TESCO METERING

Meter Service Shops of the Future

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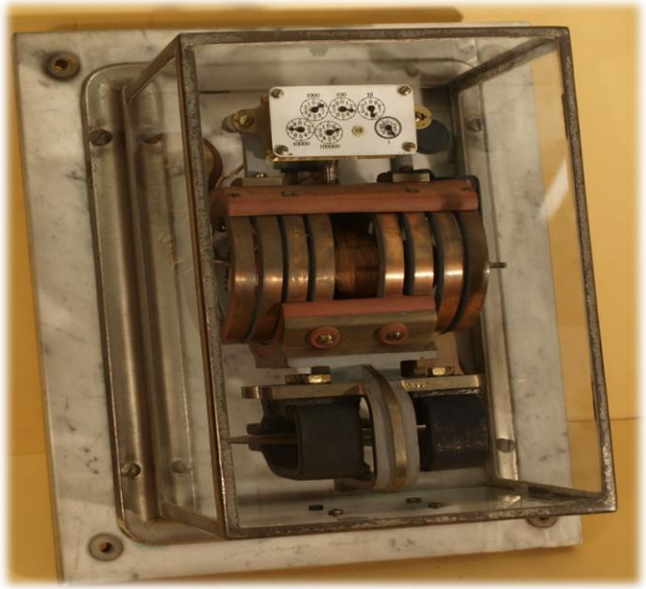
1:00 PM

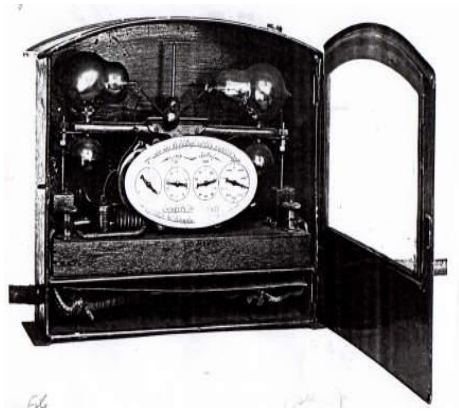
Topics to Cover as We Look to the Future

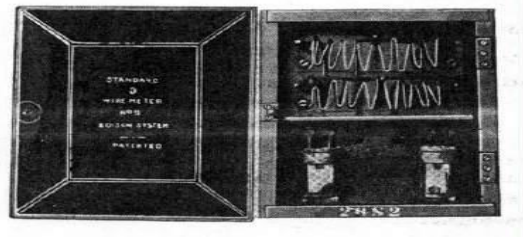
- Evolution of metering: From the 1870s to the 2010s
- Current state of AMI and the importance of smart meters in a smart grid
- The evolving role of Meter Services in the utility of the future
- Big data's impact on field operations and truck rolls
- What the future holds for meter design and functionality

1870's to 1900

- Invention of electric metering
- After early attempts, induction meters were developed—still recognizable today
- Four of today's top meter brands began production early on:
  - Sangamo (now Itron)
  - GE (now Aclara)
  - Westinghouse (now Honeywell)
  - Duncan (now Landis+Gyr)

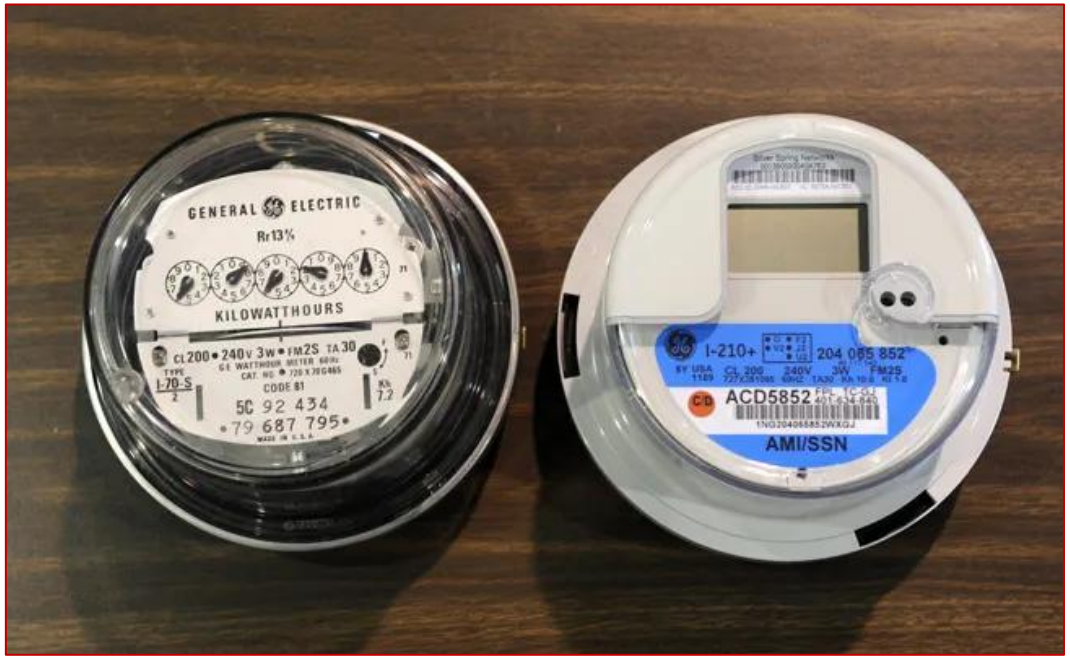






1900 to 2000

- Induction meters dominated most of the 20th century; electronic meters emerged late.
- Meter standardization began in the early 1900s.
- NC Meter School founded in 1923 (complete with a bell).
- Socket meters replaced A-base meters in the 1950s.
- Electronic meters appeared in the 1970s, but scaled in the 1990s.
- Communications integrated into high-end meters in the 1980s–1990s.
- The same four major meter manufacturers persisted into the 21st century.

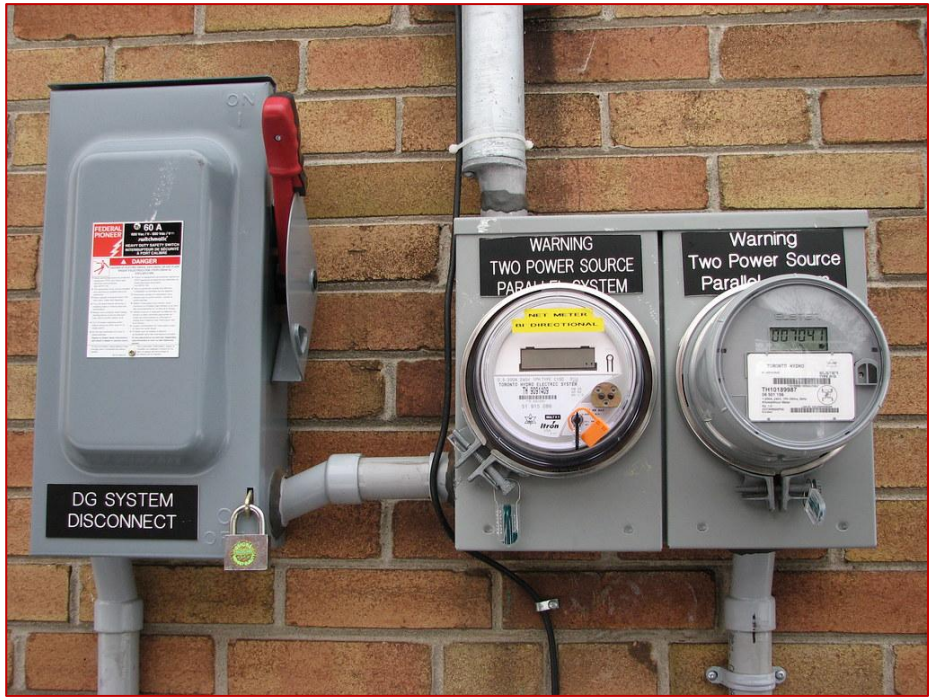


2000 to Present

- Final electromechanical meters are phased out; all new meters in North America are electronic.
- The Smart Grid concept emerges, modernizing a century-old grid design.
- Advanced Metering Infrastructure (AMI) serves as the Smart Grid's intelligence.
- Smart meters become the core, enabling two-way communication and advanced features beyond energy measurement.

2000 to Present

- New communication vendors partner with meter manufacturers to embed tech under the meter cover.
- Meter manufacturers also develop in-house communication solutions.
- Features like disconnect switches and power quality monitoring become standard under-the-cover additions.



2000 to Present

- Meters are no longer looked at as simply energy measurement devices.
- Over 85% of the meters in the US are AMI meters and half of the balance are in the process of being changed out over the next two years.
- Early adopters of AMI meters are now starting to replace their original meters.

2025 and Beyond

The best way to know the future is to pay attention to the present

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Near Term Projections

Near Term Projections

2025 and Beyond

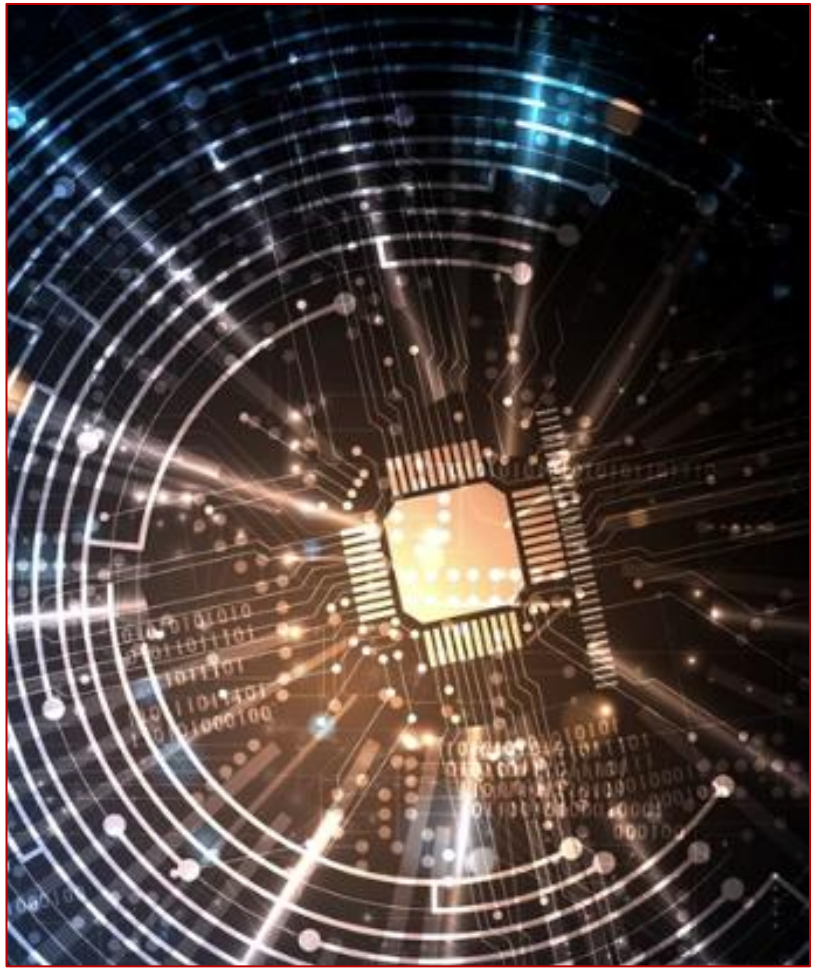
The best way to know the future is to pay attention to the present.

Best way to do this is to follow the money;
Not the news.

Information, Information and more INFORMATION

- The future is all about information and how we use this information

- The real question is, ‘How will this information change the way Meter Service Departments will operate in the future?’



New Technologies and Shifts in Meter Services and Electric Operations

- Second Generation AMI
  - New capabilities under glass
  - The electric meter as an Application Platform
    - Impedance detection
    - Theft detection
    - Broken Neutral detection
    - Telling the network where the meter exists on the network – real time, closed loop GIS mapping.
  - Additional data and additional actionable work orders coming from Meter Services
  - LTL and Private netw

New Technologies And Shifts In Meter Services And Electric Operations

- Streetlights and smart poles are becoming part of metering infrastructure.
- Meters are expanding into non-ANSI energy measurement and new services.
- Data volume is expected to increase exponentially in the next decade.
- Meters will serve as the first processor for on-demand data access by users and utilities.
- Metering will integrate with distribution, generation, storage, cybersecurity, and data analytics.
- These expanded roles will become part of everyday responsibilities for Meter Service Departments.

2025 and Beyond

There is only one thing we know for certain about metering in 2025 and beyond;

Metering will not be the same as today.
Meter Departments will be

- **New**
  and
- *Different*

2025 and beyond

AMI and Next Generation AMI

- Metering will become central to distribution operations as utility analytics mature.
- Knowledge and data will drive utility decision-making.
- AMI systems will deliver the data; analytics teams will build the tools.
- Metering professionals will guide effective use of these tools.

2025 and beyond

Tolerance for non-technical losses will drop significantly.

As utilities and customers realize these losses can be tracked and resolved, demand for more data and better tools will increase.

2025 and Beyond

As detection tools improve, tolerance for non-technical losses will decline—driving demand for more data and advanced tracking solutions.

2025 and Beyond

As power quality improves and customer awareness grows, tolerance for issues like harmonics and distortion will decline.

New tariffs or requirements may emerge, including customer-side power factor correction.

Business Use Cases for this Big Data

Data we are already looking at:

- Voltage Monitoring
  (Min, max, average)
- Transformer Loading Analysis
- Number of customers out of power
- Current demand savings from load control (kW)
- Outage Index Reporting *(SAIDI, SAIFI, MAIFI)* at multiple levels
- Cumulative outage hours *(MTD/YTD)*
- General line loss analysis

Business Use Cases for this Big Data

Data we are already looking at:

- Demand Response (CVR, Peak Reduction, Etc.)
- Power quality investigation
- Number of blinks, sags, etc. (over time specified)
- Peak condition tracking
- Power factor by circuit or time of day
- Pattern detection (Algorithm to detect patterns in voltage, demand, blinks, etc.)
- System efficiency by circuit
- Remote Disconnect/Reconnect

Business Use Cases for this Big Data

Now what can we do with this information? Well….To start;

- 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 which transformers to store in which inventory yards
- Determine when new loads are present and which transformers are in jeopardy

Business Use Cases for this Big Data

Now what can we do with this information? Well….To start;

- Locate Bad connections
- Identify increased burden/impedance
- Locate Undersized lines
- Locate broken neutrals
- 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

And Now We Want MORE……

More data

Greater frequency

Whatever bandwidth you thought you needed, now you need more.

Next Generation of AMI

Can we use our existing infrastructure?

What are the compelling new features?

Do we have to rip out and replace with new infrastructure?

What about LTL back haul or a Private Network?

What about Power Line Carrier for my remote areas?

Renewables and Storage

Renewable energy is inherently intermittent and requires utility-grade storage to ensure reliability.

Paired with storage, renewables are rapidly becoming a primary focus for new utility-scale generation and capital investment.

Renewables and Storage

- The world's largest renewable energy and storage project launched this year at Edwards Air Force Base, CA—funded largely by the Department of Defense.
- It features 1.9 million solar panels across 4,600 acres, generating up to 875 MW.
- Its utility-grade battery system stores 3.3 GWh—enough for nearly four days of power.

Renewables and Storage

- Island communities are leading the way in renewable storage. Ta’u, American Samoa operates a 1.5 MW solar system with three days of battery storage.
- In December 2023, Hawaiian Electric launched a 565 MWh storage facility on O‘ahu—meeting nearly 20% of peak demand for up to three hours.
- Hawaiian Electric has also contracted an additional 2.1 GWh of storage capacity.

2025 and Beyond

- Customers will increasingly adopt both renewable generation and energy storage at the distribution level.

- As residential loads deviate from unity power factor, utilities may need to implement:
  - Blondel-compliant metering solutions
  - VA/VAR-based measurement
  - Power factor correction methods

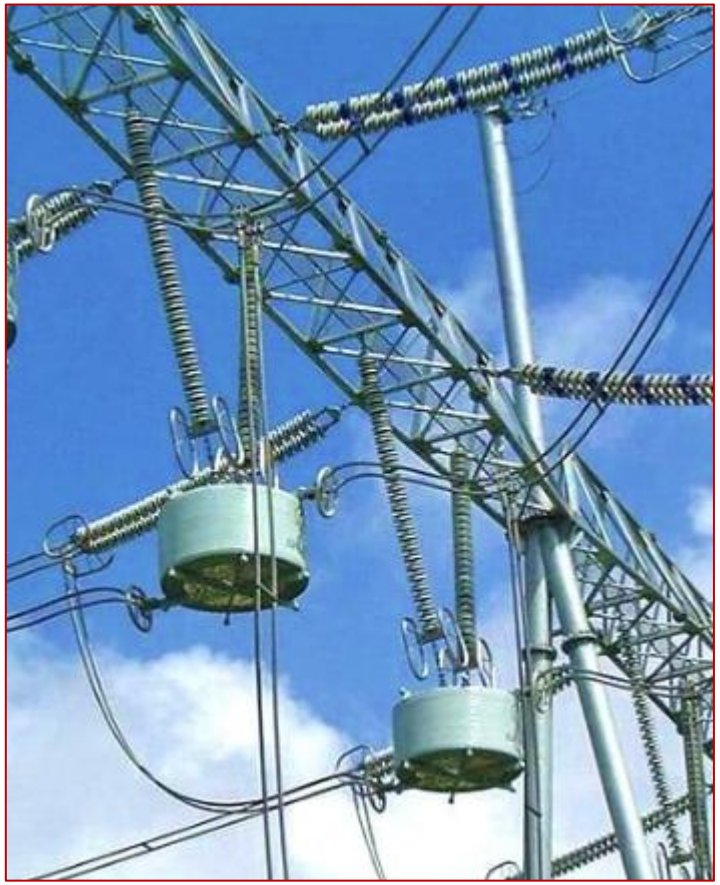
- AMI systems will begin reporting customer power factor, driving metering decisions (e.g., 12S vs. 2S meters).

2025 and Beyond

- Customers will increasingly deploy distributed renewables and on-site energy storage.
- Growth in customer generation will drive the expansion of microgrids.
- Second-generation AMI and new communication models will emerge as low-throughput, long-range (LTL) data becomes more affordable and widespread.

AMI 2.0 Infrastructure

- AMI 2.0 will leverage lower-cost LTL data and expanded coverage—no new infrastructure needed.
- Power Line Carrier (PLC) research may boost bandwidth and data frequency with minimal upgrades.
- Mesh networks continue improving, with AMI 2.0 building on AMI 1.0 infrastructure.



2025 and beyond

The shape of metering to come.

Meters that do not look like meters as we know them, will become a part of our world.

- Street lights
- Smart Poles
- Electric vehicle chargers
- Sub meters – which may now become our meters

What will Meter Service Departments Look Like?

- As in sports the basics will never change. In Tee Ball we practice hitting and catching
  and so do the Pro's.
  - We will move up a league though and this will require us to be better than we were
- Meter Tech one and two. Single phase and polyphase
- And there is more;
  - Communications experts for our network communications
  - Site testing and trouble shooting for our Transformer rated services
  - Big data analytics using our knowledge of our metering network
  - Metering in non-traditional areas with non-ANSI applications

What Will Meter Service Departments Look Like?

- Line loss can increasingly be identified and corrected through improved metering.
- If inaccurate metering is the root cause of loss variation, utilities now have—or will soon have—the tools to fix it.
- Metering teams should lead business cases for new rates and tariffs.
- Director of Meter Services roles may evolve into VP of Grid Resiliency and Reliability.
- Metering budgets will grow as it becomes central to distribution operations.

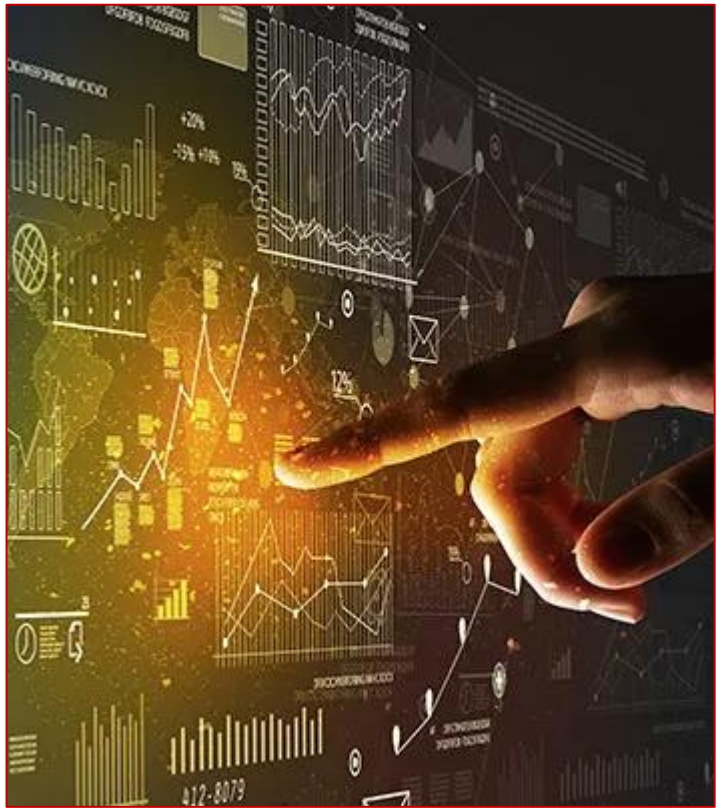
Summary – The Past and the Future

- Despite evolving technology, accurate energy measurement remains essential.

- As power quality and energy distortion become more prominent, understanding their impact on metering grows increasingly valuable.

Summary – The Past and the Future

- Combining metering and distribution knowledge with big data will drive automated AMI analytics for monitoring and improving the grid.
- Meters may evolve in form, but metering will remain central to electric distribution.
- Institutions like NC Meter School will continue supporting industry education and advancement.



Questions and Discussion

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