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METERING, OPERATIONS AND UTILITIES: 2023 AND BEYOND

TESCO's Meter School

TESCOOL ▶▶

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INTRODUCTION

- We are only now beginning to understand how much AMI has changed and is continuing to change our world.
- This presentation will touch on the power of this AMI data, new tools we can create and the challenges we are facing to use this data
- We will look at just a few of the new opportunities already being presented to us that we can use this data to take advantage of
- With some AMI systems and AMI meters approaching 15 years of age, many utilities are also beginning to consider what is next
- As DERs continue to penetrate the grid, EVs increase in presence, and electrification progresses, utilities are on the verge of change





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THE PROMISE OF AMI

The introduction 10-15 years ago and the continued development of an Advanced Meter Infrastructure (AMI) system promised more effective and more efficient Meter Service Operations

This was to be accomplished in a variety of ways starting with:

- No need to read meters (if AMR had not previously been deployed)
- No need to roll a truck to perform a disconnect or a reconnect
- Better ability to detect and respond to outages
- Better ability to detect theft
- Better ability to detect (and eventually capture) unbilled energy
- Better understanding of customer usage and ability to make better energy usage decisions



And with all of this came a promise of “Additional Capabilities and additional Operating data.”

A FLOOD OF DATA:

THE PROMISE AND THE CURSE OF AMI

- And so, the data started coming in
- Once the investment in gathering this data was made the problem quickly moved from the collection of this data to developing the tools and infrastructure to analyze this voluminous data
- There was far more data than could be analyzed or even utilized at first



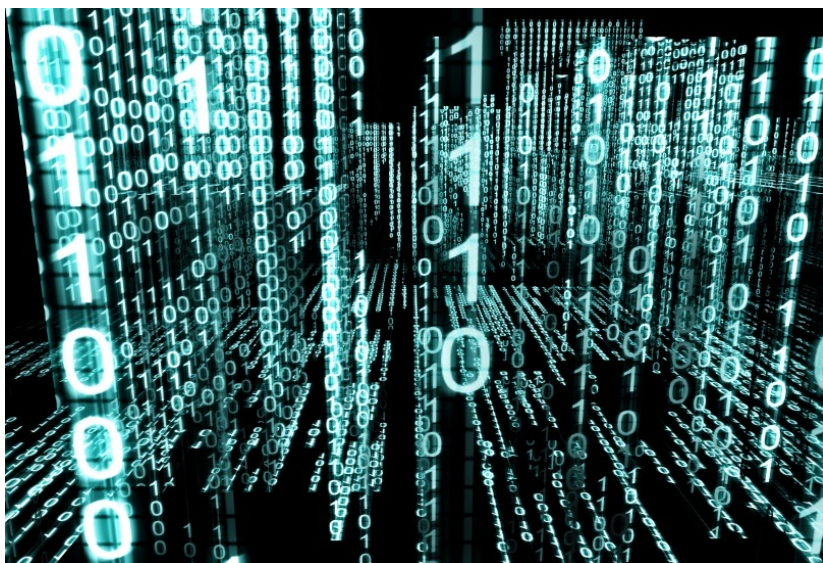
MOVING INTO THE FUTURE

- Utilities now collect hundreds of millions of events and readings every day from sources such as the following:
 - Meters (status, manufacturer, purchase date, events such as reprogramming notifications and tamper alerts)
 - Transformers (ID, circuit section, circuit ID)
 - Service points
 - Customer accounts (type, status, billing cycle)



WHAT DATA ARE WE GETTING & HOW ARE WE USING IT?

- **Meter quality assurance:** Focusing on meter reading performance enables utilities to ensure AMI reliability
 - For instance, when meter readings are expected but not delivered, the system takes note, and calculates overall performance statistics for the AMI system
 - Utilities are made privy to problems they never would have been able to identify in the past



Good Start



- **Outage event analysis and prevention:**
 - Integration enables real-time, accurate, and complete outage event analysis that helps identify nested outages and optimize field crew dispatch – all to support efficient response and restoration
 - We can often determine the exact piece of equipment causing a problem, along with the customers directly impacted by it
 - We can use outage information that is delivered along with meter readings to identify and track outages
 - These outage event reports help us to understand the overall impact of outages, then drill down to find the problem areas in the distribution network
 - We can then isolate areas of high impact and work to understand how to address them



AND OF COURSE...REPORT!

- We can filter planned outages and momentary from this data for reporting purposes and provide meaningful customer satisfaction and performance measures and trend
 - Average interruption durations
 - Number of interruptions
 - Number of customers impacted
 - These system performance indexes, and information can be shared with management, regulators, customers, media, and other stakeholders





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WHAT ELSE?

- Gain a better understanding of events, as well as what they mean:
 - For instance, we can correlate power outage events or voltage alarms with the transformers involved to identify faulty or aging infrastructure
 - We can roll trucks between 8 AM and 4 PM, Monday to Friday on non-storm days
- Generate new customer insights
- Size distribution assets
- Implement preventive maintenance techniques
- Forecast and build predictive models for demand program planning
- Develop new rate plans and services for customers
- Address Line Loss in a meaningful and impactful way

what else?



- Network energy inventory balancing
 - You can accurately compare feeder energy to aggregated meter data to track down unbilled energy
 - Some may be energy theft.
 - Some is not but is actionable once the cause is determined
- Meter events and usage information can help paint an overall picture of what's happening with a customer's energy usage over time as well as the usage from an entire sub station
 - This unified view can help detect energy theft, meter tampering or a host of equipment problems that may be affecting service levels
- Some typical filters for theft:
 - Customers can be identified who have active accounts but no recorded usage, or the converse – energy usage but no account
 - Customers with gas usage but no electrical usage over months or even years, indicate a very likely candidate for investigation, voltage issues for one customer and not others on the same transformer.



- Potentially bad metering
- Non metering of certain usage
- Failing equipment and bad connections
- Bad GIS integration and information
 - To make any of this work we need an up to date and integrated geographic information system (GIS) geodatabase
 - We need to be able to link our meters accurately to the rest of the system along with every other piece of equipment between the sub station and the meter
 - The initial investigative work will uncover not system errors but GIS errors and holes
 - Once corrected this work will begin to uncover correctible losses.



- Load profiling
 - You have accurate and highly granular transformer load profiles, especially significant for effective distribution planning when electric vehicle (EV) charging and distributed generation are involved
 - What will the impact on your system be as isolated pockets of users influence each other and purchase electric vehicles; adopt home level energy storage and renewable energy solutions
- Pricing analysis
 - Perform 'what if' rate and load shift analysis
 - Compare current tariffs with alternative pricing scenarios
 - Estimate energy costs for a new rate at different load levels



WHAT ARE SOME OF THE CHALLENGES IN ANALYZING THIS “FLOOD OF DATA?”

- The first issue is that currently data required for complete meter data analytics solution does not reside in the same database
 - While there is tremendous real time data being collected the information required to complete many types of analysis may reside in other data bases (IE system mapping data)
- 
- A circular graphic with a blue and green ring. Inside the ring, the text 'REAL-TIME DATA' is written in blue and black. A white line with a red dot at the end is drawn across the circle, resembling a clock face or a data path.
- Another challenge is that while the MDM is configured as a “Fast Write” data base, since it needs to quickly record large volumes of real-time meter information, a useful analytics tool needs to be normalized for “Fast Reads,” since it needs to provide fast access to data for users looking for real-time insights

ADDITIONAL CHALLENGES?

- **No impact on billing:**

- Making sure that you can analyze the data in the MDM system (the “system of truth”) without impacting basic billing operations in any way
- As important as meter data analytics is, this capability cannot interrupt billing and other operational systems in terms of performance, data corruption or functionality
- Bottom line: The analytics capability cannot threaten the utility’s ability to collect revenues



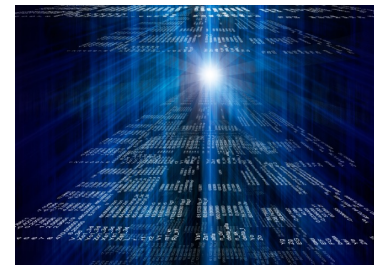
ADDITIONAL CHALLENGES?

- **Near real-time:**
 - Lastly, in order to retain its value to executives, engineers and operational staff, data analytics need to be performed in as near real-time as possible
- **The ultimate goal:**
 - To establish a repeatable data analytics discipline and infrastructure to reduce the time, cost and complexity of each incremental capability, and with the lowest risk possible to the existing MDM functionality



BUSINESS USE CASES FOR THIS BIG DATA

- Now what can we do with this information?
- Isolate and determine where we have voltage issues, correct them, and bring an entire line to the same level
- This not only works better for our customers but also allows the utility to pursue voltage reduction in a meaningful and controlled way
- Determine what transformers should be used in any location
- Determine when new loads are present and which transformers are in jeopardy
- Locate Bad connections & Undersized lines
- For Transformer Rated Services determine which ones are operating for a substantial amount of time below 10% of the rated current
- Find and remediate theft
- Find and remediate remote outages before the user knows they exist
- Find and address Power Factor issues







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NEW TOOLS FOR THE METER SHOP / FIELD

- Advanced functional test boards
- Automated firmware and setting comparison tools
- Site Verification equipment, procedures and data
-and data
-and data
-and data



AND NOW WE WANT MORE.....

- More data
- Greater frequency
- Whatever bandwidth you thought you needed, now you need more
 - Edge Computing & Distributed Intelligence



- Can we use our existing infrastructure?
- Do we have to rip out and replace with a new infrastructure?
 - What about LTL back haul or a Private Network?
 - What about Power Line Carrier?
- Is there life there for my most remote service areas?
 - Has there been form standardization?
 - Did any of our equipment go EOL?



AMI 2.0 INFRASTRUCTURE

- Second Generation AMI and potentially new communication paradigms as LTL data becomes less and less expensive and reaches larger and larger areas – without new infrastructure
- Research in Power Line Carrier Technology may provide expanded bandwidth to allow for greater data transfer more frequently without as much new infrastructure
- Mesh networks continue to improve, and AMI 2.0 is anticipating leveraging the infrastructure installed in AMI 1.0





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2023 AND BEYOND

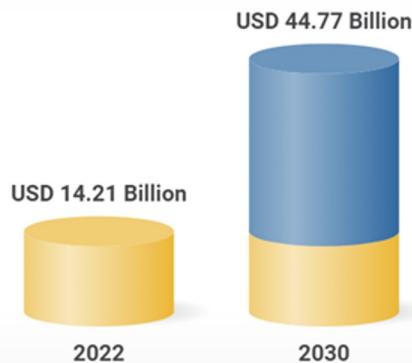
- On the distribution side customers will be encouraged to put in more and more renewable energy and they will also add more and more energy storage
- Larger customer-based energy production and solutions will lead to expanded micro grids
- Second Generation AMI and potentially new communication paradigms as LTL data becomes less and less expensive and reaches larger and larger areas



WHILE PV SOLAR CONTINUES TO GROW - ELECTRIFICATION IS ON THE RISE AND SURPASSING FORECASTS!

U.S. Residential Solar PV Market

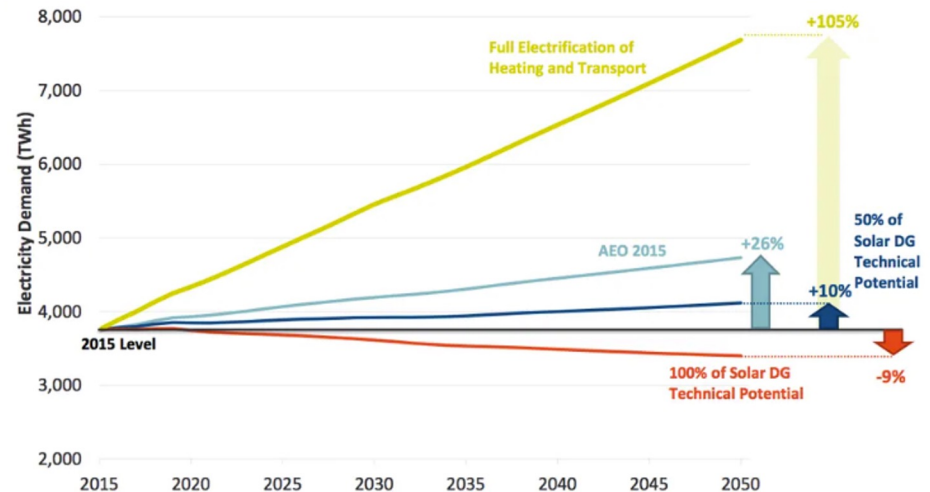
Market forecast to grow at a CAGR of 15.4%



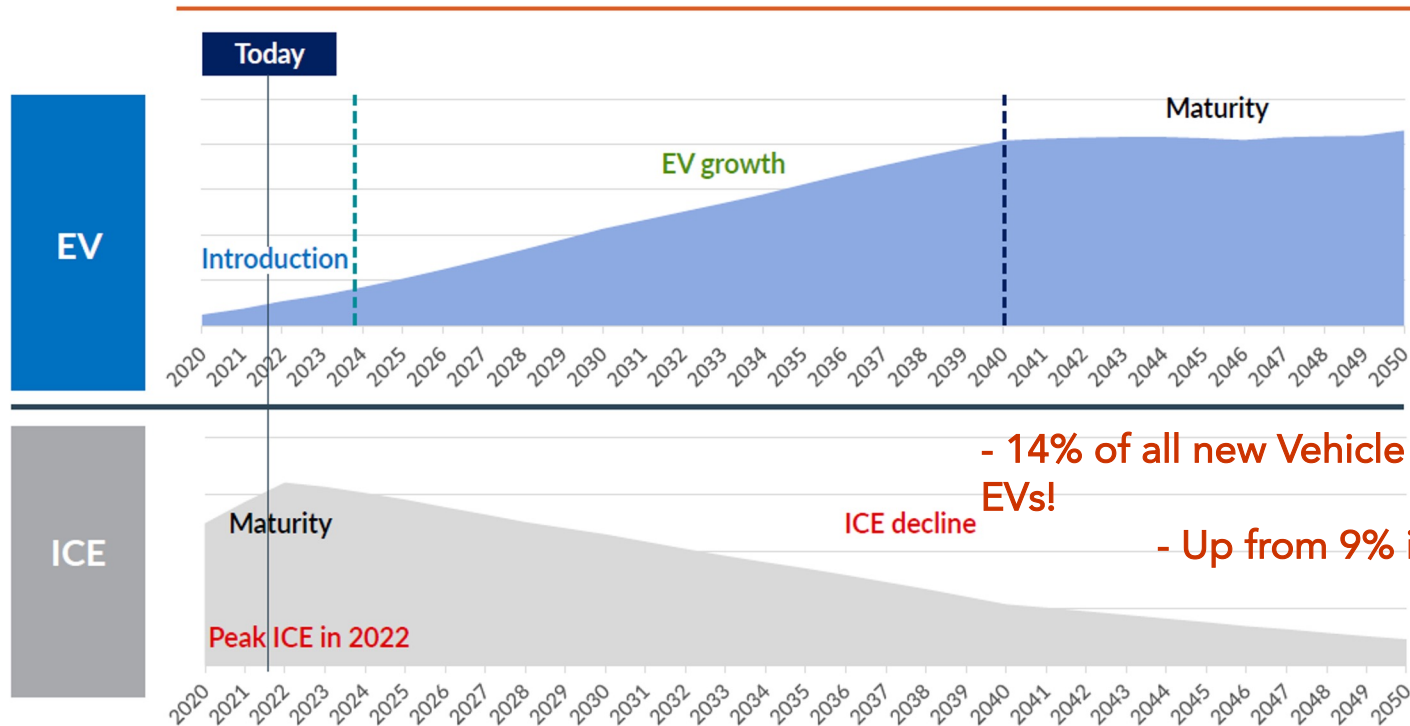
<https://www.researchandmarkets.com/reports/5416014>

RESEARCH AND MARKETS
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FIGURE 7 Projected Electricity Sales with Full Electrification



EV GROWTH AND DISRUPTION WILL BE UNPRECEDENTED!



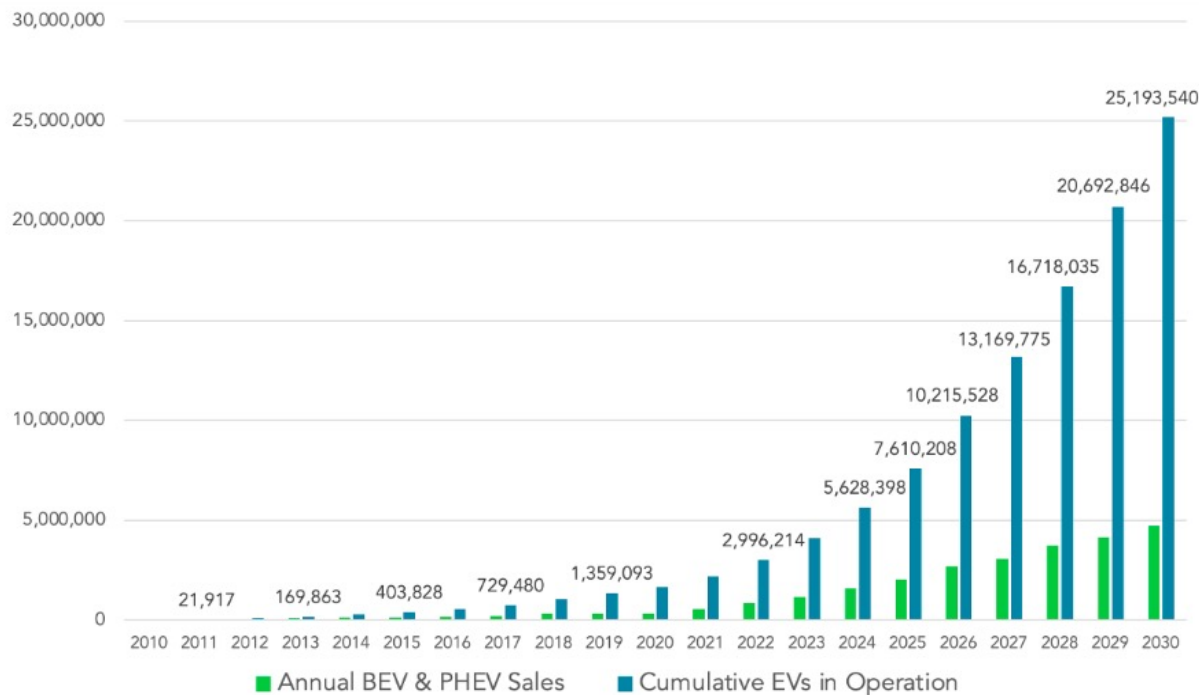
- 14% of all new Vehicle Sales in 2022 were from EVs!

- Up from 9% in 2021 and 5% in 2020

Reference: plantemoran.com/futureofmobility & EIA Data Sources

Where is the Market Going? Upwards – in a big way

Cumulative US Electric Vehicles In Operation: 2010-2030



Historical Data: GoodCarBadCar.net, InsideEVs, IHS Markit | Auto Manufacturers Alliance, Advanced Technology Sales Dashboard | Research, Forecast & Chart: Loren McDonald / EVAdoption

Manufacturers have announced over 100 EV models to be introduced by 2024





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US ELECTRIC ENERGY CONSUMPTION

Americans drove 3.23 trillion miles in 2021

If this was all done in electric vehicles getting 3 mi/kWh, then we would need 1.1 GWh of energy just to charge cars

Average household uses 10.7 MWh/yr (2021)

Charging our cars could use an additional 8.8 MWh/yr

Charging at home is a potential market worth \$145 billion per year in added revenue to electric utilities
(Average residential cost in the US for 2021 was \$0.1375 per kWh)

This is approximately an extra \$1,000 per year per residential customer who charges at home

ELECTRIFICATION FOR THE CONSUMER WILL BE COSTLY!

- For residential buildings and the end consumer, electrification may propose the following strategies among others:
 - ASHP – Air Source Heat Pump in place of gas / oil heat
 - Electric hot water – on demand, tank, via heat pump
 - EVSE – Electric Vehicle Supply Equipment – EV Chargers
 - BESS - Battery Energy Storage Systems
 - PV Solar – residential PV solar systems
- Many of these technologies have added cost for home wiring, service panel upgrades, and challenges with physical location of assets and availability of 120/240V circuits.
- The global market here in the US exceeds \$100 billion!

THE SHAPE OF METERING TO COME: 2023 AND BEYOND

- Planning for electrification will start with the AMI data each of you is now gathering
- Streetlights
- Smart Poles
- Electric vehicle chargers
- Sub meters & embedded meters – which may become “utility” meters
- New & Prior Technology as tools for enabling electrification
 - Adapters





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METER SOCKET ADAPTERS (MSA)

• What is a MSA? And How is it Tested / Certified?

II. Definition of A Socket Adapter and Why/When Used

A meter socket adapter is an enclosed construction with blades and jaws intended for installation between a meter socket and the utility meter. While utilities have installed these devices for decades, adapter utilization has increased and grown steadily over the years. Today meter socket adapters may contain additional bus bars, protective devices, metering, communications, and other associated equipment and primarily serves as an S-base meter socket. Its physical electrical aspects are covered by ANSI/NEMA C12.7 Requirements for Watthour Meter Sockets and C12.10 Electromechanical Watthour Meters. The dimensions of the base of the adapter are provided with an appropriate envelope design, as covered in Figures 2–10 of C12.10 for the intended application. Adherence to both Standards ensures coordination between the meter, the socket, and the adapter. Additionally, performance criteria for meter socket adapters are covered by UL 414 Supplement SA.

Meter socket adapters are utilized in many different applications, such as meter conversions, transfer of meter position, distributed energy connections, surge protection, metering and communication, and other associated functions. Not all of these applications and uses are certified by third-party organizations, though some may be certified by utilities or product manufacturers. While final populated assemblies could be covered under different certification standards, such as UL 414, UL 1008M, and UL 2735, the base adapter product, consisting of enclosure, blades, and jaws, is covered by the UL 414 standard.

The typical meter socket adapter is a circular “collar” type device that is installed between the meter and the meter socket. Meter socket adapters for special applications may have larger enclosures or supplemental enclosures that are connected to the basic “collar.” Meter socket adapters may also have provisions for the use of conduit to facilitate connections to other equipment not connected to line or load terminals of the existing meter socket.



https://www.nema.org/docs/default-source/technical-document-library/nema-us-80016-2022-aspublished.pdf?sfvrsn=a4caa6df_3#:~:text=A%20meter%20socket%20adapter%20is,grown%20steadily%20over%20the%20years





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METER SOCKET ADAPTERS



Surge Guard

Brooks low profile meter base surge meter socket for "whole house" resic protection in a low profile meter so

UL Listed
Industry's lowest profile design

Models:



- Current Market Products
- ConnectDER Solar Product, Generlink Product for Backup Generator, & Tesla Product for Backup Switch
- Various Surge Protectors

OTHER PRODUCTS - METER SOCKET ADAPTERS IN PLACE

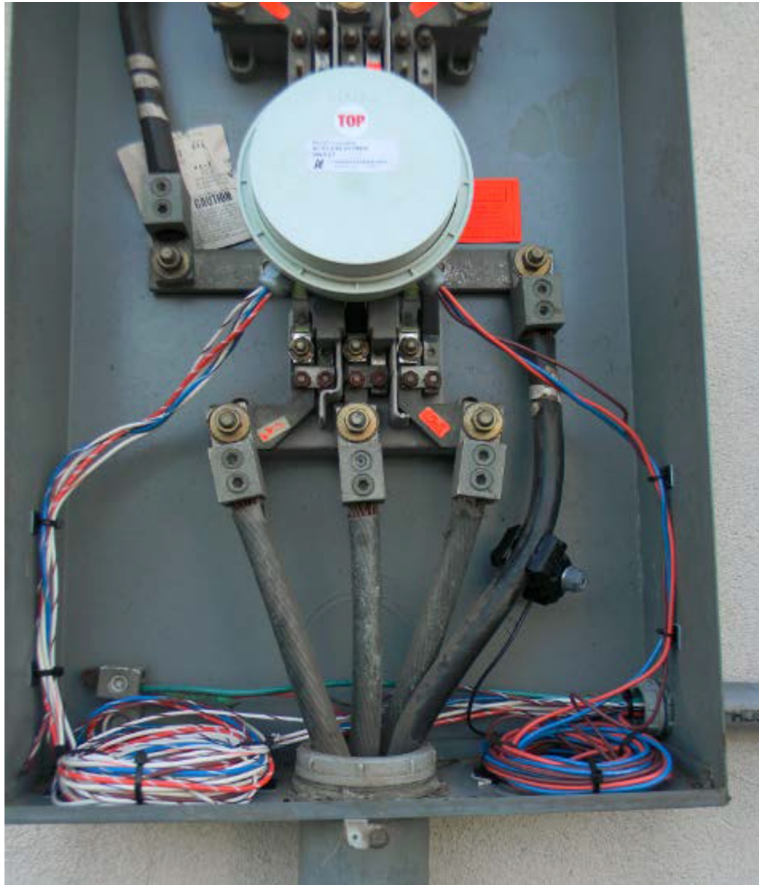
- Many utilities use a MSA for various use cases
- Socket AP - 2S / 12S or its own dedicated socket
 - Itron customers and other AMI customers to add a cellular backhaul
- 2K to 2SE Adapter
 - Many utilities went EOL on k base meters
 - Some utilities may have 5k of these installed with plans to install 20-30k+
- 16k to 9s Adapter
 - Many utilities went EOL and moved away from higher voltage and current flow bolt in meters
 - Converts a self-contained bolt-in meter via a MSA to a transformer rated meter



OTHER PRODUCTS - METER SOCKET ADAPTERS IN PLACE



OTHER PRODUCTS - METER SOCKET ADAPTERS IN PLACE





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CONNECTDER MSA FOR SOLAR AND EV

Solar MSA

- Approved in 20 states – 16,000+ units installed
- 15-minute installation, 30-minute interconnection
- 200A continuous rating (utility power); 80A continuous rating (PV input - 15kW)
- Integrated PV breaker
- UL Listed (414 - Meter Sockets)



EVSE MSA

Launching in 2023

- 15-minute installation, 30-minute interconnection
- Initial offer for 100 Amp and 125 Amp services
- Future offerings for 200 Amp services
- Integrated EV breaker and load management protection
- UL Listing pending



Meter socket adapters for ASHP, BESS, and other technologies expected in coming years

CONNECTDER EV MSA



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QUESTIONS AND DISCUSSION



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