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Current Events in Metering

Electric Vehicles and Effect on Distribution Networks

Renewables, DER's, and Energy Storage

AMI 2.0

Pennsylvania Rural Electric Association

PREA

March 4, 2025 3:00 PM-4:30 PM

Tom Lawton and Perry Lawton, TESCO

PREA Current Events

Topics we will be covering:

- Electric vehicles and their effect on Distribution Networks
- Renewables, DER's and Energy Storage
- AMI 2.0 (and an AMI Technology Primer)

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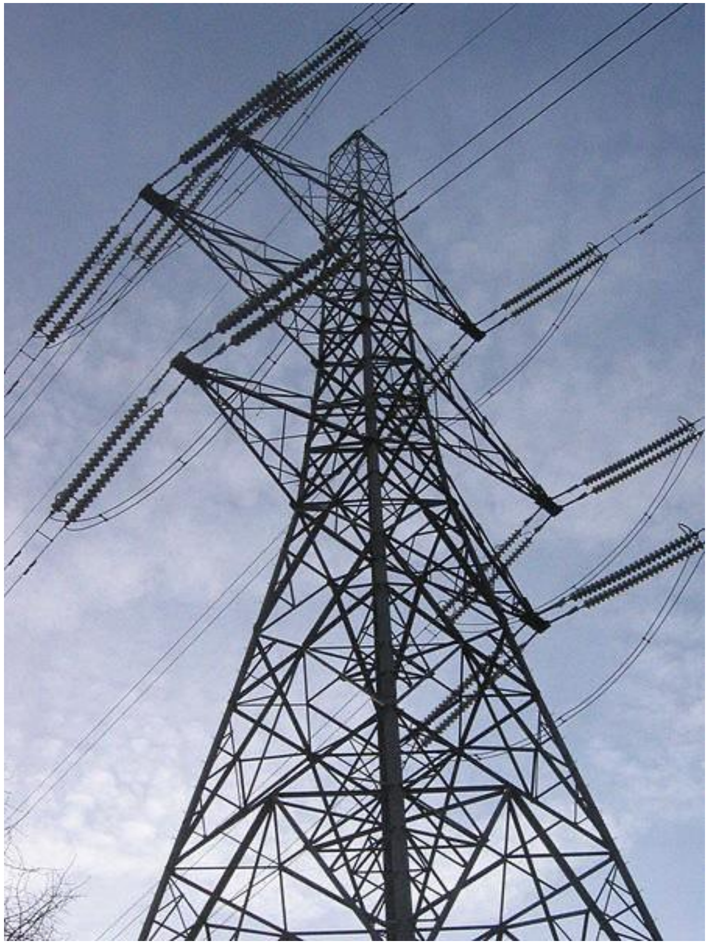
Electric vehicles and their impact on Distribution Networks

Perry Lawton

EV Topic List

- Basic impact on electric grid
- Residential application
  - How would does impact me and my personal energy consumption?
- Commercial Application
  - How does it impact my community and my utility?

Basic impact on electric grid



Increasing Demand

Equipment Aging/Upgrades

Renewable Alignment

Providing Grid Services

US TOTAL ENERGY CONSUMPTION

January 2023:

- Generated 352,140.3 GWh
- Average Residential retail price: 13.75* cents/kwh
- Based on these figures, how much do you think home charging is worth to utilities per year?

US ELECTRIC ENERGY CONSUMPTION

Americans drove 3.236 trillion miles in 2023. 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

Commercial Application

EXAMPLE: TESLA Supercharger

Example of station requirements/capability:

Per Cabinet: 192A max on each of 3 phases at 277Y480V, **~160kW (AC)**

Typical site has: 6-10 stalls
Fed by a dedicated **transformer that is rated at 500kVA to 750kVA**

Example of total usage/site:

In 2022, TESLA reported 1.5M (214,000/day) charging sessions, accounting for **9TWh of charging from superchargers alone.**

On average, each site is seeing **192,389 KWh/year**
or **527 KWh/day**

US ELECTRIC ENERGY CONSUMPTION

TESLA saw an average of 192,389 KWh per Supercharger site

If you had ONE Supercharger in your service territory, it would account for $26,453.48/year (13.75₵) in utility revenue.

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Renewables, DER's and Energy Storage and what they mean to a Smart grid

Tom Lawton

Sources of Generation in the US

In 2023, about 4.18 trillion kilowatthours (kWh) of electricity were generated at utility-scale electricity generation facilities in the United States.

60.0% of this electricity generation was from fossil fuels—coal, natural gas, petroleum, and other gases.

Natural Gas is 43.1%

Coal is 16.2%

Everything else 0.7%

18.6% was from nuclear energy

21.4% was from renewable energy sources.

Wind 10.2%; Hydro 5.7%; Solar 3.9%; everything else 1.6%.

Energy Storage - the key to Renewables

Without Energy Storage, renewables do not help us

Energy storage – capture of energy for use at a later time

Types of energy storage

- Chemical reaction - Batteries
- Mechanical reaction – Hydro/Reservoir
- Electricity – Capacitors
- There are many ways to store energy – Coal, Oil, Wood are all ways to store energy

The key is to store in ways that are easy to use at a future date and are as efficient as possible

DER – Distributed Energy Resource

- A distributed energy resource (DER) is a small-scale unit of power generation that operates locally and is connected to a larger power grid at the distribution level.
    - solar panels
    - small natural gas-fueled generators
    - electric vehicles
- The key here is that the energy produced by a DER is typically consumed close to the source.

WHAT DOES THIS ALL MEAN TO MY UTILITY?

DER's may have the largest effect on a small utility in the immediate future.

- Not under your control
- Not a part of your grid planning
- But the Utility must include this into their grid management without knowing when or if this DER may come on or off-line

Energy storage and Renewables

- Smaller Utilities can begin to generate more power locally
- If the same utility implements energy storage this can become even more lucrative
- Inter-Tie Metering and meter testing starts to become more important
- Utilities have the option to provide equipment for local generation on homes or community generation (e.g. solar on residential homes; solar farm on a community's open space or even a wind turbine; batteries in homes for charging electric vehicles and accepting power from EV's)

NEW AREAS TO CONSIDER – THE FUTURE IS HERE

Large Industrial DER's

Large Commercial DER's

Large Community Der's

DC Metering requests

Batteries on Vehicle Charging Facilities

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AMI 2.0 AND AN AMI TECHNOLOGY OVERVIEW

Tom Lawton

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Topics We Will Cover

Benefits of AMI and where we are starting from

Overview of technologies

Challenges

AMI 2.0

AMI Benefits

- Information / Data
  - Usage
  - Voltage/Current
  - Predictive Analytics
- Reduced Field Visits
- Disconnect/Reconnect
- Outages
- Net Metering
- Future Developments

PRE-AMI METER OPERATIONS

Common Features and Common Sources of Concern

Old Electromechanical Meter

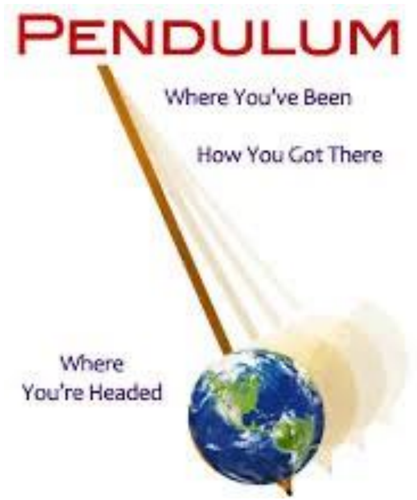
New Automated Meter

- Fewer meter techs in the field and in the shop than there were 25 years ago
- Fewer Field checks and site verifications due to lack of personnel, lack of experience and lack of expertise
- More features under glass in the meters even before AMI deployed
- Significantly more features under glass in every AMR and AMI system being considered or being deployed
- Metering losses starting to be identified “by accident” as opposed to being “by design”.

The Pendulum Starts to Move

- Meter Operations. Prior to deployment many larger utilities take an attitude of "this is only metering – how hard can that be?". Over the course of deployment Meter Operations gains a stature and a respect from the rest of the organization that was not previously accorded them – even if this is only begrudging respect.

- New tests for AMI meters (e.g. communication, disconnect) are identified
- The complexity and issues around high revenue metering are at least acknowledged by the rest of the organization
- Tests which have not been performed in years are suddenly back in vogue



THE NEW REALITIES

- Electro-Mechanical Meters typically lasted 30 years and more. Electronic AMI meters are typically envisioned to have a life span of fifteen years and given the pace of technology advances in metering are not expected to last much longer than this.
- This means entire systems are envisioned to be exchanged every fifteen years or so. In the interim the meter population and communication network inherent in the infrastructure for each utility must be maintained.
- Meter communication and meter data management are becoming as important to metering operations as meter accuracy.
- Firmware upgrades, firmware stability and cyber security are becoming increasingly important to metering departments

What Technologies Are We Using?

- Private Networks
- Cellular/Public Networks
- RF Mesh

Private Networks

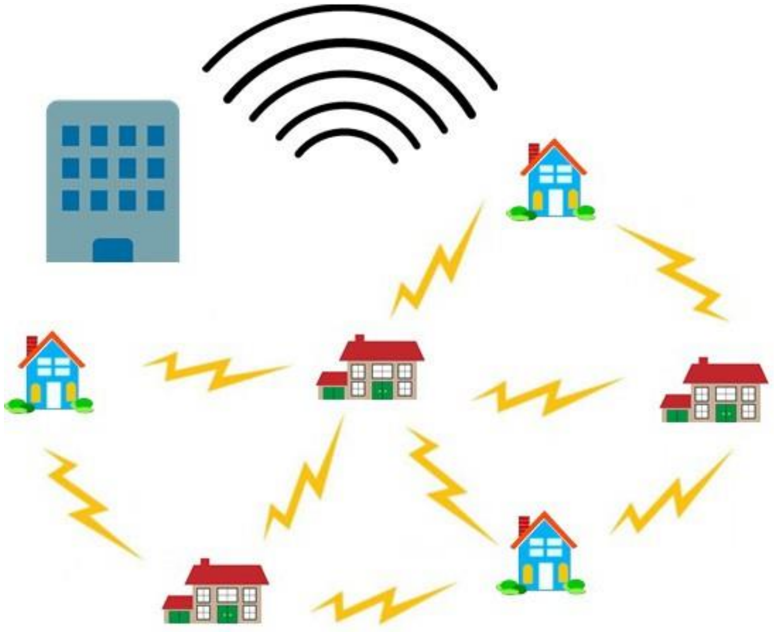
- Dedicated Infrastructure
  - Allows a great deal of data and frequency of data collection
  - Requires the utility to manage a new technology

LTE Back Haul

- Infrastructure will win
  - IoT vs. number of meters
    - New IoT devices are being installed at a rate of 127 per second or 11 million per day
  - 165 million connected electric meter customers in the U.S. and Canada

RF Mesh

- True RF Mesh
- Meters and collectors
- Software and firmware
- Head End Systems
- The difference between frequencies
  - Proprietary and non-proprietary frequencies
  - Penetration vs. distance trade-off



CHALLENGES

Expected:

- The AMI deployment team will declare victory at some point and move on. Clean-up will be left for the meter service department, and these will be the hardest meters to access and to get reliably on the network
- Firmware upgrades must be checked and tested before mass deployment
- What was previously a straightforward device has become complex with thousands of lines of code with more points of failure
- Meter Acceptance testing including far more than accuracy testing for every deployment

Unexpected:

- Meter Certification Testing never slowed down over the course of any of the deployments

WHY DO AMI METERS FAIL?

Looking back at various deployments – what are the chief causes to reject meter shipments?

Meter functional test failures including but not limited to;

- Incorrect firmware
- Bad settings
- Alarms and errors that do not clear
- Communication test failures
- Bad tables
- Failed disconnect switches

LESSONS FOR THE FUTURE?

- Are these infant mortality issues or are these issues to be concerned about going forward?
- What was NEVER the reason for rejecting a shipment – meter accuracy.
- Which are the most difficult meters for every deployment – the transformer rated meters. Often these forms are not available until very late in the deployment and sometimes not until the deployment has officially ended.

COMMERCIAL AND INDUSTRIAL METERING CHALLENGES

Most AMI deployments utilize third party contractors to handle the residential and some self contained non-2S services. The balance is typically handled by the meter service department of the utility.

As these services are evaluated for new metering technology, issues are being found at some accounts. These issues represent revenue losses due to inappropriate metering schemes or partially failed metering components (e.g. transformers, electronic components).

How are these new realities starting to affect metering operations?

- Metering is becoming more about IT. Some metering departments have been reorganized after AMI as part of the IT department.
- Metering emphasis will shift strongly toward C&I customers and further and further away from residential meters
- Metering resources are being refocused on C&I accounts.
- There are fewer levels of meter tech. Every meter tech needs to be at the higher level as there is not enough lower level work to warrant full time employees
- Utility commissions are being less forgiving of allowing rate relief for project over runs and metering inaccuracies

NEW OR EXPANDED ROLES FOR METERING DEPARTMENTS OF ALL SIZES

- Responsible for either reviewing ANSI Tests or even performing some of these ANSI Tests
- Perform Meter Functionality testing on new and returned AMI meters
- Register and communication module energy measurement comparison
- Disconnect/Reconnect Functionality
- Outage Performance
- Meter Communications Performance
- Consumer safety and combating real and perceived issues
- Near continuous research into the “next” technology and the next deployment

Shop Testing

- Accuracy testing
- Meter Communications Performance
- Software and firmware verification
- Setting verification
- Functional testing
- Disconnect/reconnect Functionality and as left setting

Field Testing and Inspection

- Work with third party deployment vendor or perform the deployment
  - Self contained
  - Transformer Rated
- Accuracy Testing
- Meter Communications Performance
- Software & Firmware Verification
- Setting Verification
- Functional Testing
- Disconnect/Reconnect Functionality and as left setting
- Tamper Verification
- Site Audits appropriate to the type of meter

Meter Farm Testing

- You will use and install a multitude of different generations of meter / firmware.
- Having a small population in a controlled area that can be assessed for performance over time can be extremely helpful.
- It’s better for the utility to find an address the problem before you become a ‘news story’

Real Life Examples of Change Management in Action

- Issues in the system not the components – what is the definition of a meter and when did the meter change?
  - Meter and communication device interface

- Feature Creep – every manufacturer wants to differentiate themselves – sometimes this works in unanticipated ways
  - Recovery from power outages
  - Short and long demand periods

- But we only changed….lessons we should have learned from Microsoft
  - Over the air upgrades

- Thank Goodness for test plans – right?
  - Half closed disconnect devices
  - Disconnect devices of unknown state
  - Meters with incorrect firmware

AMI 2.0

- Enhanced Computing Power
- Greater Communication Capability
- Integration with customer devices
- Independent Operation

AMI 2.0

- The disaggregation software gives consumers a home energy management solution that can be integrated with smart home devices.
  - Utilities will be able to provide customers a way to better control power usage.

- For a consumer with distributed energy resources (DER)—such as solar panels, home batteries, or electric vehicles that can discharge to the grid or use smart inverters—disaggregation software on the meter lets the customer manage the demands on DER equipment according to their preferences.

AMI 2.0

- Real Time dynamic energy data. Allow utilities to engage a variety of micro-generation sources to balance load and shave peak demand.
- AMI 2.0 solves the problem of identifying the location of a high-voltage residential electric vehicle (EV) charger and determining whether or not the circuit it's on can handle it.

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AMI 2.0

This will bring a range of challenges for meter departments requiring them to understand a broad array of technologies.

Meter department staffs are envisioned to have less work with AMI but often it is just the opposite.

It will be even more important to ensure operations at C&I customers as they will become energy generators as well as consumers.

SUMMARY

Benefits of AMI

- Far more information than just accurate energy usage
- Fewer but more complicated field visits
- Allows Meter Services to focus field resources on Transformer Rated Services

Overview of the Technologies

- Meters are more complex with increased points of failure
- Communications choices become very important as you will have to manage and work with them for a long time.

How AMI is changing Meter Service Departments

- Challenges Meter Services to provide far more value to the organization by providing better analytics of the data being received from the new meters
- Meter Services must add telecommunications tools and expertise
- The meter man of the future knows not only metering but they are communication experts and are involved with handling, reporting and analyzing far more customer and system data
- There are fewer “routine jobs” in the field and many of the standard tasks are no longer required. This will lead to fewer classifications of meter techs going forward and the need for a more highly trained tech.

SUMMARY (CONT.)

Metering and the Future of AMI

- Metering will be in a near constant cycle of looking for the next technology, evaluating those technologies, planning for deploying these technologies, and cleaning up the aftermath of the deployment of these technologies.
- Metering will begin to run non-metering operational groups
- Each Utility must take a far more active role as part of checking, certifying, and rechecking the functionality of their meters.

Questions and Discussion

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