Weighing the Costs and Benefits of Smart Meters

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Across the nation, electric utilities have begun transforming their electric transmission and distribution grids with digital information and control technology. A key part of this transformation is replacing residential analog meters with digital smart meters.

This advanced metering infrastructure (AMI) offers a number of operational benefits for utilities, including lower meter reading costs, faster outage detection and repair, and quicker response times in meeting customer requests for service connections and disconnections.

When coupled with pricing programs—such as rebates to encourage electricity use during off-peak demand periods and time-of-use rates for households with electric vehicles—AMI can produce direct cost savings for consumers. And by boosting the efficiency of the power grid, as well as deferring the need for additional peak-demand generation and infrastructure equipment, AMI can also generate indirect cost savings.

A new white paper by the Institute for Electric Efficiency (IEE) presents a framework for electric utilities and public utility commissions to evaluate the benefits and costs of AMI. The study, "*The Costs and Benefits of Smart Meters for Residential Consumers*," was prepared with the assistance of The Brattle Group and To the Point.

STUDY OVERVIEW

The study quantifies how the magnitude of the benefits and costs associated with AMI may vary across different types of electric utilities and customers. The cost estimates used in the study were derived from manufacturers and utility business cases. The assumption was made that as innovations occur, economies of scale take hold, and manufacturing costs decline. Prices for AMI equipment and related home automation and energy management technologies will decline significantly over the next 20 years.

The study assumes:

1. as innovations occur, economies of scale take hold, and manufacturing costs decline; and
2. prices for AMI equipment and related home automation and energy management technologies will decline significantly over the next 20 years.

In looking at utilities, the study created four prototypes, each based on real world factors that influence the overall business case for AMI, including the current generation mix, the renewable energy portfolio, the regulatory environment, emphasis on efficiency and conservation, and other factors.

The study also identified four customer market segments with varying levels of eco-awareness and value consciousness regarding energy use. Finally, the study defined alternate pathways for customers to engage in energy management.

UTILITY TYPES

The four types of utilities were:

- *Pioneer*—previously invested in automated meter reading (AMR) technology, has very high energy prices, and purchases all power
- *Committed*—relatively high energy prices, primarily natural gas-fired generation, and a mandate to aggressively pursue renewable generation
- *Exploratory*—relatively low-cost generation available, high population density, and highest demand in winter months
- *Cautious*—low population density and high annual demand growth with coal, nuclear, and natural gas dominant in the generation portfolio

The study then made a number of assumptions: each utility serves a territory of one million households; AMI is phased in gradually over a five-year time horizon; customers have a choice of rate plans, energy management technologies, and other programs; and a small percentage of customers have electric vehicles with a time-of-use rate applied on a daily basis for the entire household.

CUSTOMER SEGMENTS & ENERGY MANAGEMENT ENGAGEMENT PATHWAYS

The study divided residential customers into four segments based on their energy "worldview." Energy beliefs were based on how likely households were to use in-home energy management devices, would they engage in smart rate and other programs, what types of vehicles and appliances might they purchase, price sensitivity, and overall engagement in the use of electricity.

The four customer segments were:

- *Basic*—do not wish to engage at all
- *Comfort*—own large load homes with air conditioning, pool pumps, and smart appliances; have a minimal interest in energy engagement, and limited concern about their bills
- *Saver*—motivated by the opportunity to save money on their bills or mitigate potential bill increases
- *Green*—motivated by environmental concerns and willing to be more engaged

Within each customer segment, the study also anticipated that customers will manage their energy use in a variety of different ways, ranging from passive to active to those investing in more elaborate home automation technology. The study also assumed that customers will choose different technologies, programs, and pricing plans depending on their style of energy management.

The five customer engagement pathways in the study were:

- *Passive*—unengaged households that benefit indirectly from operational improvements due to AMI
- *Active*—engaged households that make conscious and manual adjustments to their electricity use based on energy information and price signals from peak rate plans obtained via a web portal, a display, or other communications methods (e.g., email, text, or phone)
- *Set and forget*—engaged households that use automation to adjust their electricity use via technologies, such as programmable communicating thermostats or home energy management systems, based on energy information and price signals from peak rate plans
- *Utility automation*—households that allow the utility or a third party to directly control their central air conditioner via a signal sent to their smart thermostat or to a switch on their air conditioner (customers retain the ability to override)
- *Energy partners*—highly interested and engaged households that have electric vehicles and home energy management systems to automatically control electricity usage; time-of-use rate applies to the entire household on a daily basis, not just on event days

FINDINGS

Although specific results vary by utility, the study found that even with conservative assumptions regarding consumer engagement in technologies, programs, and rate plans, utilities and their customers can expect positive net benefits from AMI investments over the next 20 years.

The study estimated the total costs of investing in AMI and associated technologies for home energy management would vary from a low of $198 million for the pioneer utility to a high of $272 million for the committed utility.

The study divided benefits into "operational savings"—such as avoided metering costs, improved outage detection and avoidance, and remote connections and disconnections—and "consumer-driven savings" resulting from customer participation in rate plans and programs with and without automation technologies, as well as consumer ownership of electric vehicles.

In looking at benefits, the study found that AMI investments produced operational savings that varied from a low of $77 million for the pioneer utility (who has already deployed AMR equipment) to a high of $208 million for the cautious utility.

The study also found that the consumer-driven savings varied from a low of $100 million for the cautious utility to a high of $150 million for the pioneer utility. Overall, the net benefits ranged from a low of $21 million for the committed utility to a high of $64 million for the exploratory utility.

In estimating the net benefits of smart meters, the study took a very conservative approach and assumed fairly low participation rates by customers in different program offerings, even after 20 years. If customers can choose their preferred rate plans, programs, and enabling technologies, and if significant investment is made to engage consumers, the prospects are even greater for faster cost recovery of the AMI investment and more extensive benefits to consumers, utilities, and society.

Interestingly, the IEE analysis also revealed that the strategy with the potential to return the greatest financial benefit to utilities and customers alike is to focus on accelerating the adoption of electric vehicles (EVs). Households that have EVs, which represented only about one percent (the percent varies across utility prototypes from 0.5 percent to 1.5 percent) of the hypothetical one million customers in a service territory, created a disproportionately high share of the overall consumer-driven savings, indicating that even modest increases in EV adoption will have a large impact on benefits.

The complete IEE white paper is available at *www.edisonfoundation.net/IEE.*

Ms. Wood, a 20-year veteran of electric industry consulting, has directed numerous economic, financial, and market analysis studies with an emphasis on financial incentives for energy efficiency, dynamic pricing, value of electric service reliability, customer choice for electricity rate options, market share, and customer willingness to pay.

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