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EXECUTIVE SUMMARY

Unlocking Grid Edge Intelligence: Turning AMI Data into DER Insights

Presenters:
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KEY TAKEAWAYS

- As DER adoption grows, utilities need more visibility and control at the grid edge.
- Advanced metering infrastructure unlocks visibility necessary to manage the grid at the edge.

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OVERVIEW

As electric vehicle (EV) adoption grows, utilities need better visibility at the grid edge to understand emerging load patterns and behind the meter behavior. Edge based analytics can help utilities turn meter data into actionable intelligence to support planning and operational decision making.

Operators such as the Sacramento Municipal Utility District (SMUD) are applying grid-edge analytics to improve EV awareness using existing AMI infrastructure, leveraging Itron's partner ecosystem to improve performance.

Itron is a global technology and infrastructure company that provides hardware, software, communications networks, and services to help utilities and cities manage energy, water, and gas. Itron provides advanced solutions for grid-edge intelligence and smart metering, enabling utilities to leverage granular, real-time performance data to improve distributed energy resources management, prevent grid overload, and optimize delivery.

CONTEXT

The presenters discussed how adding grid visibility and control through existing AMI infrastructure enables utilities to optimize DER-enhanced grid operations.

KEY TAKEAWAYS

As DER adoption grows, utilities need more visibility and control at the grid edge.

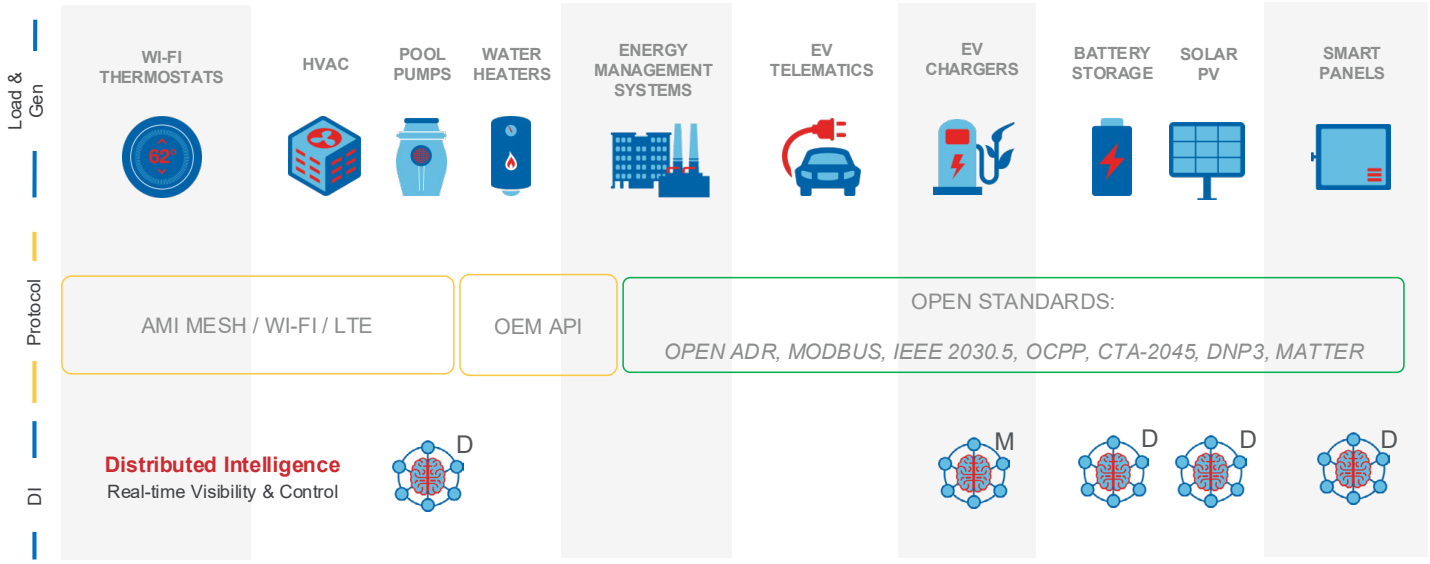
Historically, demand response has focused primarily on turning loads, such as thermostats, HVAC, pool pumps, and water heaters, on and off. However, the modern grid increasingly includes customer-owned solar PVs, battery storage, EV chargers, and other distributed technologies. While the addition of more flexible energy resources offers potential for new opportunities, DER adoption is currently outpacing the operational infrastructure needed for safe, economic integration.

The shift has introduced three major challenges that operators must address to maintain reliability and affordability and support electrification goals:

- **Limited visibility on the low-voltage side of the distribution network.** While operators can monitor and control substations through SCADA and distribution management systems, most have little to no visibility farther downstream. As DER adoption grows, utilities need a way to gain real-time visibility into both downstream constraints (e.g., thermal or voltage violations) and available capacity of nearby resources, which can be leveraged to dynamically close gaps in grid performance (e.g., voltage sag).
- **Continued reliance on static models to annually set hosting capacity makes it difficult to accurately predict DER capacity and grid conditions.** Shifting planning processes to instead leverage real-time measurements enables utilities to not only achieve dynamic operations and planning—crucial for the modern grid—but also to leverage DER measurement-and-verification capabilities to optimize customer incentive programs.
- **Without autonomous load management at the edge,** DER dispatch must rely on cloud round trips and manual intervention, reducing efficiency and response times. Adding intelligence at the grid edge allows smart meters to act as controllers, sensors, and IoT gateways, enabling utilities to automatically manage grid resources with greater precision.

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Figure 1: The modern grid comprises 10 general asset classes of energy resources



Advanced metering infrastructure unlocks visibility necessary to manage the grid at the edge.

Electric utilities can better manage the rapidly changing power grid, maintaining affordability and reliability through greater visibility and intelligence at the grid edge. The technology to achieve this is already in place—approximately 20 million smart meters containing an embedded Linux server, memory, and communication capabilities are already active on the grid and connected to DERs across utility territories.

Rather than transmitting data to a central system, leveraging these existing AMI devices to process information allows utilities to take advantage of much faster, dynamic distributed intelligence at the grid edge. A distributed energy resource management system (DERMS) allows smart meters to optimize operations based on real-time, data-driven performance insights.

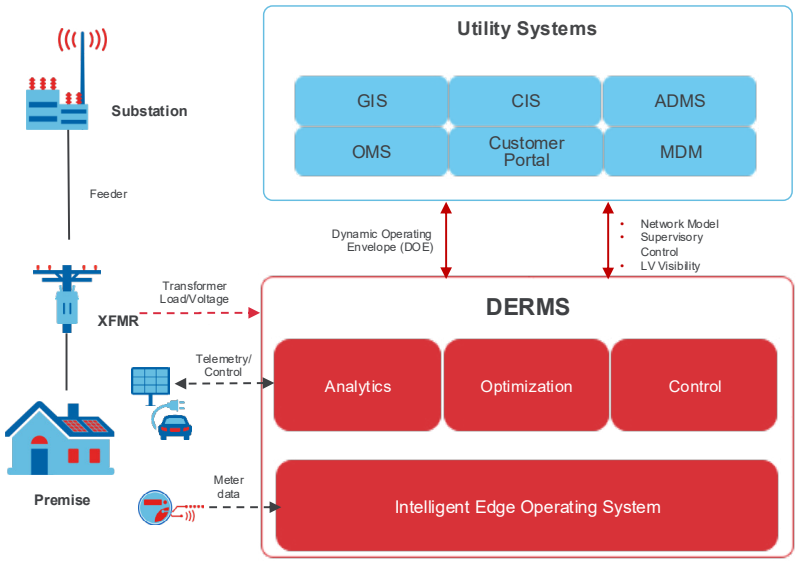
DERMS also connect into centralized utility management systems to help define customer incentives and improve supply/demand and revenue forecasting.

> "You can leverage the network that's out there, that's communicating to all these devices and allows the devices to communicate to themselves. . . When you build off of that, that really gives you an advanced way to look at distributed energy resource management."
>
> – *Nick Tumilowicz, Itron*

Note: To enable more effective resource management, the industry is moving toward greater standardization of communication protocols, such as IEEE 2030.5, across DERs.

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Figure 2: Adding DERMS to AMI enables intelligence at the edge



SMUD: Unlocking Grid Intelligence

The Sacramento Municipal Utility District Grid Edge Intelligence Project is a recent initiative to implement its next-generation AMI roadmap, which also serves the utility's broader goal of reaching zero carbon emissions by 2030.

SMUD deployed its first round of smart meters in 2009. Since then, DERs have proliferated, with forecasts projecting significantly higher growth by 2030. The additional electrification has already had a significant impact on the grid, and in the future will only increase the complexity of grid operations.

Table 1: DER proliferation in SMUD

Behind-the-meter DER	Today	by 2030
Solar	65,000 (480 MW)	92,000 (680 MW)
EVs	79,000	288,000
Batteries	1,900 (12 MW)	12,000 (75 MW)
All-electric homes	66,000	154,000

As part of initial efforts to address management gaps, SMUD sought to gain more insight into which loads were impacting the grid. The utility increased its current data-collection frequency from 60-minute intervals for residential customers and 15-minute intervals for commercial customers to five-minute intervals for all customers.

However, while this approach yielded a significantly greater volume of information that could be used to manage the grid, both grid management and program design continued to be based heavily on assumptions derived from aggregated data, rather than individual DERs.

Device-level information in near-real time would enable the utility to improve safety and performance, prolong asset life, and optimize resources. Additional insights into how individual customers are using their DERs at their premises would also enable SMUD to develop more targeted customer programs that would optimize benefits to individual customers, the grid, and the utility in both the near and long terms.

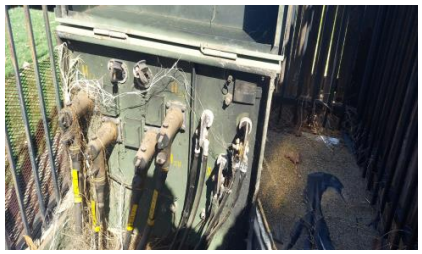
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With the original deployment of smart meters reaching end-of-life, SMUD began evaluation of replacement technologies. SMUD identified that its existing AMI infrastructure could meet the utility's use case requirements for the next 10-15 years, by deploying distributed grid intelligence applications on next-generation meters. Of the 650,000 meters in place, the utility targeted 200,000 meters for initial replacement, which provided the granular visibility needed to unlock key value-add use cases:

High impedance detection finds hidden grid risks such as loose connections or failing equipment before they turn into service interruptions. Proactive correction of issues decreases downtime and improves the overall customer experience. In one example, the high impedance detection application identified a problem at a transformer. SMUD dispatched a field crew to the site, where the technicians found an arcing connection that they repaired before it could cause an outage.

Figure 3: Detecting hidden grid risk with AMI-driven intelligence



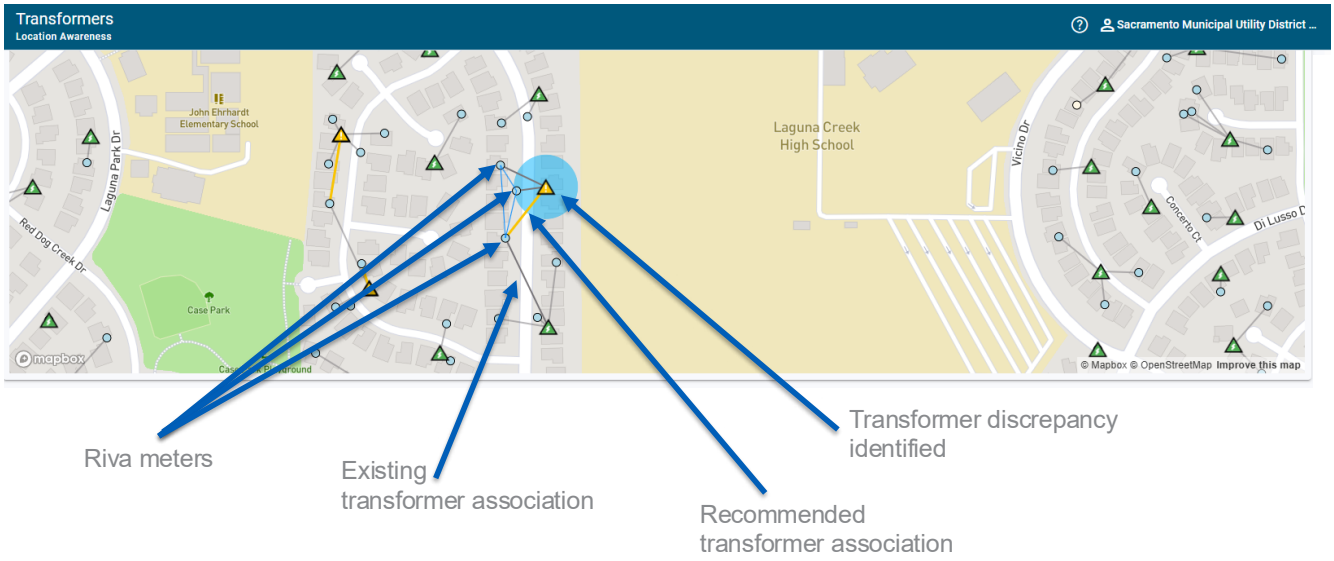




Location awareness provides accurate mapping between meters and transformers. Accurate DER-to-transformer mapping is critical to monitoring transformer health as well as DER expansion planning—as EVs and solar PVs continue to be added, transformer mismatch can create significant issues. In several instances, SMUD's location awareness application identified mapping discrepancies that did not require a field visit to confirm and correct.

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Figure 4: Location mapping improves grid accuracy



EV awareness analyzes load signatures at the meter to identify likely EV charging activity. SMUD detected 87% of EVs within seven days, 93% within 14 days, and 100% within 40 days, with high confidence in the data accuracy. EV awareness enables SMUD to develop targeted customer incentive programs and rates, rather than rely on general charging window incentives based solely on where an EV is registered (which does not necessarily account for where the EV is actually charged).

> "Having that more granular data enables us to do more targeted customer programs and to be able to help spread the load out—and hopefully shift load and shift charging behavior to better manage the grid without having significant system upgrades."
>
> – *Trevor Lamb, Sacramento Municipal Utility District*

In the future, SMUD plans to expand to solar, battery, and HVAC awareness applications. Eventually, greater visibility should allow SMUD to move toward coordinated control and customer collaboration—rather than turning devices off during peak demand, utilities could instead send messages to customers to adjust thermostats, modify charging schedules, or allow batteries to support the grid during critical periods.

Grid edge intelligence represents a fundamental shift in utility operations. By leveraging existing AMI infrastructure, distributed intelligence applications, and customer-owned DERs, utilities can improve forecasting, reduce operating costs, defer capital investments, enhance reliability, and create better customer experiences.

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ADDITIONAL INFORMATION

To learn more, visit Itron

BIOGRAPHIES



Nick Tumilowicz

Director of Distributed Energy Management
Itron

Director of Distributed Energy Management Team leader, strategist, and recognized expert in DER management—including solar, storage, and EV technologies—with decades of industry experience advancing global clean energy markets. His career spans mechanical engineering, renewable energy deployment, and global product portfolio management, enabling a strong foundation in whole system strategies and cross discipline solutions.

As Director of Product Management at Itron, Nick leads the Distributed Energy Management business, overseeing global development of Demand Response, DER, EV, and forecasting solutions that enable access to flexible customer energy resources. Previously, he led global R&D at EPRI, directing transmission, distribution, and customer connected energy storage research. At SunEdison, he managed the world's largest renewable power plant fleet across six continents, supporting data and control platforms for more than 4 GW of assets. Earlier, he built and led the service organization at REC Solar (now Sunrun and Duke Energy), helping deploy the nation's first commercial rooftop solar fleets.



Trevor Lamb

Manager IT Grants & Vendor Management
Sacramento Municipal Utility District (SMUD)

Trevor is Manager of the IT Grants & Vendor Management group at SMUD overseeing the governance process for all SMUD technology-related procurements, contract/vendor management frameworks, and software licensing compliance in addition to supporting grants with technology related components. He is the contract manager for several of SMUD's most significant enterprise technology-related vendors. He recently led efforts to develop SMUD's Next Generation AMI Roadmap, which establishes the key underlying technologies required to meet SMUD's 2030 Zero Carbon Plan. He has been working with AMI and related technologies for over 14 years and has an impressive track record of successfully managing projects and grant-related work. Trevor co-authored SMUD's successful ARRA FOA 58 SGIG application and was an instrumental core team member for that successful project (SmartSacramento) as the procurement/compliance lead.

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