Data-Savvy Networks for a SUSTAINABLE UTILITY FUTURE
Data is the foundation of a more sustainable power system — especially for enabling more renewables and creating greater efficiency. Consequently, utilities around the world are becoming more data-driven than ever, in all aspects of their business and operations. This transition, however, isn’t easy; many utilities struggle with managing, analyzing and applying their grid data deluge.

This data comes from many sources: advanced metering infrastructure (AMI), grid sensors and other utility assets — as well as renewables and other distributed energy resources (DERs), both on the grid and behind the meter. But even more data is coming from nontraditional sources, especially internet of things (IoT) devices, home energy management systems and electric vehicle (EV) charging stations.

“Fifteen years ago, we had tens of thousands of data sources connected to our grid — and that felt like a lot at the time,” said Josh Stallings, systems and standards manager for Georgia Power. “But now we’re communicating with over 2.5 million smart meters, taking multiple readings per day. And with all the new end uses that customers are adding, our data influx is growing by a factor of about one million. If we don’t get a handle on it, that could outpace our ability to take advantage of opportunities for DERs, demand response and energy efficiency.”

Historically, Georgia Power’s grid-related data was mostly compartmentalized, with separate databases for SCADA, outage management, customer relationship management, billing and work management. But today, that utility is starting to bridge these data silos.

“We’re transitioning to a more unified pool of data,” Stallings explained. “Our AMI data is now accessible beside our outage management and demand management data. We’re moving from a segmented structure to a more centralized cross-platform structure.”

Looking beyond the utility, data integration with third parties such as vendors, emergency response agencies and weather services can support grid operations that are not only more efficient and reliable but also safer and greener.
Effective use of real-time data also keeps network models accurate and up-to-date. These models are the foundation of utility operations and resource planning, so their accuracy determines a utility’s ability to optimize capital and operational budgets. This helps utilities maximize the benefits of DERs, efficiency and demand response. It also supports advanced strategies such as non-wires options to expand grid capacity, DER management systems (DERMS), advanced feeder management and outage prevention.

Currently, most utilities are doing their best to work with their existing data and tools. This playbook explores what more might be possible by expanding those resources.

It may seem daunting to ponder the considerable, diverse opportunities that data can offer to utilities and customers. Fortunately, data management and analytics partners can help utilities navigate this learning curve, with secure and scalable services to support emerging technologies and use cases.
Utilities must stay closely attuned to customers, which means being ready to respond to changing or emerging consumer preferences. The advanced services that customers now expect to have require robust data collection, management and analytics. That’s one reason why grid data, and its management, have become a high business priority for Georgia Power.

As utilities shift to treating customers more like customers — and less like ratepayers — customer segmentation becomes a key driver of business value. “What does a customer’s energy usage tell us about who they are and what they want?” said Rachel Gold, senior manager for utilities at the American Council for an Energy-Efficient Economy (ACEEE). “For many utilities, basic customer segmentation is a fairly new task. They’re still figuring out who their customers are, and finding opportunities to provide value to them: comfort, savings and alignment with consumer interest in sustainability. AMI has become a powerful customer engagement tool.”

Consequently, utilities are increasingly designing programs that deliver insight based on analysis of customer energy usage, leveraging data as a communication tool. “These offerings can be very popular, as long as the utility doesn’t get too specific about what they know,” Gold said, adding, “Don’t be creepy with customer data.”
The ability to get data from, and communicate with, many consumer devices is helping residential customers become more active grid participants — primarily via automated demand response programs. Historically, residential demand response was mostly confined to rudimentary remote cycling of air conditioners or water heaters during a handful of system peak events each year. But with advanced analytics, AMI systems can disaggregate specific uses — say, a home heating system, water heater and EV charging. This paves the way for programs that reward customers for helping to shave system peaks, or to compensate for renewable intermittence or local grid disturbances — not just once in a while, but every day.

“Utilities are always seeking to improve the quality and reliability of service. The new capabilities that customer devices provide can help utilities maintain voltage levels, prevent outages and generally manage the grid more efficiently — as long as they can effectively manage and analyze all that data,” said Brad Williams, vice president of industry strategy, Operational Technologies, for Oracle. “Taking customer resources into account is how we’ll be able to manage much higher penetrations of renewables on the grid and fulfill the potential of smart appliances. This is how we’ll achieve much deeper insight into power flows on the grid.”

In Georgia, the pace of renewables growth is accelerating. Nearly 1000 MW of solar capacity was added to Georgia Power’s grid in recent years. So far, this has mostly been solar farms and community solar, but rooftop residential and commercial solar installations are expanding quickly there. This is putting pressure on Georgia Power to ensure the real-time accuracy of its network model.
“A fundamental challenge ahead of us is integrating customer usage data into the control center which means we need to link each of our customers to the correct transformer line segment in our network model,” said Stallings. “We have a fully connected network model from the generation source to the transformer, but we lack a graphical view of where every customer is.”

Such an information gap can have significant consequences. For instance, when a customer adds rooftop solar, the utility might misunderstand which circuit and transformer they’re connected to. “When that happens, we’d see their solar output show up on a totally different part of the grid, which throws off how we manage our grid assets,” said Stallings. “Removing those errors means we can deploy all of our resources as needed.”

As Georgia Power eyes opportunities to introduce locational incentives, or real-time demand response programs that would dispatch customer resources to support grid operations, accuracy is essential for success. “It also means we can't fully incorporate the value of that solar as a resource on our grid. If we want a resource to support circuit A, but it’s really on circuit B, that’s a problem for how we manage our grid.”

Data and analytics from devices behind the meter can also enable utility programs that support these devices. For instance, the utility might notice that a customer’s water heater or pool pump appears to be malfunctioning, and proactively offer that customer repair services, or a rebate or discount on an efficient replacement. Or, they might notice a steady drop in rooftop solar output and offer a service to clean the panels. Detection of such conditions and delivery of this information to program staff can be automated, increasing program utilization with relatively low incremental investment.
Improved Situational Awareness

Currently, most utilities have little or no visibility into the operation of DERs or individual loads on their grid. They see the net effects of renewables, smart appliances, storage or efficiency measures, but usually little else. But when utilities do have this visibility, through data and analytics, their options for managing the grid expand strategically as well as tactically.

For example, when utilities integrate, at the control room level, continuous and granular weather data, that helps them predict not only solar output for specific grid locations but also likely customer behavior and energy consumption patterns. Anticipating grid conditions, not just reacting to them, provides more flexible options for maintaining service quality and reliability.

Williams explained that predictive grid management does not necessarily require real-time data from solar generation, storage or other DERs. “Many utilities can get AMI readings at 15-minute intervals, plus alarms for reverse power flow, low voltage or other line problems,” he said. “When you combine that existing data with highly accurate network models and weather data, machine learning algorithms can account for past performance. All of that provides a far more accurate DER forecast.”

This can compensate for a lack of sensors supplying real-time data on conditions at the grid edge. “As long as you have a real-time feed of substation data, then you can use a load allocation algorithm to separate loads from DERs,” said Williams. “Use the substation as the basis for estimating power flow. Just aggregate all the data from the grid edge up to the connection point. The machine learning algorithm compares that to the AMI history: what was happening on that part of the grid at that time? By integrating these data types, we can get a very deep understanding of how the grid really functions.”
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Josh Stallings, systems and standards manager for Georgia Power

Understanding the grid at this depth and level of detail also helps utilities proactively target programs and projects. Which parts of the grid have the most capacity to add rooftop solar, or might benefit most from incentives for smart appliances or energy efficiency upgrades? These decisions can be made based on actual grid data and conditions.

Stallings emphasized that the traditional utility culture of developing solutions in-house typically cannot provide results as fast as they are needed. “We want to get our network model to the point where we know exactly where all customers are, from a graphical and electrical standpoint. We’ve been trying to develop that in-house. But now we are pursuing a vendor solution to fix that problem,” he said. “Sure, we’ll pay a little for it. But a good vendor could implement in six months what we haven’t been able to do in a year or two of going it alone.”

Working with data and analytics solution providers entails a collaborative learning curve. Every utility and market is unique, and each vendor offers unique capabilities.

“It’s very much a partnership in our case. We’ve learned that we don’t have all the answers — and I haven’t met a vendor who has either,” said Stallings. “It’s about blending expertise and giving vendors insight into our specific business challenges.”
Utilities can develop a comprehensive information management strategy that supports your data strategy. Best results generally involve blending in-house data, expertise and resources with outsourced and vendor-developed solutions.

To get started, it helps to focus first on use cases that offer a fast payback, such as transformer/asset load management. “There’s usually a lot of low hanging fruit there,” said Williams. “Even a single project can demonstrate the effectiveness of a data-driven approach.”

For instance, utilities can mine data to determine which transformers are most at risk of overloading — which can entail lengthy, costly emergency repairs and significant disruption to customers. Placing mobile generation to serve customers during a planned repair or replacement during normal business hours can reduce costs considerably, with no disruption.

Next, utilities can use operational data to inform and enhance business processes: billing, marketing, customer service, appliance and maintenance programs, etc. Also, this data can help evaluate program performance. “Regulators tend to appreciate it when you can report back not just kWh savings, but how this program also enhanced grid operations and reliability,” said Gold. “Plus, by monitoring performance, the utility discovers ways to make programs work better.”
In the long-term, a data-driven utility is best equipped to deploy efficiency, storage, renewables and demand response in ways that meet customer expectations. Plus, it positions utilities to accommodate transformation such as the electrification of transportation, participate more effectively in smart cities partnerships and expand revenue options through creative programs that proactively meet emerging needs.

The challenges on this path encompass several dimensions:

- **Cultural.** Organizational silos and a compartmentalized mindset. Also, utility personnel have long been rewarded for being cautious rather than innovative.
- **Technical.** Integrating data and analytics into the utility operations center, and executive and departmental dashboards, to support sound real-time decisions.
- **Financial.** Utility accounting and finance strongly favors capital expenditures over operating expenditures in the resource planning process — and data and analytics initiatives tend to be viewed as OpEx, not CapEx
- **Lack of vision.** Failing to consider the trajectory of technology development and related issues, such as environmental, policy and regulatory trends.

At this time where conditions and technologies affecting the grid, as well as data and analytics options, are shifting almost too quickly to comprehend, experienced data partners can help guide utilities to invest in turning their data into an asset. This could prove as essential to new utility business models, and more sustainable power systems, as the deployment and integration of power grids at the turn of the last century.
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