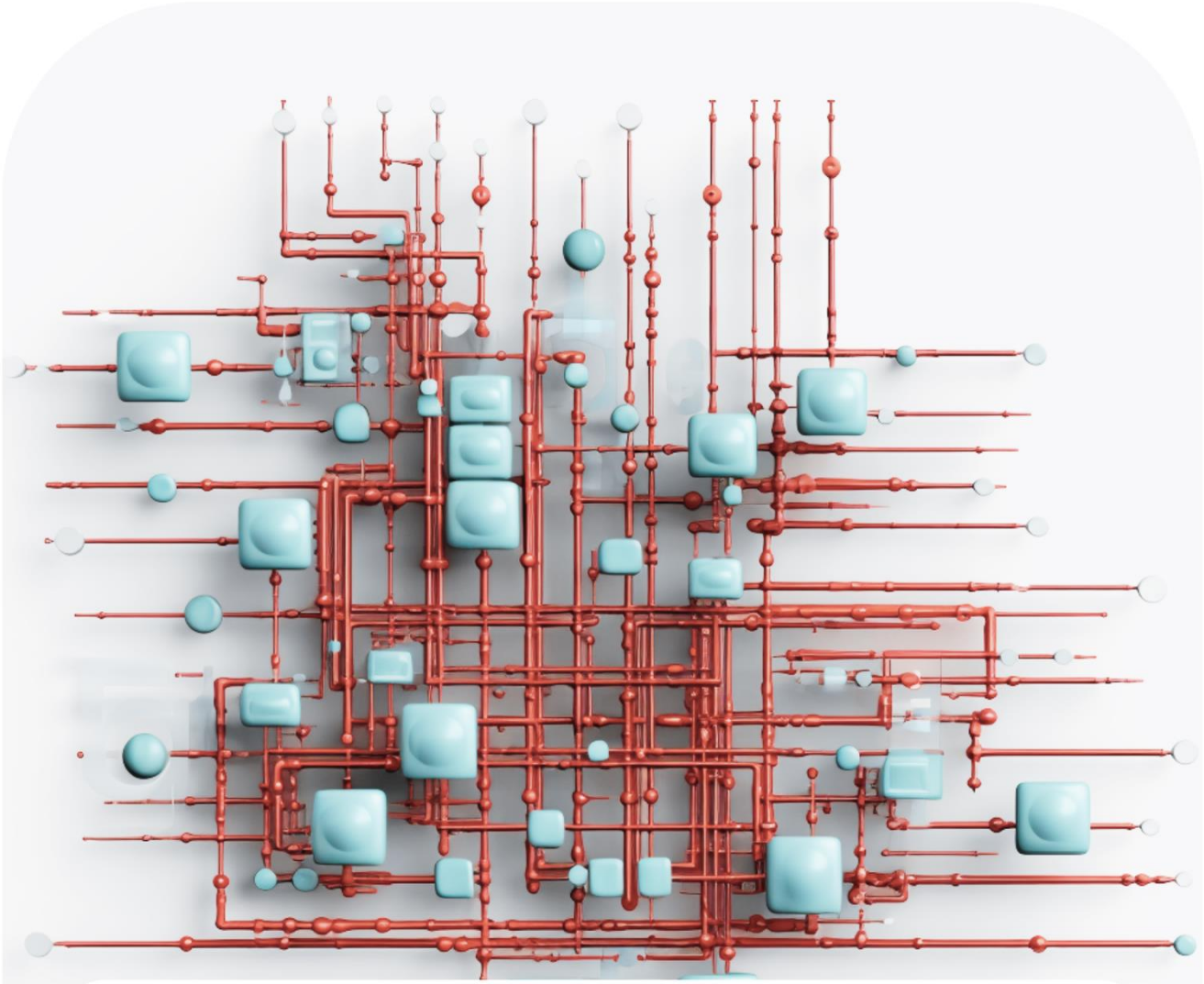


ENERGIZING THE SMART GRID WITH AMI DATA

THE Energy Authority®

INTRODUCTION

Utilities have adopted Advanced Metering Infrastructure (AMI or *smart meters*) to automate billing and remotely activate customers. These basic applications of the value of AMI have driven efficiencies for many utilities as they ceased to rely on error-prone meter readings and reduced truck rolls needed to turn on meters for customers.

However, AMI enables frequent transmission of a much richer dataset than kilowatt hours (kWh) alone. Many utilities have found that managing the ever-increasing amount of data generated by AMI systems can quickly overwhelm existing IT infrastructure, rendering any meaningful analysis impossible.

Fortunately, advancements in data architecture, machine learning, and artificial intelligence applied to the AMI dataset give utilities the unprecedented ability to monitor, analyze, and model their distribution systems. The Energy Authority (TEA) created its Data DynAMIcs service to meet an emerging need for public power and help its clients access these state-of-the-art capabilities.

Data DynAMIcs offers analytics-as-a-service to help store and manage client data and leverage state-of-the-art analytics to achieve new insights into distribution systems and customer behavior. This paper discusses several Data DynAMIcs services TEA's clients use to navigate the energy transition.

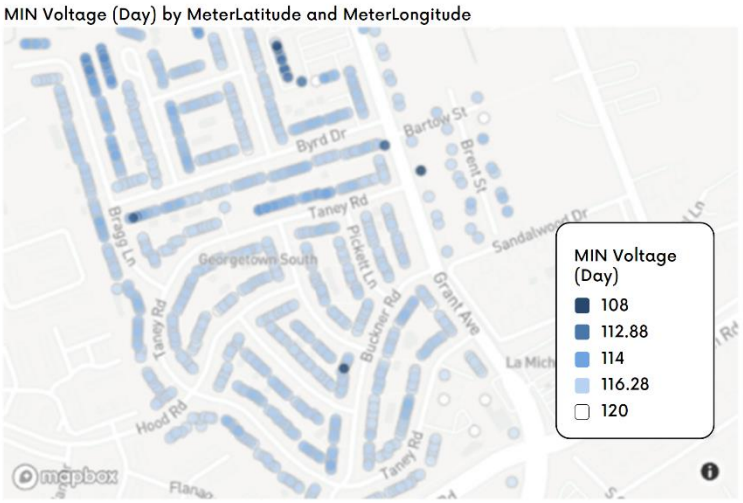
DELIVERED ENERGY SERVICES

Despite all the changes in the marketplace and regulatory environment, utility customers still expect cheap and reliable power.

Delivering energy, water, and gas efficiently and sustainably to the customer means understanding what is happening on the distribution network at any given point. High-resolution AMI data can provide easy-to-see returns for grid and asset management use cases.

VOLTAGE INSIGHTS

Although often overlooked during AMI systems installation, voltage data reveal fundamental insights into distribution system health. TEA's Voltage Insights identifies problematic voltage areas with high granularity. Engineering teams can use the insights to identify locations not meeting ANSI voltage standards. Utilities identify customer installations of DERs, like rooftop solar panels, which they can then monitor for voltage anomalies across the distribution system.



Voltage Insights enhances distribution system design with more accurate voltage data. It also models potential demand savings through conservation voltage reduction (CVR). Moreover, this feature yields increased customer satisfaction since the utility conducts proactive monitoring and maintenance on the system and reduces preventable outages.

FIGURE 1- DAILY MINIMUM VOLTAGE BY METER LATITUDE & LONGITUDE

TRANSFORMER LOAD MANAGEMENT

As utilities grapple with long lead times and high prices for distribution transformers, Data DynAMIcs helps to manage their fleet of these critical assets. The Transformer Load Management (TLM) tool combines Geographic Information System (GIS) Audit and Voltage Insights to monitor individual transformer loads by kVA actuals relative to rating. The service identifies both overloaded and underloaded transformers, thus allowing utilities to mitigate supply chain issues and proactively extend transformer life. Figure 2 depicts a transformer consistently over its rating in March, April, and July.

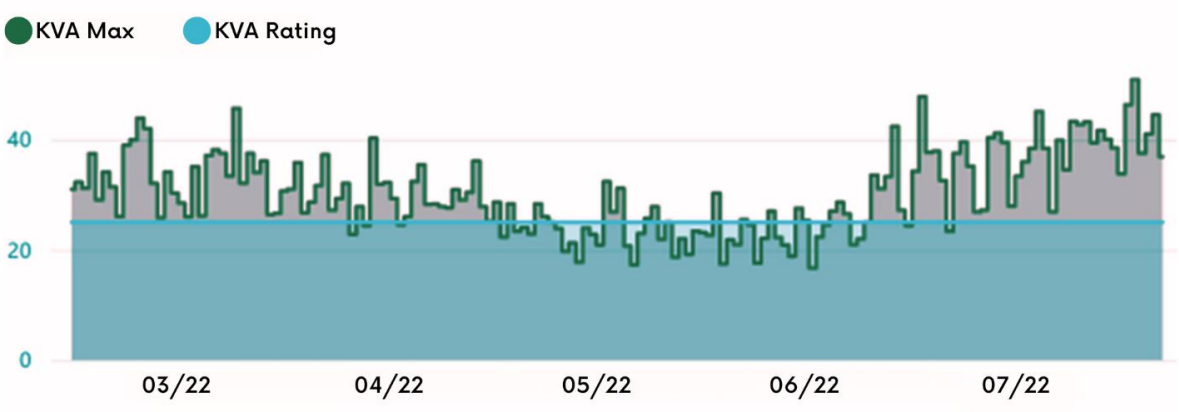


FIGURE 2 - TRANSFORMER LOAD VS. RATING

WATER METER HEALTH ANALYTICS

Consistent zero readings indicate either a faulty water meter or a genuine zero-usage case, typically requiring a truck roll to verify status. Data DynAMIcs deploys a machine learning model to differentiate between valid and fault-related zero reads. The model helps utilities prioritize field activity based on actual faults and estimated revenue. Moreover, utilities can recover lost revenue quickly, take advantage of active warranty timeframes, automate field activity processes, and optimize field resources by ensuring crews deploy to the sites more likely to require maintenance.

CUSTOMER INSIGHTS

With smart meters, utilities have greater visibility into how their customers use energy. AMI data can provide significant value for utilities when they can harness the information. For example, utilities could identify opportunities for new customer programs, improve return on investment for existing programs, and create more touchpoints for meaningful engagement with their customers and communities. Using its flexible Common Data Platform, TEA integrates AMI and other customer data to develop tailored customer segments, including building and load segments, that offer unique insights into residential and commercial customers' energy usage behavior (Figure 3).

These segments point to 'win-win' candidates for targeted outreach, including demand response (DR) programs, peak event communications, time-of-use rates, energy efficiency programs, energy audits, and education campaigns.

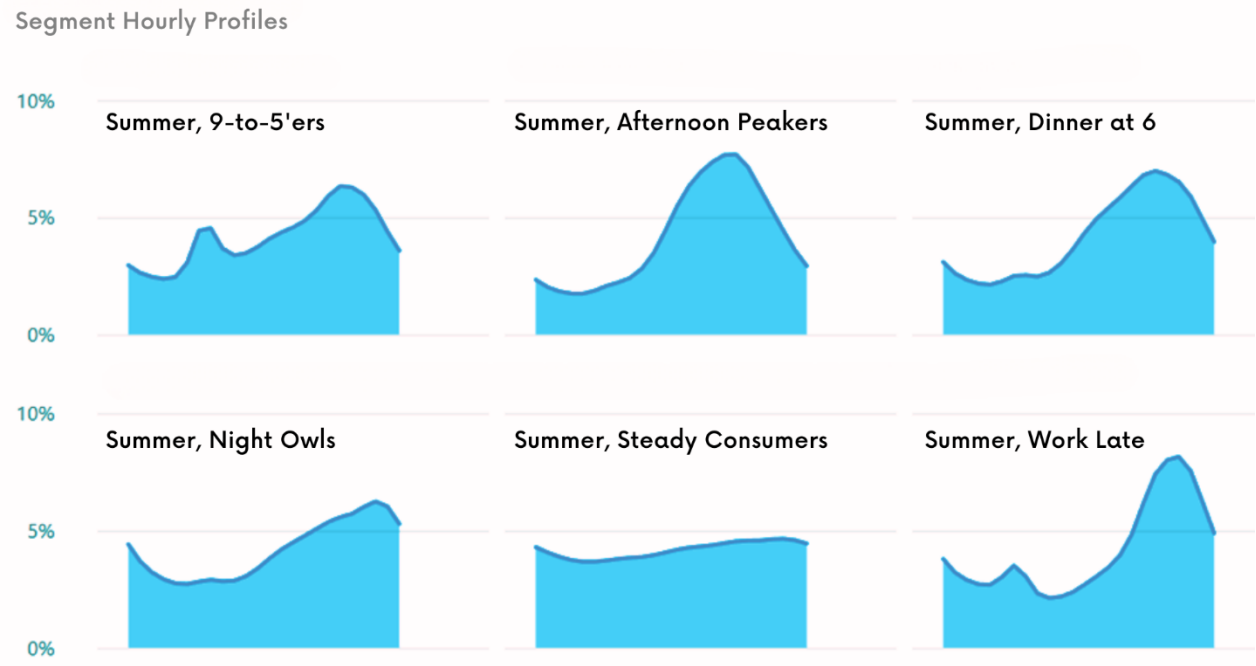


FIGURE 3 - EXAMPLE OF RESIDENTIAL SUMMER LOAD SEGMENTS

DEMAND SAVINGS ANALYSIS

AMI data enables significant insights into peak demand drivers and how customers contribute to the feeder, substation, and system-level peaks. The Data DynAMIcs service identifies the top contributors to peak demand across the distribution network and estimates the total and individual demand savings potential from targeting utility programs to these top consumers. Utilities can use deemed energy savings from energy efficiency (EE) programs to understand the real impact to demand from targeted EE installation and compare across different programs to identify those with the highest savings potential for a given area.

RATE CLASS COST OF SERVICE

A well-developed load factor strategy can impact a utility's annual net operating margin. Identifying which customers are more efficient or should belong to which rate class is a time-consuming and manual process. Rate Class Cost of Service studies are performed infrequently due to the vast amount of data needed from various customer and meter sources, the complexity of the calculations, and the lack of sophisticated tools. Utilities without necessary in-house talent turn to outside consultants, further impeding a successful outcome.

TEA's Data DynAMIcs platform integrates data and automates the delivery of Load Factor analysis for Cost of Service studies. The interactive reports are easy-to-use visuals that support the results of testing various Load Factors for what-if scenarios. The benefits include improving data latency to pricing and rates departments and supporting strategies around DER/EV rate programs.

TIME-OF-USE RATE DESIGN & PILOT EVALUATIONS

Residential time-of-use (TOU) rates have gained momentum in recent years due to the increasing need to mitigate peak demand as utility customers adopt electric vehicles. TOU rates offer greater flexibility to help individuals better manage their energy use while benefiting the utility as a strategy to manage peak demand effectively. However, successfully designing and implementing a TOU program is complex and challenging.

TEA's Data DynAMIcs provides insights to enable utilities to understand the customer-level impacts of different TOU rate scenarios as they refine their rate design. TEA provides support in implementing and evaluating real-world effectiveness via pilot programs.

DISTRIBUTED SYSTEMS

As rooftop solar installations increase and electric vehicle adoption accelerates, utilities must find solutions to manage their distribution systems.

Knowing where assets are physically located is critical, so GIS data must be accurate. Only then can the high-resolution data and remote monitoring and control of AMI technology enable DR programs at the residential level.

VIRTUAL GIS AUDIT

Utility GIS applications contain a dynamic data set that often requires extensive maintenance. TEA's Data DynAMIcs turns a labor-intensive and expensive effort into an automated GIS data audit. Using two advanced algorithms that leverage the relationships between meter voltage and power, the meter-transformer GIS linkage is audited virtually with confidence levels assigned to likely mismapped meters.

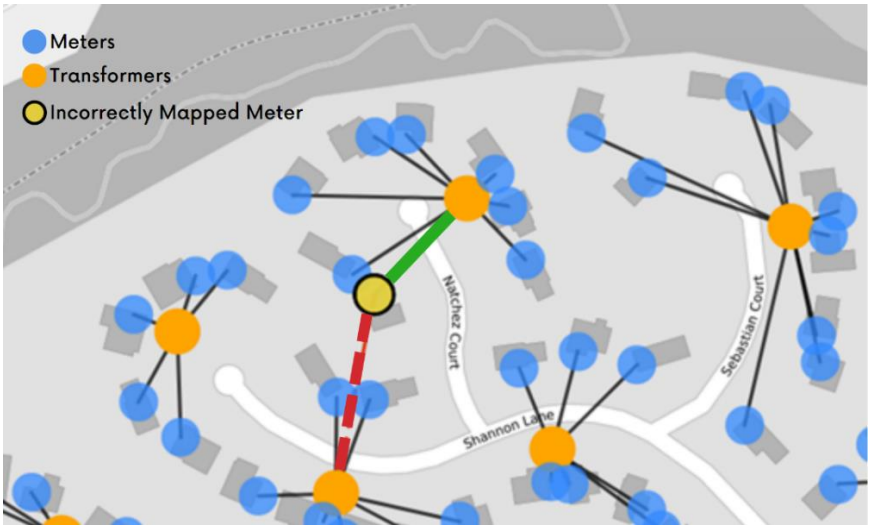


FIGURE 4 - VIRTUAL GIS AUDIT ALGORITHMIC CORRECTION

Clients have reported as much as an 80% decrease in errors in their GIS database, improving the impact of their outage management systems and automating full line walks, allowing engineering focus on critical incident responses. Figure 4 depicts a simplified representation of the Virtual GIS Audit algorithm.

DEMAND RESPONSE PROGRAM EVALUATION

With an improved system model[1], utilities can further quantify the demand reduction associated with specified appliances (e.g., heating/cooling, water heaters, smart thermostats) and develop a financial impact analysis at the system level. This allows DR program managers to understand the impact of DR programs during peak events by season. It also allows them to quantify average customer savings for each program/appliance and building type (e.g., apartment, single-family). With these tools, utilities can target program expansion for the highest potential households.

CONCLUSION: A PROVEN AMI ANALYTICS SUITE FOR THE ENERGY TRANSITION

The above capabilities are a sample of what TEA's Data DynAMIcs clients use to see and manage their distribution systems with unprecedented insight. From Distributed Energy Resource (DER) growth monitoring strategies to load management program evaluations to deeper customer engagement program analysis[2], advanced analytics supported by data science and machine learning enable utilities to take action with high certainty, benefiting the entire organization and the community it serves.

Whether your utility values fewer truck rolls, proactive transformer maintenance, quantified energy efficiency, or DR impacts, Data Dynamics is the suite of tools for utilities that demand the most from their AMI investment.

TEA DATA DYNAMICS
ELEVATE • ENERGIZE • ENRICH

To learn more, contact Jamie Mahne, VP, Client Services & Chief Client Officer at jmahne@teainc.org or call 904-356-3900.

[1] S. Valovcin, N. Abe and B. Massey, "Using Smart Meter Data to Estimate Demand Reductions from Residential Direct Load Control Programs," 2022 IEEE International Smart Cities Conference (ISC2), Pafos, Cyprus, 2022, pp. 1-6, doi: 10.1109/ISC255366.2022.9922481. https://ieeexplore.ieee.org/document/9922481

[2] Exploring the Perception for Demand Response among Residential Consumers, Daniel Torstenhsson, Fredrik Wallin, Energy Procedia 2014, 61, pp. 2797-2800. https://doi.org/10.1016/j.egypro.2014.12.318