# ADVANCED METERING INFRASTRUCTURE

Beyond Smart Metering

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AMI IS CHANGING THE WAY UTILTITIES AND CUSTOMERS MANAGE ENERGY

Across the nation, electric utilities have been deploying smart meters as the building blocks for the future smart grid. Current reports estimate Advanced Metering Infrastructure (AMI) in over 50% of US households, with upwards of 70 million AMI devices deployed. Installations are expected to continue with an estimated 90 million by 2020. However, the drivers and uses of AMI have evolved significantly since the first adopters replaced their electro-mechanical meters many years ago.
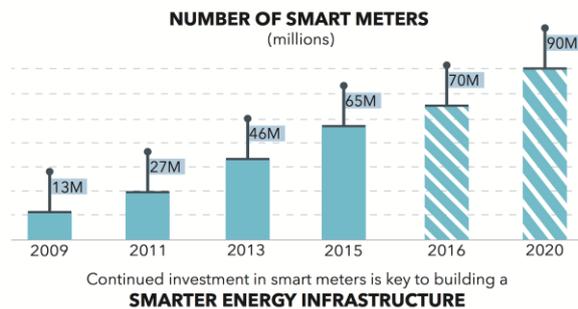
Source: The Edison Foundation - Institute for Electric Innovation – Smart Meters at a Glance

Since its beginning, AMI has evolved significantly in both a business context and in technological capability. Early deployments were focused on the meter and the reduction of O&M associated with meter reading. Later deployments viewed the meter as a gateway into the home, offering more options for customers to personalize their electric usage and business relationship with their utility. Current and planned efforts are now focusing on the meter as a sensor in the larger context of the electric grid.

METER AS A CASH REGISTER

Since electricity was first metered over 120 years ago, the industry and the technology has evolved through many changes.

The original business cases for AMI focused on the point-of-sale advantages. These included the various functions and enablement capabilities associated with automated meter reading, customer tariffs, and revenue protection. Early generation AMI simply automated the meter reading process by improving on electromechanical and AMR solutions with two-way communication to the meter. Processes and business models remained largely unchanged, albeit modified to capture the business case benefits associated with eliminating manual reads, improved accuracy and the increased ability to offer interval rate programs.

Next, AMI business cases evolved beyond reducing meter reading costs and started pushing the ability of

AMI to reduce the customer's bill through deeper knowledge into their usage and retail programs designed to match their usage needs. These new strategies typically included a focus on demand-response objectives reached though the introduction of time-sensitive rates and home display units. Increased reliability, reduced theft, reduced bad debt, improved customer service, and fewer field visits were other areas of benefits that began to gain attention as more utilities initiated AMI pilots and programs.

The technical solutions that met these requirements were different to the capabilities of the meter solutions prior to AMI. They provided two-way communications to the meter to enable functions initiated by the utility company, such as remote disconnects, load limiting, on-demand reads, on-demand power status requests, associated load control devices connected to the meters, and meter firmware upgrades.

Home area networks evolved using the meter as the gateway to other energy devices such as smart thermostats, load control switches and in-home displays. This ushered in a new era of solutions and capabilities.

METER AS A GATEWAY

As the early AMI deployments progressed, several forces emerged which began to change the utility landscape. This phenomenon precipitated a transformation of the traditional business model. Customers started to exhibit an increased desire for a role in their energy management and conservation. New regulatory policies and markets evolved. Utilities were under increased pressure for operational and workforce efficiencies in order to increase earnings while maintaining rates.

Many utilities recognized that these pressures forced an entirely new level of engagement and information sharing across the value chain — one in which the customer is an active participant in the management of their energy usage through better understanding of their usage and adoption of services specific to different customer needs. In order to accommodate these new solutions, the AMI ecosystem evolved, extending from the customer to the utility's back office system. Home area networks and in-home devices were deployed to give customers near real

time information on their usage and habits. Today, many utilities see the home area networks as a logical extension of demand side management and energy efficiency programs. Home area networks combined with in home displays and smart appliances provide customers with more control over their energy usage and bills they previously possible.

However, in spite of the promises, few of these programs deliver on the long-term benefits promised. Many see initial promising benefits, only to watch these dwindle as the newness of the technology erodes. Undeterred, many utilities have begun to broaden their services to their customers by expanding into more online access and management options, cell phone applications, and budget setting options that allow customers to set goals and high usage alerts. Prepay programs, remote connect/disconnect for vacation and transitory housing, and expanded rate options and programs (TOU, RTP, and many of their derivatives) are offered to match energy solutions to the changing expectations of the customers.

Over the last couple of years, the advent of Smart Home devices has begun to influence customer home automation and energy management towards third party providers and away from the utility. Although the need for customer usage data has shifted to the open market, to fully leverage the value of these devices, utilities still require the data from AMI to support TOU and RTP programs.

METER AS A SENSOR

While the concept of AMI for customer billing purposes is relatively mature, the technology continues to evolve. The AMI meter has proven to be so much more than a measurement device to produce a customer's bill. Utility operators are now able to use advanced meters as distribution sensors and the networks as platforms for expanding distribution dutomation deeper into the secondary market. In addition to typical consumption metering, advanced meters are sensors that can measure / monitor:

- Frequency
- Individual phase voltage and current
- Total harmonic distortion
- Voltage sags and swells
- Power factor
- Reactive and apparent power

The result? With AMI, utilities can move from merely reading meters automatically to actually managing and controlling key aspects of the grid. The data and functionality available from AMI meters enables utilities to optimize their power distribution grid by leveraging the AMI data for feeder rebalancing, better capacitor placement and utilization, improved conductor sizing, optimization of voltage equipment, capacitor automation, loss minimization functionality, and transformer load management to illustrate just a few of the possibilitie. With modern analytics and predictive science, a whole new world awaits when it comes to automating, predicting, monitoring and controlling the grid, enabling self-healing capabilities and creating entirely new relationships between utilities and their customers.
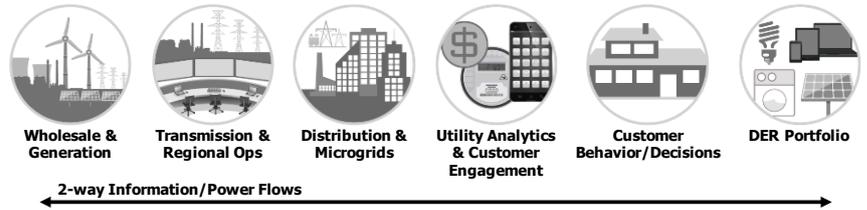
AMI programs are providing utilities with the catalyst to jump start or boost their data analytic programs. Utilities are seeing value in the AMI data through enhanced customer segmentation analyses, allowing for more personalized services and programs, increased accuracy in estimated time of restoration in outages, faster outage identification and localization, and improved asset condition and health predictive analytics.

The AMI network is a multi-purpose platform that creates options for leverage across other utilities, municipalities and areas of the business. Many utilities and solution providers are beginning to explore shared platforms and AMI as service options. Gas and water utilities are in discussions with the electric utilities in their shared territories to explore how they can leverage the existing AMI networks for their own AMI endeavors. Municipalities are starting to explore the use of the RF mesh networks for enhancing Smarter City aspirations.

Unilateral Supply (fleet, PPAs, bulk power) → **T&D** → **Meter**

1-way Power Flow
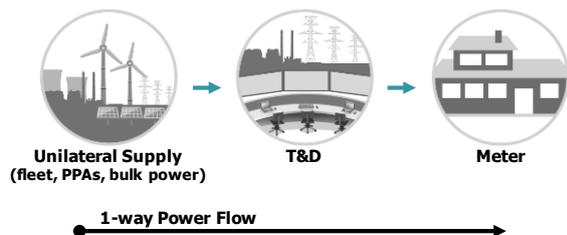
How electricity is produced and consumed is undergoing a massive transition. Many more trends

are emerging that will expand the evolution value of AMI. The energy value chain is evolving into a more participatory network. As a result, it is also becoming increasingly more complex to manage. The traditional energy value chain focused on one-way power flow. It served the industry well for over a century. The

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2-way Information/Power Flows

modern energy value chain must accommodate multiple layers and accommodate two-way flow of power and information.

In this new paradigm, the importance of proper creation and collection of measurement data cannot be overemphasized. The majority of DER participation is likely to be of intermittent renewables. As distributed energy resources — such as private or rooftop solar PV, energy storage systems, electric vehicles, and connected home devices like smart thermostats and smart appliances — continue to grow, electric companies will need greater visibility into the performance of these systems to better utilize resources in efficient distribution grid operations. In order for these DER solutions to truly impact the grid and transform the way we consume and distribute power, it will be imperative that accurate and timely information on capacity and accessibility is available. The data generated by smart meters provides basic information for seamlessly integrating these distributed resources and modeling their behavior. AMI systems will play the role of enabler by collecting data on the energy being used and available to optimize the grid and balance the loads.

AMI has come a long way. As the trends show, the journey is truly just beginning. Throughout these evolutions, one thing has remained true — AMI is not like other projects. It is a regulatory program, an operational program, a product design program, a software implementation program and a construction program all in one. It is as expensive as it is complex and it will continue to transform the utility business and the role of the utility in the lives of their customers for many years.

ABOUT THE AUTHOR

Jason Kinslow has over 20 years of experience as a consultant in the energy and utilities industry. He has experience across many of the verticals within the industry; distribution, transmission, customer services, shared services, and generation (fossil, hydro, and nuclear). Jason has worked for many of the US and Canadian utilities, as well as ones in England, Holland, South Africa, Australia, and New Zealand.

Prior to joining HKA, Jason was the lead partner over IBM's AMI practice.

Throughout his career, Jason has helped utilites through organizational transformations, implementing process and cultural change, utility asset management, operational strategy development, investment portfolio optimization, AMI/ Smart Grid strategies business cases and implementaitons, and risk management.