AI-POWERED DATA-VISUALIZATION

PLAYBOOK

FOR LOAD RESEARCH AND GRID PLANNING

bidgely

Most utilities today are already using visualizations such as heat maps or line charts to depict how power is moving across their grids.

But today's grids are 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.

As a result, we're entering an era in which precision, AI-powered data visualization tools are essential to predict future load patterns, encourage grid-stabilizing customer behaviors, and manage distributed energy resources.

To support energy providers in implementing AI-powered data visualization strategies, we've developed this *AI-Powered Data Visualization Playbook for Load Research and Grid Planning*, including:

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

STEP 1: BUILD A TERRITORY-WIDE, BOTTOM-UP VISUALIZATION FOUNDATION

A bottom-up approach to data visualization 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 as the basis for many of the analyses required for downstream efforts. This approach made sense in the past when smart meters were not commonplace. However, with increasing AMI deployment, it is less often necessary to rely on imprecise sampling.

Applying AI to smart meter data, energy providers can identify the foundational building blocks of service territory energy use: the consumption of individual appliances within a home. What that means from a grid management standpoint is a much deeper and more granular understanding of usage.

ACTION STEPS

- Leverage AI-derived disaggregated home energy data to create a 360° customer energy use visualization for every household in your service territory.
- Aggregate the 360° customer energy use data to develop insights across precise customer segments, such as home ownership, appliance ownership and geography.
- Examine data visualizations iteratively, tracking customers and customer segments over time to identify trends.

GETTING STARTED

CREATE A 360° CUSTOMER ENERGY USE VISUALIZATION FOR EVERY HOUSEHOLD

AMI-derived household energy use data enables energy providers to cost-effectively create highly accurate and comprehensive appliance-level energy use visualizations 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 homes have pool pumps and whether they are single speed or variable**
- **Insights into appliance health**

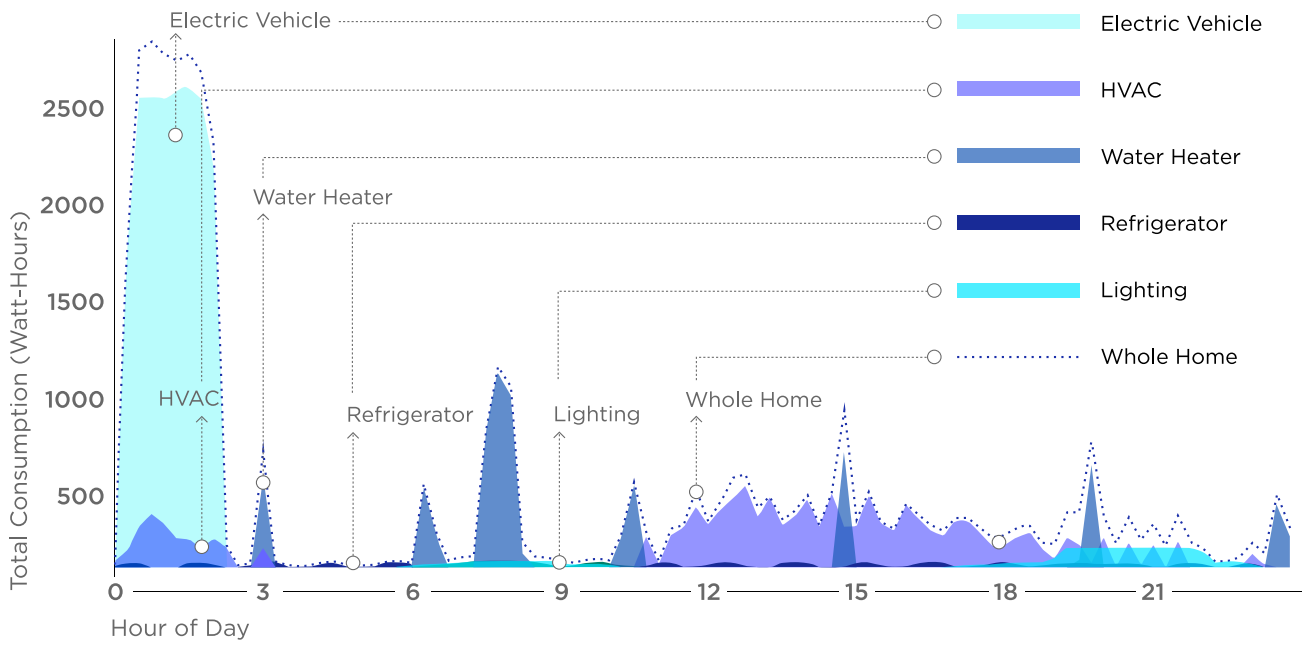
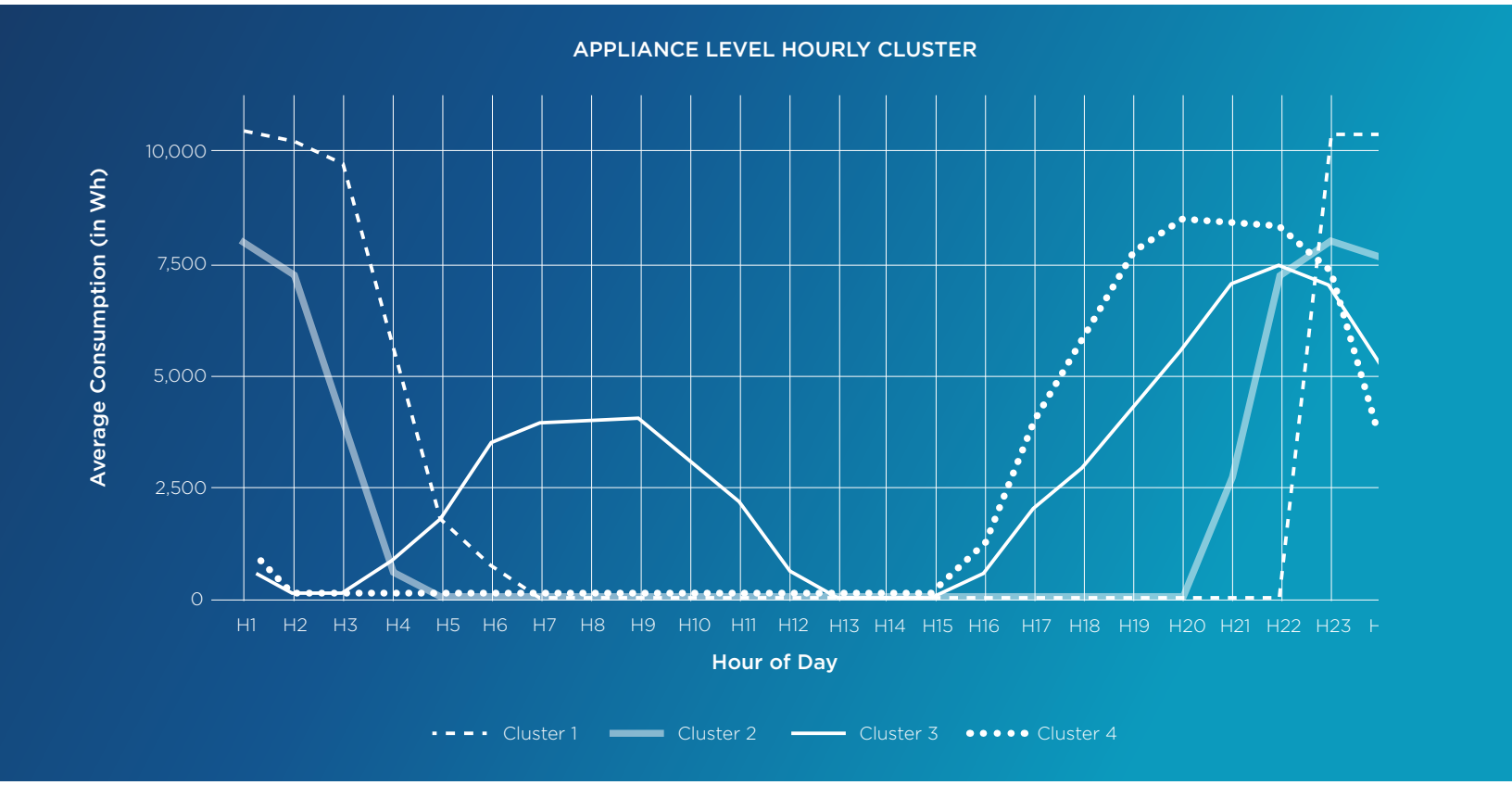


Figure 1: Bidgely's patented, AI-enabled disaggregation analytics let energy providers see behind the meter at the appliance level to understand each customer's unique energy profile.

AGGREGATE 360° CUSTOMER ENERGY USE DATA TO REALIZE SEGMENT-LEVEL INSIGHTS

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.



VISUALIZE CUSTOMERS AND CUSTOMER SEGMENT DATA ITERATIVELY TO IDENTIFY TRENDS

Real-time, AI-powered customer energy use visualizations capture essential aspects of a customer's lifestyle over time, and reveal 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 empowers energy providers to embrace changes to the status quo and evolve with the grid.

STEP 2: PLAN TO REALIZE ORGANIZATION-WIDE VISUALIZATION VALUE

When AI-powered data visualization is employed cohesively across energy organizations, the benefits are far-reaching. While one team can use the tool 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 data visualization from the start 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 data visualization solution.
- Choose a single AI-powered data-visualization platform that all groups can use.
- Create a process for identifying customer segment energy use patterns likely to significantly impact programs or services.

GETTING STARTED

ESTABLISH A CROSS-FUNCTIONAL DATA VISUALIZATION TEAM

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

CHOOSE A DATA VISUALIZATION PLATFORM THAT ALL GROUPS CAN USE

The data visualization 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.

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

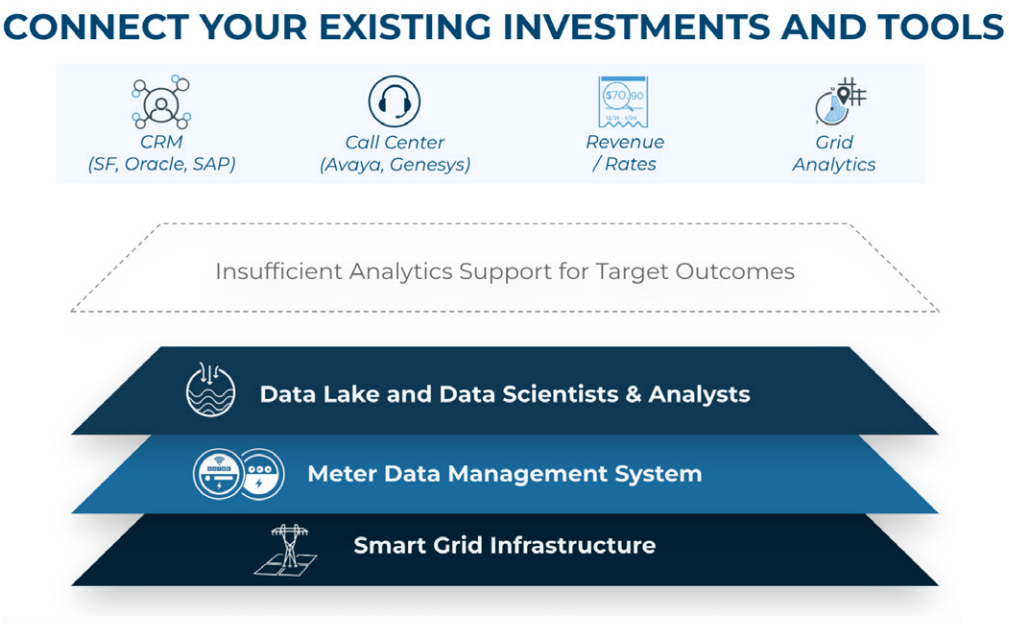
CREATE A PROCESS FOR IDENTIFYING AND SURFACING ENERGY USE PATTERNS

If data visualization is to serve as a single source of truth from which all teams can benefit, it is important to have processes in place to share findings about energy use patterns that have relevance to multiple departments.

Turning again to EV adoption as a case study, if, for example, 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.

DON'T LET YOUR DATA DROWN IN YOUR DATA LAKE - TAP INTO EXISTING DATA INFRASTRUCTURE INVESTMENTS

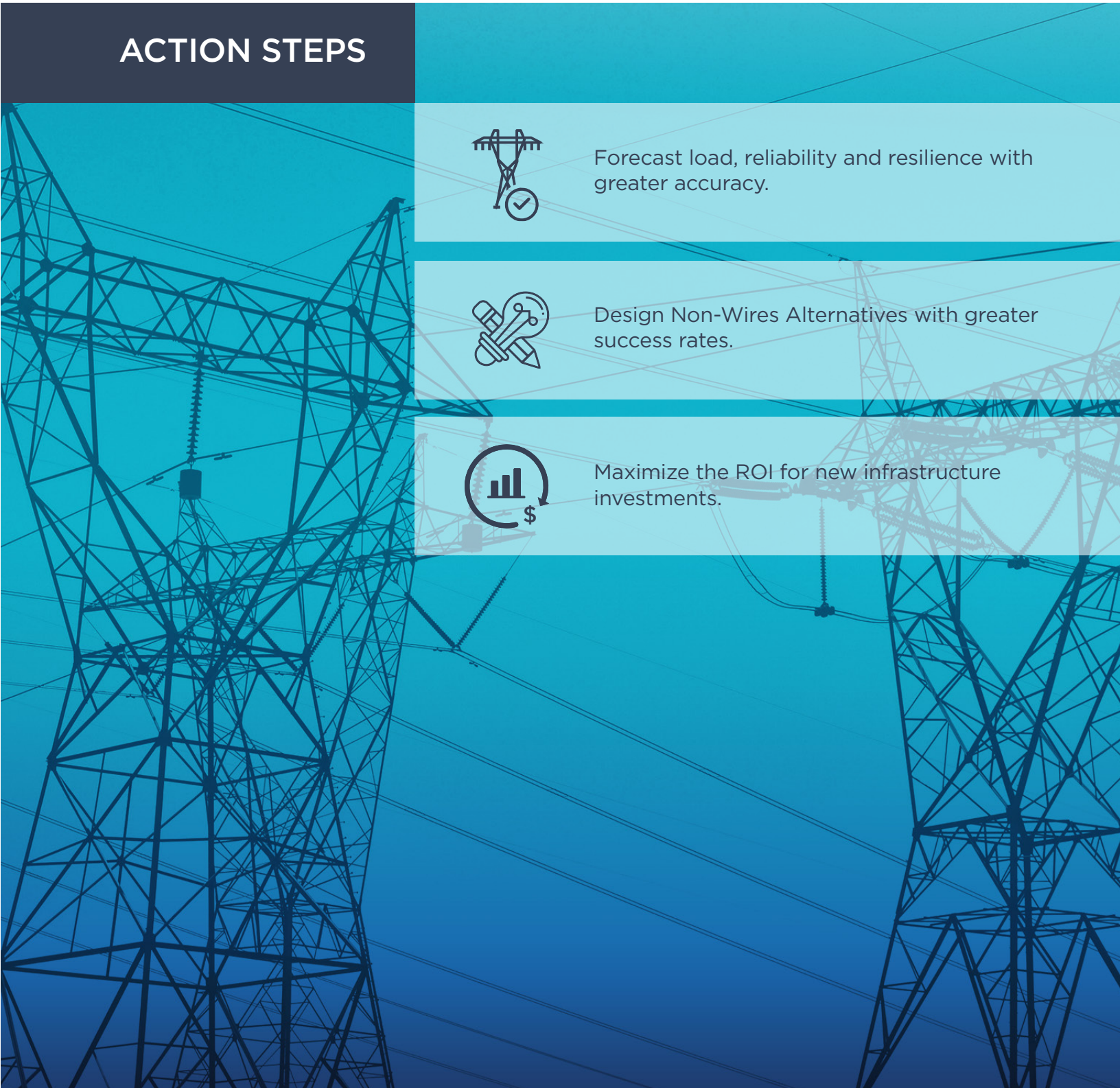
Most energy companies already have the underlying technology in place for digging insights out of their grids. And these can be tapped to extract even more value.



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

With insights garnered from AI-powered data visualization, 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 greater 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.

Such visualizations can also inform impact analysis of beneficial electrification on peak load by viewing load shapes for electric heat pumps, electric water heaters, and EVs.

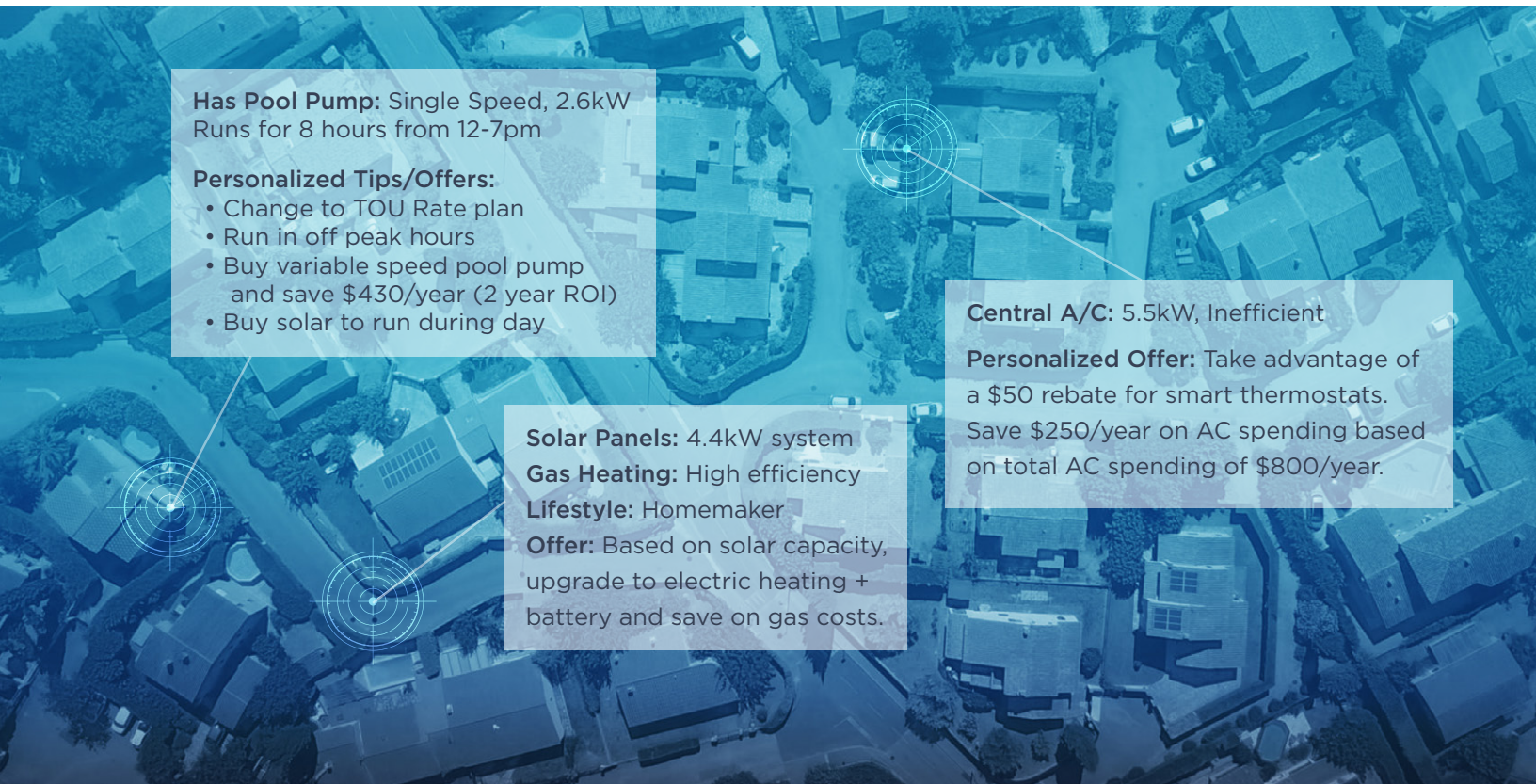
DESIGN MORE SUCCESSFUL NON-WIRES ALTERNATIVES

AI-powered data visualization provides a more precise picture as to which sectors are coming under strain, a valuable input when evaluating non-wires alternatives to shed load.

In geographic areas with constrained substations, 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.

Visualizing 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

Because AI-powered data visualization enables energy providers to more accurately determine where grid constraints may exist or are likely to develop, it can serve as a guide for where and when to upgrade or install grid infrastructure, and how to size those assets.

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.

BECOMING A FUTURE-READY UTILITY

We know 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 energy consumption data into actionable intelligence through AI-powered data visualization, utilities can predict future load patterns, encourage grid-stabilizing customer behaviors, and successfully manage distributed energy resources.