AI-POWERED DATA ANALYTICS

PLAYBOOK

BETTER GRID OUTCOMES THROUGH BEHIND-THE-METER 8760 INTELLIGENCE

EV GRID CAPACITY PLANNING | DER GRID CAPACITY PLANNING | EXTREME WEATHER-RELATED PLANNING

bidgely

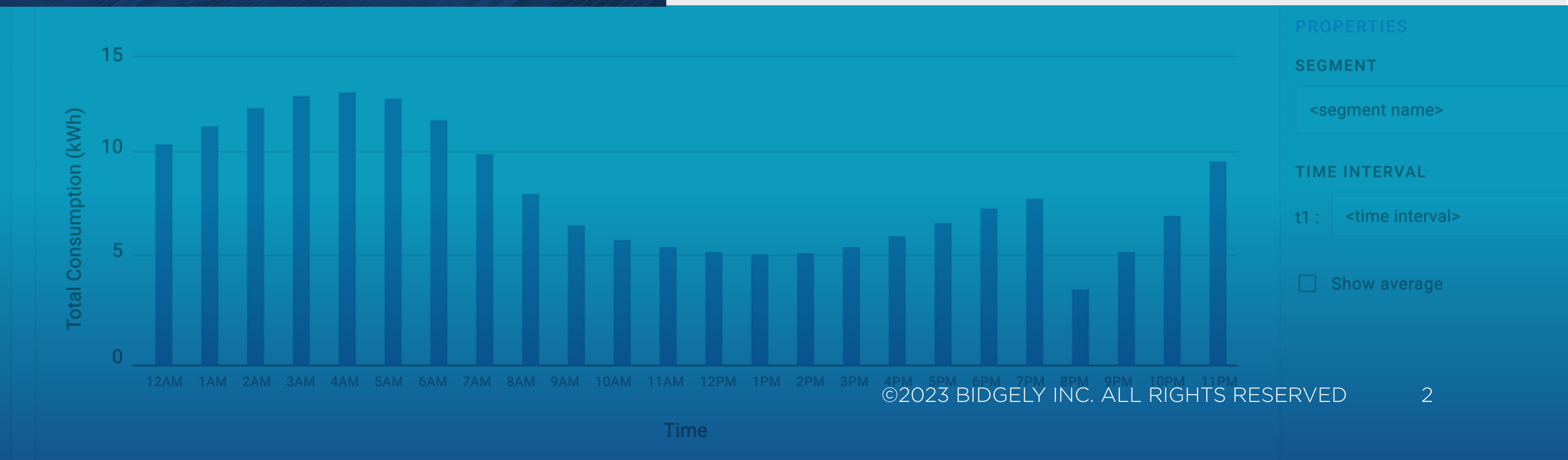
The grid is growing exponentially more complex. Distributed Energy Resources (DERs) such as solar and wind are shifting the predictability of energy generation, while an increasing number of consumer electric vehicles (EVs) and large-scale EV fleets have introduced more variability and greater peaks on the demand side. These electrification and decarbonization trends are disrupting utilities' traditional approach to grid management.

As a result, we're entering an era in which granular, AI-powered data science tools are essential to predict future load patterns, encourage grid-stabilizing customer behaviors, manage distributed energy resources, and above all better understand the load impact on grid-facing assets such as distribution transformers, feeders and substations. Utilities need the capability to evaluate grid performance starting behind the meter at the appliance-level, and on an hour-by-hour basis for all 8760 hours in a year.

To support energy providers in implementing future-ready grid planning and management strategies, we've developed this AI-Powered Data Analytics Playbook: Better Grid Outcomes Through Behind-The-Meter (BTM) 8760 Intelligence, that sets out best-practice approaches, including:

- **Step 1:** Build a Territory-Wide, Bottom-Up "8760 Energy Model" (8760) Data Foundation
- **Step 2:** Plan to Realize Organization-Wide Meter Data Value
- **Step 3:** Make Better Informed Decisions about Non-Wires Alternatives and Infrastructure Investments

In addition, to round out the playbook, we examine three use cases of 8760 data-informed grid strategies in practice: **EV and DER grid capacity planning and extreme weather-related planning.**



STEP 1: BUILD A TERRITORY-WIDE, BOTTOM-UP "8760 ENERGY MODEL" DATA FOUNDATION

A bottom-up approach to data analysis looks first and foremost at analytics derived at the individual home consumption level.

Historically, load research has been done at a moment in time and on a small set of customers. This approach made sense in the past when smart meters were not commonplace. However, with increasing AMI deployment, it is no longer necessary to rely on imprecise sampling.

In a major leap forward, energy providers can now apply AI to smart meter data to identify the foundational building blocks of service territory energy use: the consumption of individual appliances within a home. AMI data offers significant opportunities to learn in great detail about the individual load curve of each customer and how much they contribute to the grid. What that means from a grid management standpoint is a much deeper and more granular understanding of usage and its impact on each of the grid assets.

ACTION STEPS

Leverage AI-derived disaggregated home energy data to create an individual customer energy use profile for every household in your service territory.

Aggregate the data at the grid asset level to produce 8760 load curves for specific segments.

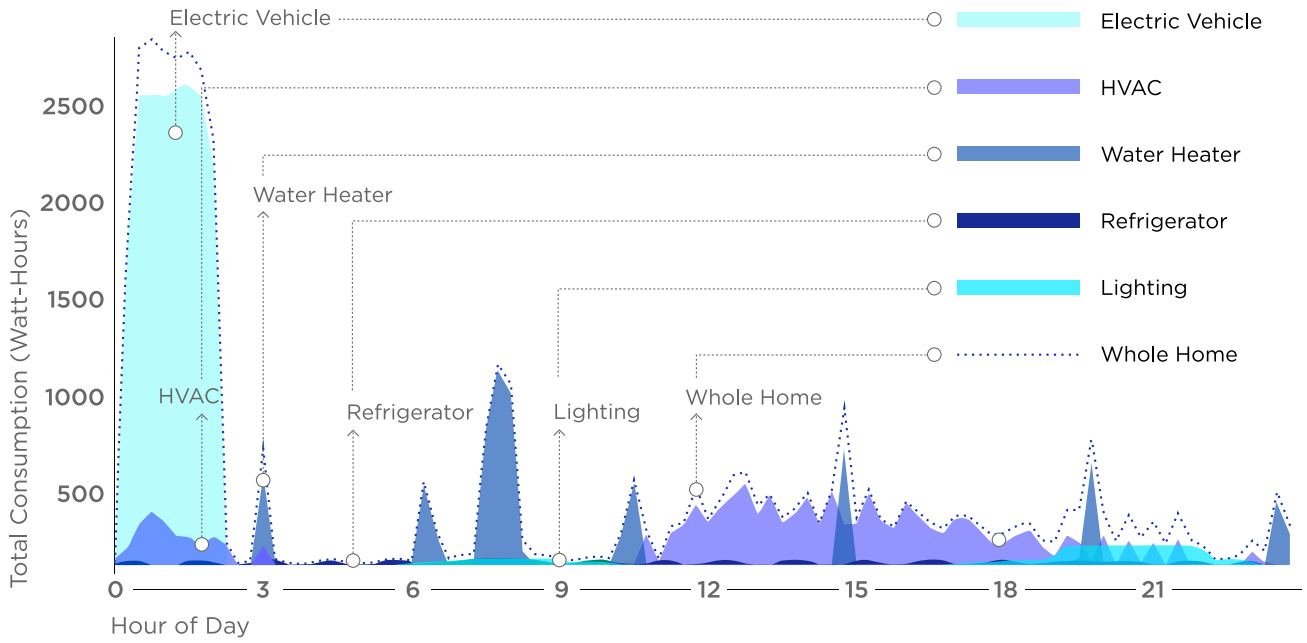
Enhance load research by examining 8760 data iteratively, tracking customer and customer segment data over time to identify trends.

GETTING STARTED

CREATE AN INDIVIDUAL CUSTOMER ENERGY USE PROFILE FOR EVERY HOUSEHOLD IN YOUR SERVICE TERRITORY

Disaggregated household energy use data enables energy providers to cost-effectively create highly accurate and comprehensive appliance-level energy use profiles for every residence. These profiles reveal essential load research data inputs, including such things as:

- **Which homes have EVs and who is charging during peak hours**
- **Which homes have inefficient or degrading HVAC systems**
- **Which customers are using the largest loads for particular appliances such as cooling**
- **Which customers are ideal candidates for new rate structures**



Bidgely's patented, AI-enabled disaggregation analytics let energy providers see behind the meter at the appliance level to understand each customer's unique energy profile.

AGGREGATE THE DATA AT GRID ASSET LEVELS TO PRODUCE 8760 LOAD CURVES FOR SPECIFIC SEGMENTS

When energy providers are empowered to conduct load research based on how load is being used at a each household in a service territory, those building block insights can then be aggregated to provide actionable intelligence at both the customer-segment and grid-asset levels — for example, in connection with a specific feeder or substation.

8760 granularity enables appliance-specific load shape analysis by the hour on weekdays or weekends, summer or winter, across different geographies and for different rate plans. It is then possible to compare various profiles to see the effect of rate plans, demand response and distributed energy resource management systems on load shift efficiency.

This analysis also reveals how much flexible load is available by transformer, feeder or substation, which can be particularly useful in identifying what demand is shiftable during critical peak events.

ENHANCE LOAD RESEARCH BY EXAMINING 8760 DATA ITERATIVELY, TRACKING CUSTOMER AND CUSTOMER SEGMENT DATA TO IDENTIFY TRENDS

Disaggregated customer energy use data captures essential aspects of a customer's lifestyle over time, and reveals the variation in customer behavior or occupancy at different points during the year. Customer profiles reflect current household conditions and how they have changed from one month to the next, including the impact of unexpected environmental and societal events.

The ability to track customer energy use on an ongoing and iterative basis makes it possible to identify emerging and growing trends before they impact grid operations to enable more accurate and strategic planning.

For example, in the case of electric vehicle grid planning, AI-powered data visualization allows teams to pinpoint where constraints may exist or develop. This approach also enables meaningful comparisons between various customer profiles and segments to determine the effect of rate plans and demand response and distributed energy resource management systems (DERMS) to analyze the load shift efficiency and identify how to fine tune load shift programs to align with changing conditions. Ultimately, by leveraging 8760 household energy use data, energy providers are empowered to embrace changes to the status quo and evolve with the grid.

STEP 2: PLAN TO REALIZE ORGANIZATION-WIDE DATA VALUE

When meter data analysis is employed cohesively across energy organizations, the benefits are far-reaching. While one team can leverage it to deliver greater grid stability and reliability, another can optimize marketing programs and improve demand response, while a third works on boosting customer satisfaction.

The key to realizing this cross-organizational value is to regard meter data and meter analytics like disaggregation as a single source of truth from which all teams can benefit, and then establish internal leadership and processes to realize that ROI.

ACTION STEPS

- Establish a cross-functional team to collaboratively identify all of the potential needs, benefits and costs of a meter data analytics solution.
- Choose an AI-powered data analytics platform that can enrich and add value to existing legacy systems.
- Prioritize high value analytics use cases which will have the most impact on the business.

GETTING STARTED

ESTABLISH A CROSS-FUNCTIONAL METER DATA ANALYTICS TEAM

Establishing an inter-departmental team to identify big-picture data analytics needs, benefits and costs is essential to breaking through the silos of traditional utility organizational structure and creating a more holistic solution that better satisfies utility-wide needs.

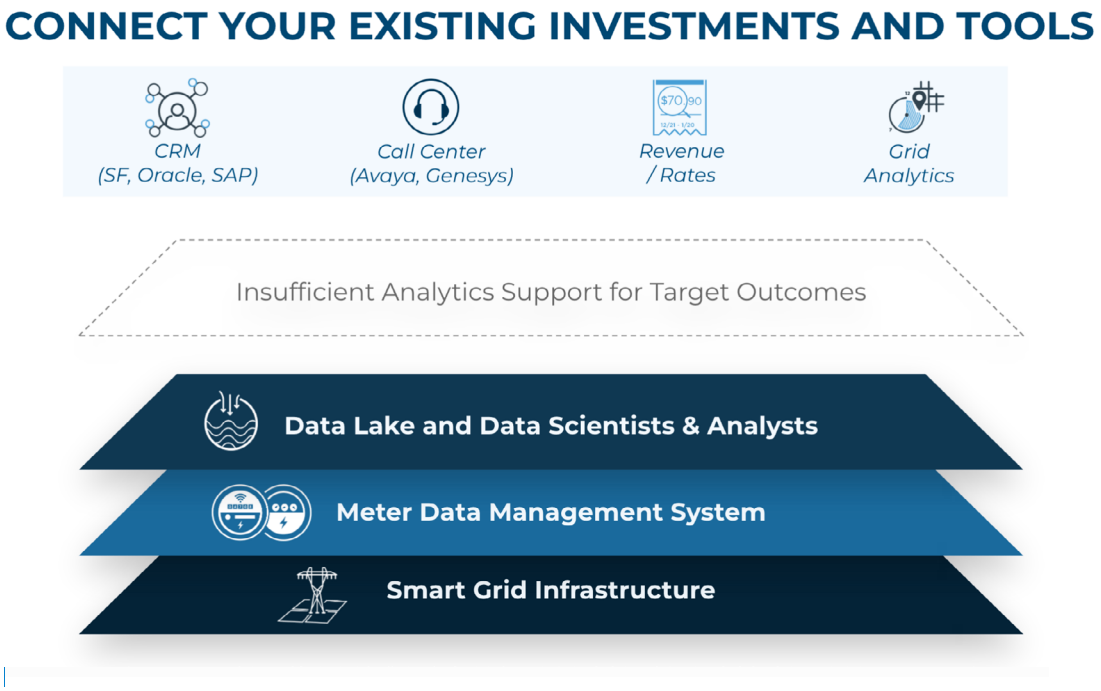
Consider the diverse perspectives that representatives of the technology, rate planning, demand-side management, call center and grid planning teams would bring to solution analysis. Each team has its own long list of use cases for leveraging meter data to improve the ability to execute.

CHOOSE A DATA ANALYTICS PLATFORM THAT CAN ENRICH AND ADD VALUE TO EXISTING LEGACY SYSTEMS.

The data analytics team's charter should include identifying solutions that can be leveraged by multiple groups within the organization. Because some teams will have different needs and requirements than others, it can be tempting to purchase spot solutions from multiple vendors. However, it's important to keep in mind that holistic offerings can help break down unnecessary organizational silos, while department-specific offerings often reinforce them.

Organization-wide usability is not only a matter of providing essential functionality for multiple departments. It also requires that a solution seamlessly integrate with existing tools and data systems to enrich the overall data stack and extend platform ROI across the board. Don't let your data drown in your data lake.

Usability is also an important metric, as data analyst groups are over-extended. A data analytics platform should enable self-service by non-technical staff to ensure there is no backlog in realizing data value.



PRIORITIZE HIGH VALUE ANALYTICS USE CASES WHICH WILL HAVE THE MOST IMPACT ON THE BUSINESS.

If meter data is to serve as a single source of truth from which all teams can benefit, it is important to have processes in place to prioritize use cases based on impact, such as those that have relevance to multiple departments.

Turning again to EV adoption as a case study, for example, if the grid planning team observes that a pocket of EV adoption is emerging, that data is not only important to their infrastructure planning but also to the demand-side management team as they design new behavioral managed-charging programs. Official insight sharing protocols help ensure data discoveries benefit all groups.

STEP 3: MAKE BETTER-INFORMED DECISIONS ABOUT NON-WIRES ALTERNATIVES AND INFRASTRUCTURE INVESTMENTS

Over the next 10 years, Non-Wires Alternatives (NWAs) and optimized capital investment strategies will become core instruments in energy providers' toolboxes. Utilities that leverage meter data analytics will realize a higher return on investment, lower operating costs, and a flexible business structure that is more resilient to extreme events.

With insights garnered from AI-powered data analytics, utilities can identify granular opportunities to reduce demand, implement targeted infrastructure improvements and expedite congestion management and investment planning decisions.

ACTION STEPS

Forecast load, reliability and resilience with improved accuracy.

Design Non-Wires Alternatives with greater success rates.

Maximize the ROI for new infrastructure investments.

GETTING STARTED

FORECAST LOAD, RELIABILITY AND RESILIENCE

With a bottom-up understanding of appliance ownership — including how much appliances are used, when they are used and where — energy providers are able to visualize territory-wide load shapes on an appliance basis.

These load shapes can in turn be used to forecast overall peak load five to 15 years into the future, by combining load shapes with macro-level assumptions about housing and appliance ownership.

They can also enable scenario-based forecasting, such as by informing impact analysis of beneficial electrification on peak load by viewing load shapes for electric heat pumps, electric water heaters and EVs.

DESIGN MORE SUCCESSFUL NON-WIRES ALTERNATIVES

Analyzing load curves for every grid asset reveals their maximum, minimum, and average demand to inform both strategic load shifting programs on constrained assets and beneficial electrification on assets with spare capacity.

With a precise picture as to which substations are coming under strain, identifying which appliances are contributing to peak load and quantifying their ownership reveals which NWA programs have the greatest energy-saving potential as well as how such programs can be optimally targeted.

Similarly, 8760 load curves can reveal those grid assets with spare capacity where concentrated beneficial electrification efforts would yield economic benefit with lower infrastructure impact.

Analyzing real-time household consumption activity further enables hyper-personalized communications to each customer to encourage the essential behavioral changes needed to support grid balancing and reliability.

For example, knowing when a customer runs a pool pump, and for how long reveals a highly targeted list of customers who run their pumps during peak times and who are therefore ideally suited for load shifting programs.

MAXIMIZE NEW INFRASTRUCTURE ROI

In addition to balancing variable demands by deploying NWAs, it is important to also deploy infrastructure strategically. Decisions about where to deploy larger transformers or invest in a substation upgrade are more difficult without data-based forecasts that account for EVs, solar, and other DERs. Because AI-powered data analytics enables energy providers to more accurately determine where grid constraints may exist or are likely to develop, they provide a guide as to where and when to upgrade or install grid infrastructure, how to size those assets, and how to strategically deploy capital in the right priority.

This applies to both traditional grid infrastructure as well as new investments in public charging stations. With insights into where high-growth EV pockets currently exist and where they are likely to emerge, energy providers are better able to identify prime locations for public EV chargers.

8760 DATA ANALYTICS IN PRACTICE

EV AND DER GRID CAPACITY PLANNING

Until the introduction of electric vehicles, we had never before seen such concentrated load growth in targeted geographic areas. Hotspots are developing, with some areas experiencing no load growth and others experiencing tremendous load growth that will require infrastructure investment. 8760 data analytics make intelligent infrastructure investment possible, using behind-the-meter data to prioritize where to invest in new transformers or substation upgrades, and what areas to target for non-wires alternatives.

Intelligent infrastructure upgrades first require understanding of the load curves that exist today.

Aggregating the in-home EV charging for all customers and analyzing patterns by time of use, day of the week, amplitude/charging levels, charging frequency and geographic locations (zip code, city, county, transformers, feeders, etc.) creates a comprehensive view of customers' charging patterns, enabling grid-level insights and program design that is optimized for every EV customer segment. This analysis reveals both current penetration and growth patterns by grid asset for purposes of infrastructure upgrade planning and load shifting program design, enabling data-driven decisions about where load shapes are currently problematic, where they may be problematic over the next 1-2 years, and where there is more time to address load growth.

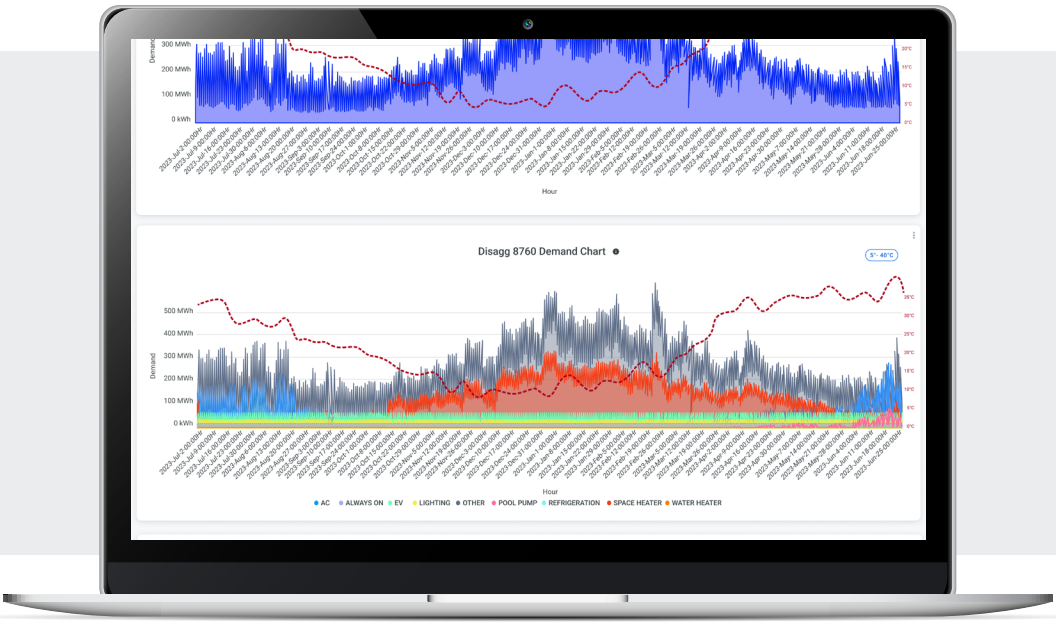
Similarly, as renewable energy penetration increases and fundamentally changes the time of daily peaks and the shape of load curves, granular behind-the-meter intelligence also provides essential DER insights. For example, in distribution planning, it's critically important to understand not only where EV hotspots are emerging, but also those households that have both solar and an EV. With this data foundation and load shape intelligence, utilities are able to implement more effective NWAs and more effectively target customers with load shifting programs.

EXTREME WEATHER-RELATED PLANNING

In 2022, the Pacific Northwest experienced a week of record-breaking heat, soaring temperatures in California triggered the highest energy demand on record for CAISO, and countries across Europe logged record temperatures during punishing heat waves that swept across the continent. These aren't once-in-a-lifetime events anymore, and in fact are likely to not only continue, but also to get worse.

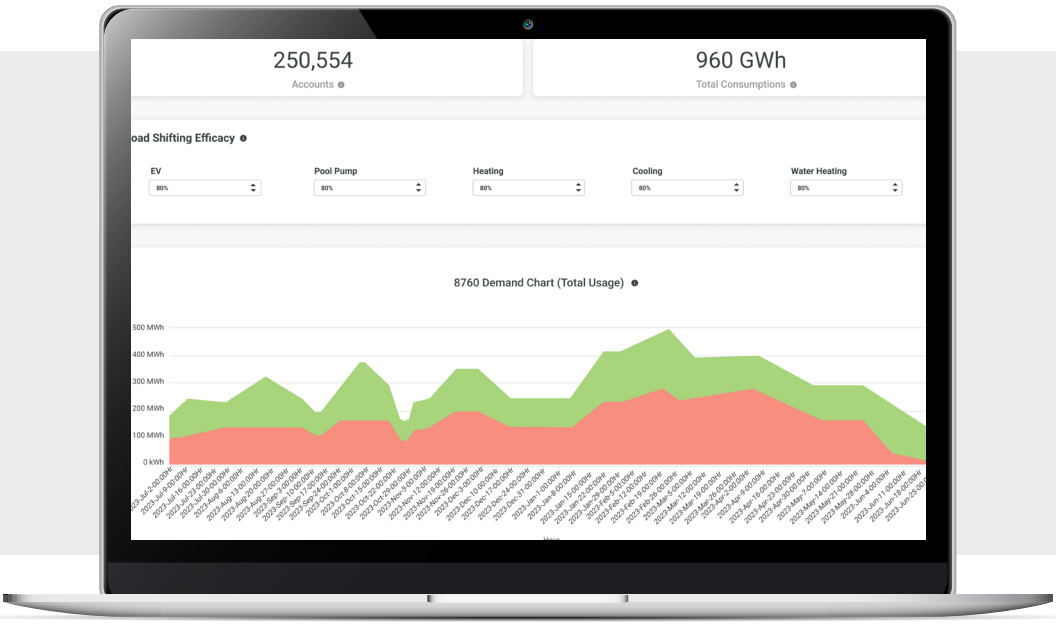
As average temperatures increase and cause greater and more frequent grid constraints, utilities need more sophisticated tools to analyze the impact of temperature on grid capacity and mitigate the risk of extreme heat overwhelming transformers.

By integrating ambient temperature data together with household energy use data, energy providers are able to uncover new patterns and important correlations between temperature and grid capacity to inform planning for future heat wave events. For example, looking at load profiles for previous 100 degree days, and understanding what the load profile for back-to-back 100°+ days might do to your system is an important in planning for extreme temperatures.



BECOMING A FUTURE-READY UTILITY

The grid will only continue to grow more complex in the years and decades ahead. Those utilities that can tackle this complexity with tools to simplify grid management will remain the most nimble for the changes ahead. By turning disaggregated energy consumption data into actionable intelligence through AI-powered data analytics, utilities can predict future load patterns, encourage grid-stabilizing customer behaviors, and successfully manage distributed energy resources.



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