

# **Whitepaper on Advanced Metering**

How Can We Manage What We Cannot Measure?

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## **Executive Summary**

The Energy Policy Act of 2005 requires state utility commissions to consider whether to have regulated utilities (and retail electric suppliers) implement a new PURPA standard related to “Time-Based Metering and Communications.” States are required to consider the adoption of a smart metering standard. Delaware has opened a docket to evaluate the desirability, feasibility and cost effectiveness of requiring smart metering technology, including time of use metering, to be utilized throughout, or selectively, within the service territories of Delmarva Power and Light Company. This paper gives an overview of advanced metering as well as dynamic pricing and discusses how these new technologies could be cost effective for residential customers.

Advanced Meter Reading(AMR) technology has given us the ability to collect and read the meter without a visual inspection, through the use of radio, power line, and wireless-based communications. While AMR meters have allowed utilities in recent years to reduce labor costs and increase meter reading accuracy, so far there really isn’t any other direct benefit to the customer. With the more “Advanced Meter” or “Smart Meter”, utilities are able to provide customers with price signals and more detailed usage data, giving the customer the ability to manage their usage in response to such information.

The majority of installed meters in our region have not been specifically designed or installed to fulfill the requirements of distributed generation or demand response metering. We need to evaluate and analyze customer price responsiveness in order to support real time policy and planning activities. Many utilities, policy makers, and customers are reluctant to fully embrace dynamic pricing, partly because the benefits are highly uncertain and costs will increase. We expect initially to examine the results of pilots conducted in the states, or if that review is inadequate, it might be necessary to conduct a Delaware-specific pilot. We are conducting an advanced metering workshop to determine the appropriate path forward.

## **State of the Industry**

The Energy Policy Act of 2005 requires state utility commissions to consider whether to have regulated electric utilities (and retail electric suppliers) implement a new PURPA standard related to “Time-Based Metering and Communications.” States are required to consider the adoption of a smart metering standard. Therefore, Delaware has opened a docket to evaluate the desirability, feasibility and cost effectiveness of requiring smart metering technology, including time of use metering, to be utilized throughout, or selectively, within the service territories of Delmarva Power and Light Company.

Currently, the majority of residential electric consumers are not provided with a very basic piece of information - a price signal that would enable them to become smarter energy consumers. Failure to apply new technologies to electricity consumption results in lost opportunities to allow residential electric consumers to manage their electric service. Examples of lost opportunities are conserving electricity, shifting more electricity usage to the off-peak periods, lowering electricity bills and making electricity systems more efficient. Technological advances have brought real-time price information within the grasp of consumers. This paper is intended to give an overview of advanced metering along with dynamic pricing and to begin a discussion on how these new technologies could be cost effective to residential customers.

By lowering overall demand at times of high wholesale prices, customers can reduce their own electric costs and also help to lower costs for all customers in the region. The customers who consume during times of peak demand or supply shortages collectively contribute to driving up the wholesale price for everyone. While a customer’s fixed-price rate may protect them from an immediate price increase, their consumption behavior contributes to higher wholesale price volatility, which results in higher wholesale prices and retail rates for everyone. Therefore, all customers will end up paying for the choices made by them and their neighbors. Competition allocates resources in the most efficient manner through the use of price signals. As prices increase customers will respond to these higher prices by consuming less and forcing the price down. However, it is essential that customers be able to see the price for this paradigm to work. How can we modify the markets to encourage and empower customers to change their consumption based on changes in wholesale electric prices? One way is through dynamic pricing using the smart meter as the enabler.

## **Standard Meter**

Standard meters, the meters most commonly used today, are designed to measure the amount of electricity used by the customer. The standard meter may also include functions to measure time-of-use and/or demand with data *manually* retrieved over monthly billing cycles. Meter readers go building-to-building visually inspecting the meter and manually recording the usage data. One disadvantage of this system has always been the difficulty, and sometimes impossibility, of gaining access to the meter. In many buildings or homes, the meter may be landscaped over, overgrown with bramble, or inaccessible because it is inside the house. These situations make it difficult for the

utility to estimate bills and causes consumer dissatisfaction in receiving multiple estimated bills. A conventional system is reliable but it does not yield any added-value data that allows a utility to know more about how, when, and why its customers are consuming electricity. The standard meter also does not provide utilities with detailed information to design, build and operate its systems more efficiently or cost-effectively. This information is necessary because utility systems must be sized to serve peak demand. A standard meter ranges from \$20-\$25<sup>1</sup>.

### **AMR-Automatic Meter Reading**

In the 1990's, general advances in technology began to be applied to metering. The most significant advancement was in the area of communications. Technology has advanced to collect and read the meter without a visual inspection, through the use of radio, power line, and wireless-based communications. The Automatic Meter Reading (AMR) systems produced cost savings for utilities due to reduction in labor costs, and increased meter reading accuracy making it easier for utilities to provide customers with billing data and for Customer Service Representatives to advise customers, particularly regarding outages.

Meters are available that allow measurement in smaller intervals and allow "time of use pricing" and "critical peak pricing". However, they do not have communications capabilities.

AMR technology has allowed utilities in recent years to reduce costs. However, while these cost reductions presumably have been passed on to customers as a benefit, there is no other direct benefit to the customer from an AMR deployment. With the more "Advanced Meter" or "Smart Meter", utilities are able to provide customers with price signals and more detailed usage data, giving customers the ability to manage their usage in response to such information. Advanced metering also provides utilities with more capabilities to manage their distribution systems and operations more efficiently and reliably, with features such as outage reporting and restoration verification. A one-way AMR meter ranges from \$40-\$45<sup>2</sup>.

### **Advanced Metering**

Advanced metering reflects two distinct elements: "**meters** that use new technology to capture complex energy use information and **communication systems** that can *capture* and *transmit* energy use information as it happens, or almost as it happens."<sup>3</sup> Over the past 15 years, advances in communications technology (e.g., internet, power line communications, and wireless) were applied to metering which created "Advanced Metering" or "Smart Metering". A two-way advanced meter ranges from \$50-\$95<sup>4</sup> depending on the technology.

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<sup>1</sup> Prices obtained from Landis + Gyr, Inc. dated August 1, 2006.

<sup>2</sup> Prices obtained from Landis + Gyr, Inc. dated August 1, 2006

<sup>3</sup> New York State Energy Research and Development Authority, (Fall 2003), A Primer on Smart Metering.

<sup>4</sup> Prices obtained from Landis + Gyr, Inc. dated August 1, 2006

The key criteria that define advanced metering include the following:

- Continuously available communications
- Interval measurement
- Dynamic pricing
- Information to the customer
- Frequency of transmittal
- Information to the utility

### **Demand Response/Dynamic Pricing**

One of the key options in addressing today's energy challenges is Demand Response. Policymakers are showing increased interest in dynamic pricing as a means to encourage demand response. **Demand response** refers to the reduction of customer energy usage at peak times to help address system reliability, reflect market pricing, and support infrastructure optimization. Demand response programs may include dynamic pricing/tariffs, price-responsive demand bidding, contractually obligated and voluntary curtailment, and direct load control/cycling. **Dynamic pricing** refers to prices based on variable time periods. The most common types of dynamic pricing are time-of-use pricing (TOU), critical peak pricing (CPP), and real-time pricing (RTP).

**Time-Of-Use Pricing (TOU)**-Energy prices that are set for a specific time period on an advance or forward basis, typically not changing more often than twice a year (summer and winter season). Delmarva Power & Light Company has a tariff offering customers this type of pricing which a limited number of customers participate in. Delmarva has not actively marketed their TOU tariffs since electric restructuring occurred in 1999. Delmarva Power currently has three Time of Use Rates for Residential customers. R-TOU is available to the first 500 applicants, R-TOU-Non-Demand is available to the first 5,000 customers, and R-TOU-Super Off Peak is available to all customers but there are contract period requirements. There are currently 122 customers in total enrolled in these programs.

**Critical Peak Pricing (CPP)**-Energy prices that are priced on a TOU basis, but where certain hours on certain days when the system is experiencing high peak demand are subject to higher hourly energy prices (critical periods).

**Real-Time Pricing (RTP)**-A rate in which the price of electricity fluctuates hourly. Customers are typically notified of RTP prices a day-ahead or even on an hour-ahead basis

Dynamic pricing is designed to reduce peak demand. However; another benefit of this pricing methodology is a small reduction in total electricity consumption. Dynamic Pricing programs have been around since the mid-1980's beginning with experiments by utilities in California, followed by the development of the two-part RTP

at Niagara Mohawk. Dynamic pricing began to get nationwide attention when the industry noticed the spectacular results at Georgia Power.<sup>5</sup> These are just a few that have had some success, however, these programs were for Commercial and Industrial customers. Several utilities have demonstrated that voluntary dynamic pricing programs are capable of generating substantial demand response. However, most programs have attracted only modest levels of participation, in large part because programs were narrowly targeted and passively marketed.

### **What have we learned**

A small number of programs have demonstrated that it is possible for voluntary dynamic pricing programs to attract a significant number of participants and generate a substantial level of price response. Exelon(Commonwealth Edison) and The Community Energy Cooperative have initiated the Rate Residential Hourly Energy Pricing (“RHEP”) pilot program offered to ComED’s residential customers. This is the nation’s first extensive residential real-time electricity pricing program. Participants in the program are provided with a range of support services through the associated Energy-Smart Pricing Plan (ESPP), offered by the Community Energy Cooperative, a local non-profit organization that helps small energy consumers reduce their energy costs. As a pilot, the tariff is serving primarily as an experiment to investigate how residential customers will respond to hourly prices and also to see what types of supporting services and tools are most valuable to residential customers receiving RTP service. Enrollment for the pilot was capped at 1,000 customers for 2003 and was raised to 5,000 in 2004. Marketing of the program was the responsibility of the Cooperative, who solicited participation through mailers, advertising, and community meetings. During the three years of the program, participants saved an average of approximately 7% and have reduced their peak electric demand by as much as 20%. Interval meters are provided to the customers at no charge, and the costs were borne by the Cooperative.

Two years ago Delmarva Power and Light Company and the Delaware Public Service Commission staff held workshops to implement a smart metering pilot. That was established as a result of the settlement of the Conectiv-Pepco merger in Docket 01-194. At that time Delmarva Power did not consider its current TOU program successful. It was not clear whether this was due to inappropriate rate design, lack of customer interest in such programs, or possibly the lack of enthusiasm in the marketing of the program. The smart metering pilot was put on hold after several workshops due to the time constraints associated with developing the SOS procedural process and setting reliability standards.

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<sup>5</sup>Georgia Power has, by far, the largest base of participants of any RTP tariff offered to large C&I customers. Currently about 1600 customers are enrolled. Very few customers have left the program due to the variety of risk management products available to participants, who are kept informed of price trends through annual workshops held by Georgia Power. The largest load reductions observed have been in the order of 800MW, which occurred in 1999. Braithwait and O’Sheasy (2000) report that, over a period of high price hours, participants in the hour ahead tariff reduced their average demand by approximately 250 MW in aggregate, and those in the day-ahead tariff reduced their average demand by approximately 500 MW. George Power attributes a total peak demand reduction of 300-350 MW to its RTP tariffs. Barbose,Galen, Goldman, Charles & Neenan, Bernie. (December 2004). A Survey of Utility Experience with Real Time Pricing. E.O. Lawrence Berkeley National Laboratory, Appendix C 97-99.

### **Where are we now**

The public utility commissions of Delaware, the District of Columbia, Maryland, New Jersey and Pennsylvania, along with the U.S. Department of Energy and PJM Interconnection, have established the Mid-Atlantic Distributed Resources Initiative (MADRI) to develop regional policies and market-enabling activities to support distributed generation and demand response in the Mid-Atlantic region. The MADRI Metering Working Group designed a survey to take a census of the current meter population throughout PJM, to characterize the advanced metering and communications infrastructure currently in place, and to investigate the functional capability of advanced metering and how advanced meters are currently being used.

Results of MADRI's Survey show that Advanced Meters and AMR meters are not yet the standard in the Mid-Atlantic States.

- \* Two-thirds of all installed meters are basic Watt-Hour meters.
- \* Less than 2% of all standard meters have data storage capabilities because the majority of standard meters only have the capability to measure usage.
- \* Advanced Meters are about 1% of the total meter population; but measure almost 20% of the region's electricity sales.
- \* More than a third of all meters are AMR meters.

Interviews with utility metering managers suggest that the market for Advanced Meters will expand when the demand for hourly priced electricity grows. The majority of installed meters have not been specifically designed or installed to fulfill the requirements of distributed generation or demand response metering. An obstacle to wider implementation is that these more technically complex meters are also reported to have a higher cost and shorter expected lives than traditional meters. Another barrier to wider implementation of this metering technology is the potential technical obsolescence as well as the cost of the software necessary to communicate with the meters and to interface with the customer billing systems. Higher life-cycle costs than conventional meters are potentially one reason for the slow penetration of AMR and Advance Meters in the utility marketplace (the larger and more technically complex meters have much shorter estimated lifetimes than basic meters for residential customers). Since AMR and Advanced Meters have not gone through a complete life cycle, the expected lifetime reported in the survey is more likely an accounting lifetime i.e., time over which to depreciate the value of the meter, rather than a measure of how long the meter is actually in use before replacement.

There is also uncertainty regarding who can or should own advanced meter equipment and who can or should own meter data. Historically, utilities and customers have collected, managed, and applied meter data for their own specific needs guided by service specifications in utility tariffs. An equipment supplier interviewed during the

survey noted that customer-side hardware and software are available to satisfy the information needs of customers interested in time of use rates and demand response programs. However, current electricity pricing structures and the status of distributed resources programs do not provide sufficient benefits for end-users to invest without government subsidies such as those available in New York and California.

New technology by itself also introduces uncertainty. The rapid advance of metering technology has grown tremendously over the last ten to twenty years. Utilities are concerned about how new technology impacts their substantial, historical investments. Uncertainty about future technological developments and the fear of stranding costs may be contributing to the paralysis of some utilities in addressing the needs of 21<sup>st</sup> Century electricity buyers. Open architectural tools and a clear understanding of benefits may be able to move decision makers beyond the current unsatisfactory status quo.

### **Where do we want to be**

With rapidly rising energy prices it is important to find ways to help consumers manage their costs. Until now, only large customers had access to this kind of option. While advanced metering may not be appropriate for all customers, it may give many households the opportunity to save money and create an incentive to reduce demand. Pricing programs must be designed and offered to meet customers' wants and needs, so if residential customers want dynamic pricing then we need to find a way to design a customer friendly program and we need to keep in mind not everyone will sign up. Customers have very different wants and needs. To some that may mean a no hassle, fixed bill, others may want TOU or RTP; each segment will view their preferred pricing program as the "cheapest" for them because it meets their needs.

### **How do we get there**

We need to evaluate and analyze customer price responsiveness in order to support real time policy and planning activities. Many utilities, policymakers, and customers are reluctant to fully embrace dynamic pricing, partly because the benefits are highly uncertain and costs will increase. Therefore, we need to focus on resolving key uncertainties regarding costs and benefits so that dynamic pricing programs can be standardized and widely marketed. It is critical that the pilots be rigorously evaluated and the results made available to the broader policy community. We expect initially to examine the results of pilots conducted in the states, or if that review is inadequate, it might be necessary to conduct a Delaware-specific pilot program. We are conducting workshops to determine the appropriate path forward.

In order to achieve demand responsive pricing, changes will be required in state regulatory policy in areas such as; investment in metering, communications, and software technology; and education of customers so that they can respond appropriately.



