

## **AMI Overview**

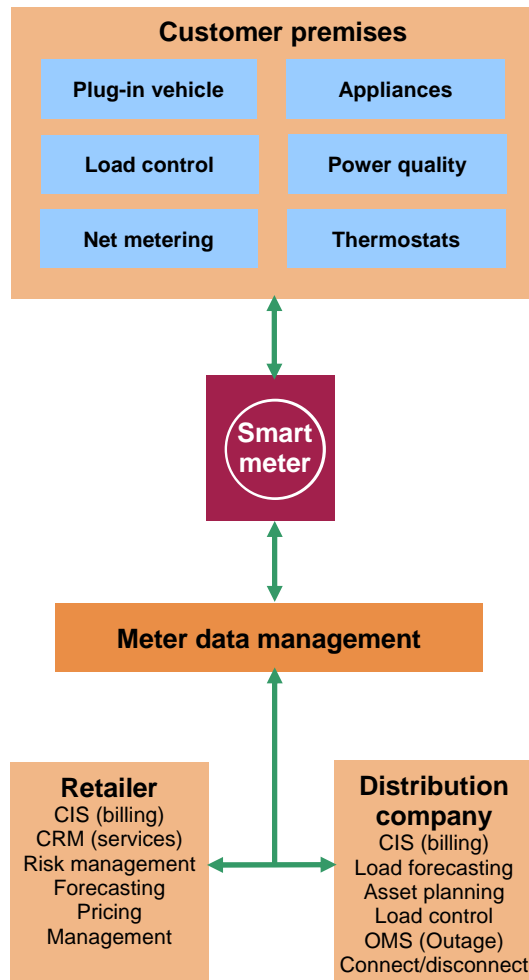
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AEIC Workshop, San Antonio, TX

## What are utilities thinking about Smart Metering?

# Understanding of Smart Metering terms



### ▪ Meter definitions Energy Insights used in research:

- **AMR (Automated Meter Reading):** Any metering system where the meter reader does not have to manually enter the numbers from the meter.
- **Smart Metering or AMI (Advanced Metering Infrastructure):** A subset of AMR with three main characteristics:
  - Solid-state or computerized meters that collect time-series (interval) energy use data and are programmable to support features like time-of-use rates
  - Two-way communication between meters and utility
  - Able to support applications beyond meter reading, such as demand response programs
- **Smart Metering definitions:** Most utilities had a basic understanding of a Smart Meter, but many used different terms for Smart Meters. Some utilities preferred to use AMI, and a few still just used AMR to describe either AMR or Smart Meters.
- **Going beyond the meter:** A few utilities had a more advanced grasp of Smart Metering and the components that work with Smart Meters. For example, one utility said that it preferred to use AMI because it captured the associated hardware, software, and services that are necessary for effective Smart Metering, such as those areas listed in the figure to the left.

Source: Energy Insights, 2007

# Functional AMI Situations

From a Load research perspective, there are four situations with AMI

- No automation – “old school” – IDR meters, read with handheld devices. Could also include phone line reads here.
- AMR – drive-by data collection using RF.
  - No interval data collection through AMR system
- AMI with ability to “switch on” interval data collection at any given site.
- AMI with interval data collection everywhere, all the time.

# FERC Definition of AMI

According to the FERC, Advanced Metering Infrastructure is a system that

Allows for the collection of interval data (hourly or shorter time periods) on at least a daily basis.

NOTE: This does not necessarily include two-way communication

# Interval data and AMI

Focusing on the last two scenarios for interval data

- Switch interval data collection on or off for arbitrary meters
  - Used to collect interval data for a subset or sample of customers (albeit allowing for a much larger sample than with traditional interval data recorders)
  - Limits on how many meters can be switched on in small geographic areas (capacity constraints). There can be a cost implication here
- Collect interval data for all customers all the time
  - Enables dynamic pricing options
  - Data management becomes major issue – MDMS crucial
  - There will still be missing data
  - Sampling may still be appropriate

# AMR/AMI technologies

- **Types of AMR and AMI**

- **Radio Frequency (RF)**

- Fixed network – enables other applications
    - Drive-by – only monthly meter reading possible

- **Satellite/Paging/Cellular**

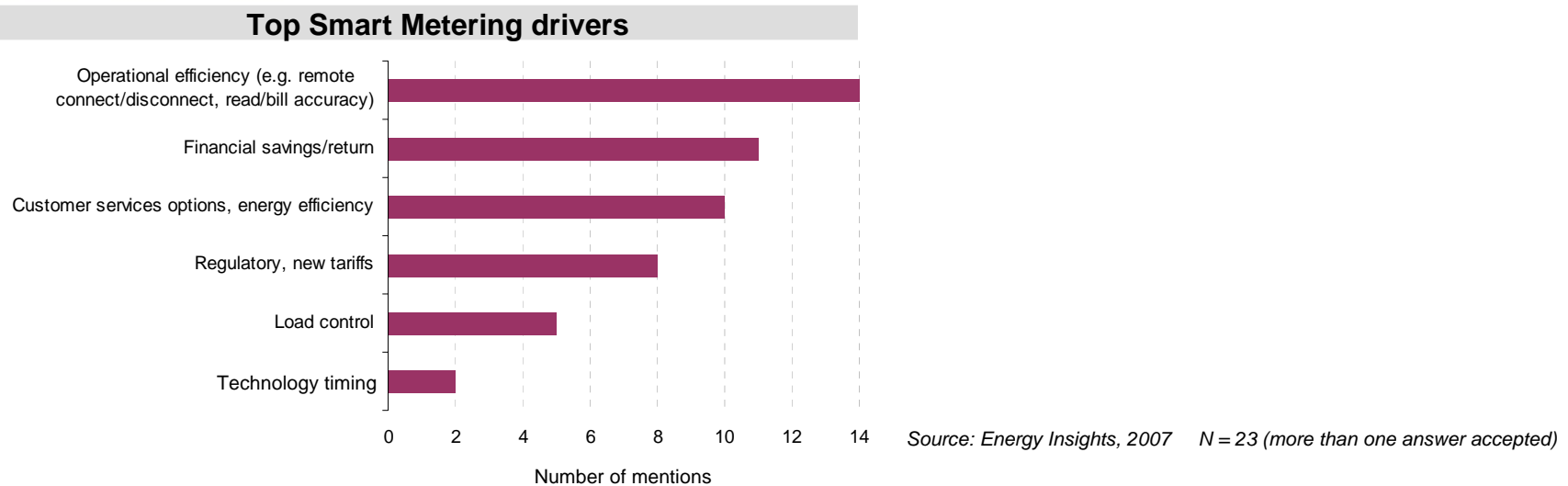
- Some use existing utility infrastructure, others require new infrastructure
    - Limited bandwidth, but enough to get interval data

- **Powerline**

- Several different approaches, from slow & low bandwidth to high speed broadband over powerline (BPL)
    - Big benefit is that the utility already has the power lines in place

## What are utilities thinking about Smart Metering?

# Top business drivers for Smart Metering

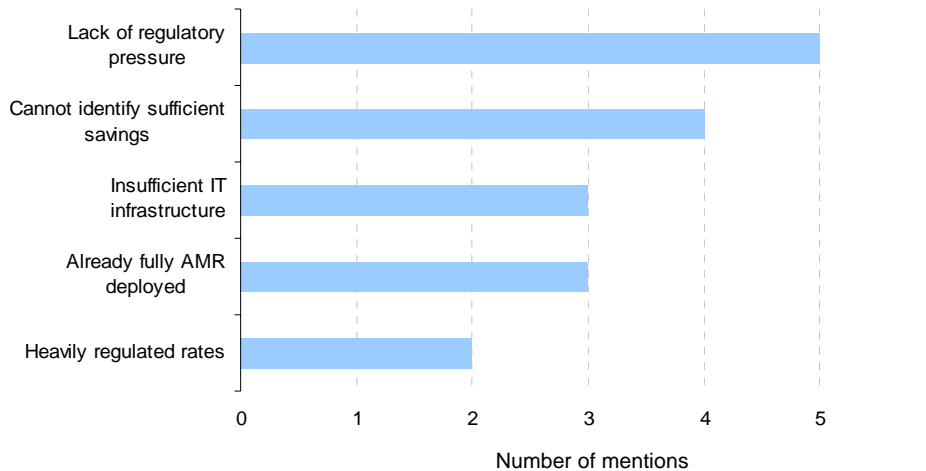


- **Generally, respondents thought a successful Smart Metering implementation would drive customer satisfaction and service up, while reducing costs. Regulatory compliance and recovery of expenditures are also somewhat important.**
- **Any need for more advanced features?** More advanced features, such as time-of-use pricing did not appear to be substantial drivers for Smart Metering investments. Often, utilities saw advanced features as providing benefit “farther down the road”.
- **Today, utilities want the basics:** As the figure above demonstrates, utilities are looking to Smart Metering to help them achieve operational efficiency in terms of reading and billing accuracy, and remote connect/disconnect.
- **Regulatory:** Although regulations impact Smart Metering efforts, some utilities are waiting to see how the EPart and time-of-use pricing regulations will play out. Other utilities are moving forward based on EPart’s timeframes for offering time-of-use, regardless of their state/province’s regulations. Utilities are aware, but in many cases still planning.
- **Many groups needed to move Smart Metering forward:** Not only is executive support usually needed, but finance can play an important role since they benefit from improved meter/billing accuracy.

*What are utilities thinking about Smart Metering?*

# Business drivers preventing Smart Meters

Top drivers preventing Smart Metering



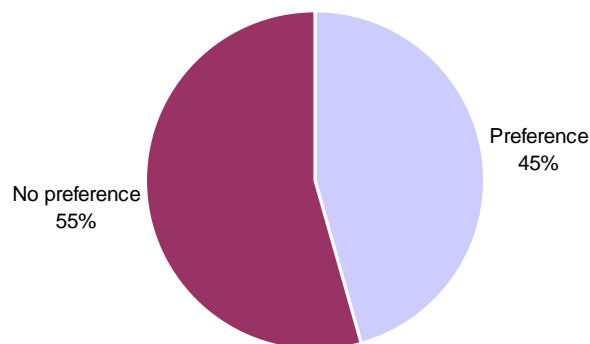
6 Source: Energy Insights, 2007 N = 23 (more than one answer accepted)

- **No surprise, but the lack of regulatory pressure and insufficient savings most often kept utilities from investing in Smart Metering. Some utilities also did not have sufficient IT infrastructure to support Smart Metering or had already made substantial investments in AMR.**
- **Many utilities understand the benefits of Smart Metering:** Some utilities that did not have plans for Smart Meters understood the benefits of Smart Metering. In some cases, Smart Metering is not moving forward because different departments within the utilities disagree on the need for Smart Metering.
- **A convincing success story may not sway these utilities:** In many cases, since they understood the benefits, utilities did not feel a convincing Smart Metering success story would push their utility to go forward with Smart Metering. This was based on business objectives rather than technology.

## What are utilities doing about Smart Metering?

# Beyond the meter—Communications

### Any communications preference?



Source: Energy Insights, 2007 N=23

### Communications technologies mentioned by utilities

BPL (4)  
Cellular (3)  
Handheld devices  
Internet  
Land lines (3)  
Microwave  
PLC (9)  
Radio Frequency (6)  
Satellite (2)  
Wireless/WiFi (6)

*Note: Those categories listed without a number were named once.*

Source: Energy Insights, 2007 N=23

- **Generally, utilities thought communications were an important part of Smart Metering.**
- **Open to different communications options:** Most utilities seem fairly open to using multiple communications technologies. Even those that have a communications preference often discuss preferences for multiple communication technologies, depending on different needs with their service territories.
- **It is not necessarily all about wireless:** As the list above demonstrates, utilities are using or considering a variety of technologies—whether wired or wireless. In the interviews, utilities referred to PLC most often of any communication technology. RF, Wireless and BPL also received a fair number of mentions.

## Appendix

# Technology breakouts

Broad Technology Category	Technology
<b>Hardware</b>	Communications/Networks Physical Meters Servers Smart Handhelds, RFID, related HW Storage
<b>Services</b>	Installing new communications network IT consulting (staff or skills augmentation) IT outsourcing (general outsourced arrangement) Meter installation consulting (staff or skills augmentation) Meter installation outsourcing (general outsourced arrangement) Upgrading existing communications network
<b>Software</b>	Meter Data Management (generally the repository) Meter reading/communications software (between meter and systems) Meter systems interfaces (between other systems and MDM) Web enabled end-user applications (via multiple online channels)

# Potential benefits of AMI for load research

- Ability to quickly and easily turn on and off data collection
  - Flexibility allows load research to easily create a special sample for ad hoc analysis, such as DSM or rates studies, short-term program evaluation, geographic samples, or short-term extreme weather impacts
- More available data because the entire service territory is covered and larger samples are possible
  - More coverage allows analysis that requires an oversample -such as a market segment load analysis or estimates of unbilled revenue
- Low cost allows for quicker study startup and more frequent sample replacement

## Load researchers and AMI currently

- Energy Insights conducted a study (late 2006) to see how load research managers were utilizing AMI data
  - Utilities we spoke with still struggle with data not being collected and an inability to access the data in an efficient manner
  - Currently, many of these utilities conduct load research in the usual fashion - using load research interval recorders and duplicating the AMI system data collection.
  - Some utilities are investing in an MDMS to provide access to the interval data
  - Although the promise of using AMI for load research has not been fully realized, most of the utilities remain optimistic that it will happen in the near future.
  - We recommend that load research get involved with any decisions on AMI or an MDMS so that the interests of load research are considered.

# Current problems with AMI

- Technology not collecting data
  - JEA had a system 99% deployed, but not all the meters were activated, lots of customers with missing data (though it often is for only a few intervals)
- Lack of access to the data
  - AMI data now resides with an IT or AMI department so accessing interval data can be more complex.
  - For example, one utility now has to make a request to IT for a specific set of data. Then after a couple of days they receive a flat file of the data, which then must be imported into their analysis software.
  - Load Research group no longer “owns” the data

# Load researchers and AMI

- Collecting interval data for load research doesn't seem to influence AMI decision
- Load researchers should be involved in the investigation and justification of AMI

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▶▶ “AMR – That's the reason they keep pulling out my residential RUGs!”

– *Former load research manager at PSCo/NCE*

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- ▶ Early decisions impact future possibilities
  - Big decisions: fixed network vs drive-by
  - Little decisions: the right kind of meter or ERT
  - Economics: incremental cost for interval data?
- ▶ Intangibles: load researchers are a valuable resource because they understand technical issues of metering as well as rates and pricing

# Technology issues

- **Technology used will impact load research potential**
  - Drive-by systems don't allow interval data collection
    - But worse, some systems don't allow an ERT on an IDR meter, so sample customers can't get AMI
  - Bandwidth can have impact
    - Original Turtle system – low-end system only sends 4 pieces of information each day – still in use in some applications
    - Some systems can only handle one day of interval data, so they must be read every night
  - Accuracy and consistency can be an issue
    - Xcel uses AMI interval data for load research samples
    - But “Cellnet interval data has not been approved for billing use”

# Economic issues

- **Contract with AMI vendor can impact interval data collection**
  - Some contracts include a limited number of interval metering sites at no incremental cost
  - Others had to pay an incremental cost for each interval metered site
  - This structure of the contract can dramatically affect the economics of implementing new studies
- **There are also costs associated with changeover**
  - As of late 2006, Xcel had not yet changed all their sample points in AMI areas to AMI interval data collection because of cost

# Sample design

- **Coverage can be an issue**
  - **Puget Sound Energy:** with over 95% coverage, they discard sample points in areas without AMI
    - Introduces bias, but probably not much
  - **Xcel (North):** design sample without considering AMI coverage; then during installation, either switch on interval data collection or install an IDR meter
  - **Useful for studies focusing only on covered areas**
    - Dominion Virginia Power – competition pilot area was covered
    - Xcel – savers switches in Metro area

# Missing data

- **Missing data is different with AMR/AMI**
  - Some sites are consistently perfect
  - Some are consistently missing a lot of data
  - Most are almost complete –missing a day or two a year
  - For Dominion Virginia Power Pilot – one year
    - 7.6% all bad
    - 2.6% perfect
    - 89.8% almost all good
  - Xcel tried using tests of “packet success rate”
    - Didn’t really work as well as it should have
- **Like the nursery rhyme:**
- *When it is good, it is very, very good, but when it is bad, it's horrid!*

# Recipe for success

- **Get involved early on – make sure your needs are met**
  - Don't let load research be an “afterthought”
- **Always consider the interfaces**
  - Several companies had trouble integrating AMI interval data into MV-90 – two bypassed it altogether
  - Set up automated monitoring of data collection
    - Allows quick response to problems, less data loss
    - Can identify need for sample point replacement
- **Be aware of potential problems**
  - Weather has different impact
  - Missing data patterns will be different
  - VEE becomes more difficult and more important

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▶▶ “A good IT person is invaluable”

– *Dominion Virginia Power*

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# There are benefits

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“It is so nice to be able to just turn them on, whenever we want to. We don’t have to send letters to customers, or work with the metering department, or anything.”

– Xcel

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- **Short-term studies are particularly effective**
  - Savers switch test – short-term test of AC Cycling switches, testing groups of “forty or fifty thousand” at a time
- Nightly data collection can enable faster turnaround of data, particularly at the end of a season or a calendar year

# MDMS is crucial

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▶▶ “We think the best way to approach it is to look at a meter data management system hand-in-hand with looking at AMI.”

– *Detroit Edison*

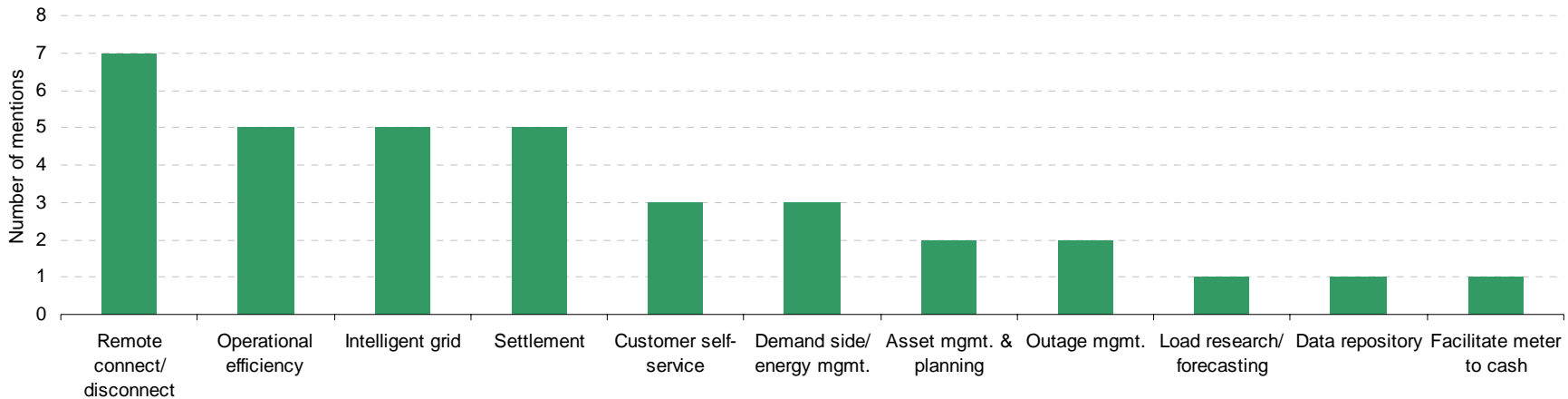
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- A system for easily accessing a centrally stored data warehouse will be critical for using interval data for load research – or for any other application.
- Select an MDMS before installing AMI, if possible.
  - Doing so assures that the MDMS will work well with the technology and the business process software already in place.

# What are utilities doing about Smart Metering?

## Beyond the meter—MDM

### Most important objectives of MDM



Source: Energy Insights, 2007 N=23 (multiple responses accepted)

- **Meter data management (MDM) definition:** An enterprise-wide data repository for metering data collected from any customer type through varying communication methods from many different meter systems. It rationalizes, cleans and manages data to establish a “system of record” of meter data, which can then be securely used in a variety of billing, analysis, and operational applications. The best MDMs are based on open architecture, provide easy, secure access and are fully scalable.
- **There was an overwhelming agreement that an MDM should be purchased:** Although there were a variety of reasons, most utilities agreed that they needed an MDM.

# Summary - AMI and interval data

- AMI is becoming more prevalent
- An opportunity for load research, but can also cause problems
  - Load research is not always involved in AMI business case
  - Technology & economics can impact interval data capabilities
  - Solution: to be involved in pilots, testing, and business case
- Sample design can be affected
- Data analysis doesn't change much, but structure of missing data is different
- Opportunity for benefits
  - Quick sample implementation
  - Short-term, geographically-specific studies are easy and cheap
  - Faster data collection turnaround
- A meter data management system (MDMS) is crucial

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