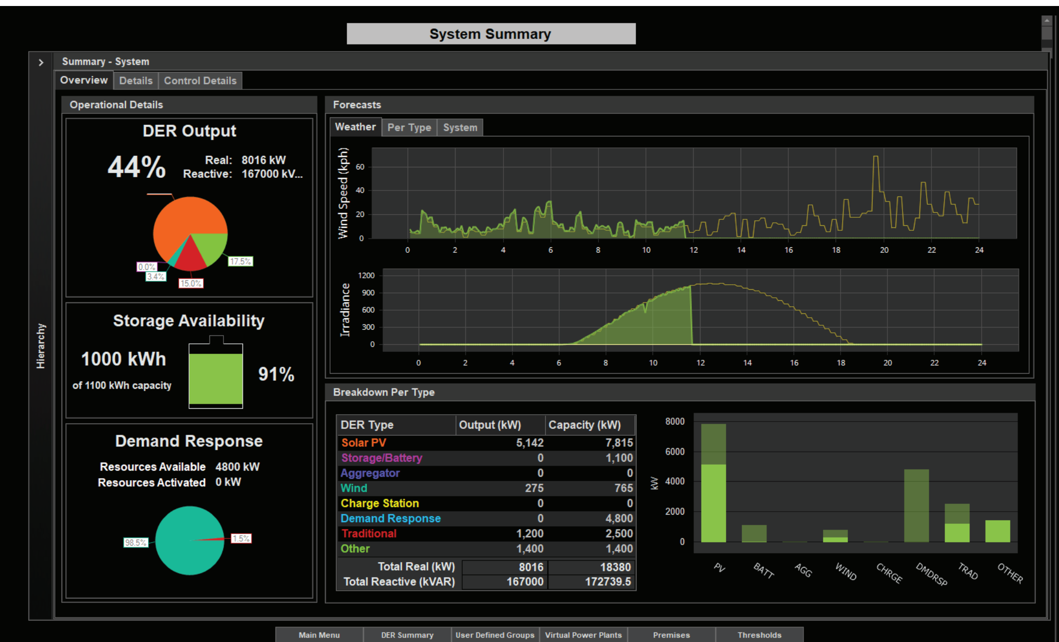
A key feature of any DERMS software is to give utility operators the ability to track, understand—and in some cases—control the behavior of the thousands of DERs connected to the grid. Until recently, accessing that information was all but impossible, effectively making DERs a black box for operators; they knew they were out there, but understanding their impact on the grid was, at best, an educated guess.

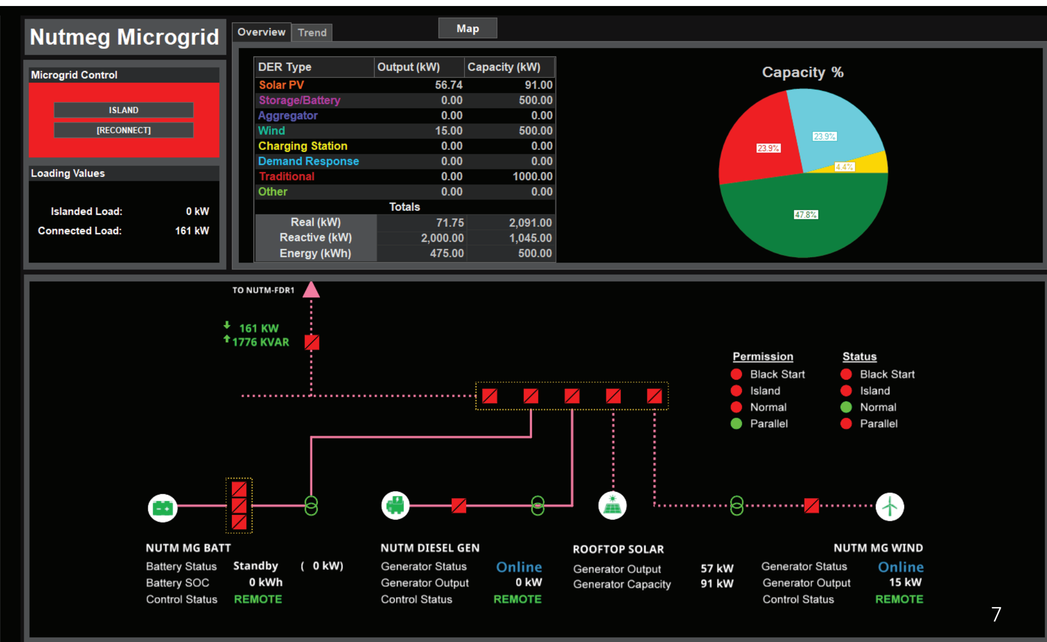
Part of the problem can be attributed to the way DERs have typically been connected to the grid. Before installing solar panels, for example, a homeowner must apply for an interconnection permit, which allows them to connect their system to the grid. Once approved, information from that permit—like the location of the system and how much electricity it generates—might be recorded in a spreadsheet for use by customer-facing teams.

Importantly, though, that data often doesn't find its way to real-time operators responsible for managing the grid. As a result, they are forced to work in the dark; they may have a broad estimate of the number of DERs on their system, but their location and how much they contribute to load on the grid are a mystery. Without that data, it is difficult for operators to predict when problems might occur, how to avoid them and how to react when they do.

In other cases, it may even cause problems. If operators are unaware a particular neighborhood or region contains a large number of DERs, bringing them online—particularly if the substation is already at or near capacity—could lead to a breakdown or cause transformers to fail, causing interruptions which could otherwise have been avoided.

Enterprise DERMS software overcomes each of those challenges. The systems allow operators to see, in real-time, what devices are connected to the grid, their location and how they impact load, making it far easier to balance the load and keep the power on. Using advanced tools to analyze





power flow, DERMS allows operators to analyze the impact of DERs on the grid, to create alarms that warn when DERs are causing issues, and—in some cases—to control how they operate by shutting them down or curtailing operation to mitigate potential problems.

By enabling increased grid efficiency, DERMS also allow utilities to extend the life of existing equipment, like substations, distribution transformers and more, resulting in significant savings in capital investments. At the same time, they also add value, through the creation of virtual power plants and by enabling greater access to wholesale energy markets, and in the process, encourage greater investment in DERs ranging from rooftop solar panels to battery storage to in-home smart devices.

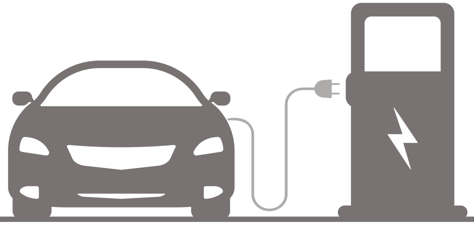
Forecasting and Optimization

While DERMS are critical to helping keep the grid up and running, they also play an important role in making it greener by allowing utilities to plan for and manage more precisely how renewable energy is integrated into their systems by looking an hour, a day, a week or even a month into the future.

Using forecast tools, the software can predict when solar panels or wind turbines will be generating the most power throughout the day. If, for example, the system anticipates solar generation to peak between 2:00 and 4:00 p.m.—pushing the grid over capacity—it can redirect some of that energy into charging batteries. Later in the day, or overnight, when solar generation drops, those batteries can be discharged, supplying green energy to the grid.

By making additional non-carbon intensive resources available to grid operators, DERMS—along with other digitalization technologies—will play a key role in helping deliver a more sustainable world.

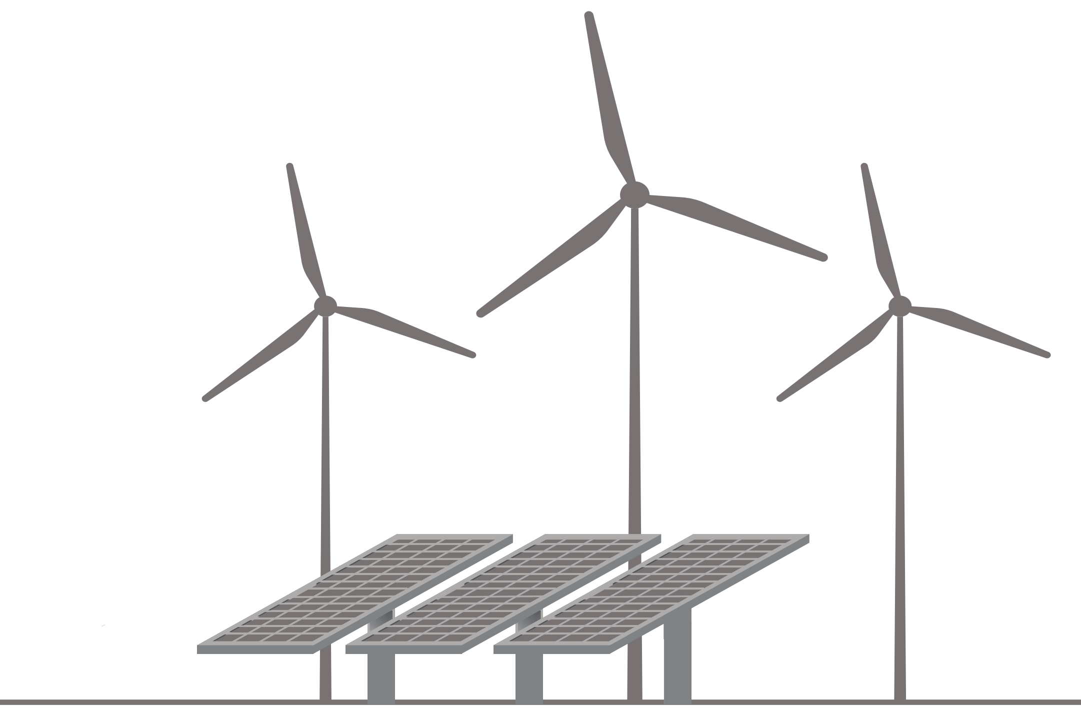
By providing an unprecedented level of visibility and predictability into DERs on the grid, DERMS software acts like the system's brain, allowing operators to know exactly what devices are connected to the grid, how to use them and how to optimize their performance. Accurate forecasts paired with intelligent scheduling can assist in shifting or flattening peak demand for the system. Taking advantage of leftover capacity of DERs during scheduled periods allows these DERs to also be used in grid operations to assist with capacity, frequency or voltage events that arise throughout the day.



Aggregation and Market Participation

With the introduction of FERC Order 2222 in North America, entities capable of aggregating 100kW of power (either generation or demand response) are eligible to bid that power into the wholesale energy markets. Similarly in Europe, aggregators can utilize their flexibility by offering power-balancing bits from 1MW.

DERMS can play a key role in supporting this requirement. Providing the visibility and control of these DERs is a starting point, but the systems also offer a way to integrate DERs with existing generation or transmission systems and the wholesale markets. The ability to aggregate the DER and provide a single generation unit while also being able to disaggregate the market signal is a function that falls well within the DERMS domain.



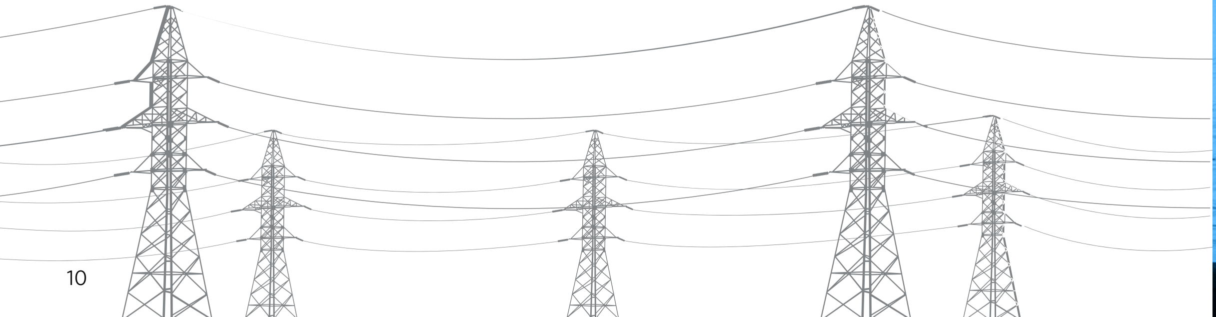
Conclusion

Like many other asset-intensive industries, utility providers today are facing a period of intense change as the world makes its way through the energy transition.

As their business model becomes more complex, utilities must find new ways to not only keep the power on for customers, but also meet the challenge of managing thousands—or even millions—of devices, each of which has a different and specific impact on the health of the electrical grid while also planning for a more distributed, diverse future.

For those companies with the vision and determination to take advantage of the opportunity, DERMS software offers not just a solution to those challenges, but also a pathway to create significant new value for utilities through operational improvements, more efficient utilization of existing assets and the harnessing of DERs to create non-carbon emitting grid resources.

As the world navigates the uncertain waters ahead, DERMS is a new tool in the utility operators' toolbox, one that will help them both adapt to the dramatic changes to come and transform their businesses to deliver a sustainable, and profitable, future.



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