Smart Meters and Dynamic Pricing Need Each Other

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Abstract— Smart meter deployment is underway in Illinois and since electricity customers pay a monthly fee to support smart grid deployment, questions have been raised on the benefits of smart meters and an eventual smart grid. Hourly pricing can provide immediate consumer benefits to residential customers.

Since 2003, Elevate Energy has administered residential hourly electricity pricing programs for ComEd and Ameren Illinois. The results are tremendous: average electricity supply savings of over 15 percent and a price elasticity of over 2.5 percent. The programs also help those who need it most, including retirees and low-income households. In addition, participation in hourly pricing helps lower capacity charges for all customers and reduce greenhouse gas emissions.

But hourly pricing adoption remains low among residential customers with fewer than one percent participating. Will the onset of smart meter deployment drive greater adoption of dynamic pricing?

Index Terms— Electricity supply industry, Electricity supply industry deregulation, Supply and Demand

The state of Illinois is in the process of installing smart meters in 4 million residential households in ComEd territory and roughly 780,000 (62%) households in Ameren Illinois territory by the year 2019. In addition, there is an open docket at the Illinois Commerce Commission (ICC) to explore accelerating the smart meter rollout further. The cost of smart meters is funded by residential customers through a monthly fee that's wrapped into their bill. So, what's in it for them? Ultimately, a lot. In addition to increased reliability and reduced operating costs, smart meters provide a platform from which to build on services, pricing options and technology that will enable customers to interact and integrate with their utility to provide the best possible service at the lowest possible cost. Some of these services and technologies may not be available at this time, but that doesn't mean consumers cannot immediately benefit from smart meters. Smart meters can deliver immediate consumer benefits to residential customers now though dynamic electricity pricing options that are currently available. This paper will discuss those benefits, including the savings achieved by hourly pricing customers,

the size of the potential market for hourly pricing programs, environmental benefits, and the benefits of hourly pricing programs to electric vehicle owners.

I. HOW HOURLY PRICING WORKS

The default electric rate for residential customers in Illinois is the fixed-price rate or "flat rate." This means the price of electricity does not change throughout the day. The price you pay for electricity is the same at 3 a.m. as it is at 3 p.m. So, if customers shift usage to the early morning or evening hours to get a lower rate, that doesn't work if they're on the flat rate. However, ComEd and Ameren Illinois offer hourly electricity pricing programs to their customers, so they can take advantage of lower off-peak prices. With an hourly pricing program, participants are simply charged the hourly market rates for electricity that are provided by the independent system operator - PJM in ComEd territory and MISO in Ameren Illinois territory. Unlike the flat rate, the hourly market rates can change every hour of the day based on demand for electricity. These dynamic hourly rates provide customers with incentive to shift electricity usage to lowerpriced times, such as nights and weekends, to lower their bill and help reduce peak loads. When participants in hourly pricing programs shift their load, everyone benefits - capacity charges and greenhouse gases, and smog emissions are reduced for all, creating a cleaner, more sustainable electric grid.

II. HOURLY PRICING RESULTS IN ILLINOIS

In 2007 an Illinois state law went into effect that required ComEd and Ameren Illinois to offer an hourly electricity pricing option to all residential customers. ComEd created a program called the Residential Real-Time Pricing (RRTP) program, and Ameren Illinois launched the Power Smart Pricing (PSP) program. Both programs are "opt-in", meaning a customer must enroll in the program to participate. There is also a monthly fee that's currently \$0.39 for RRTP and \$2.25 for PSP, as well as a 12-month minimum stay. Since 2007, the average savings for participants in both programs has been more than 15 percent off the electricity supply portion of the electricity bill, as compared with what they would have paid on the default flat rate. Data analysis of participants' electricity usage in hourly pricing programs also identified peak load reductions of 25 percent for PSP and 12 percent for RRTP[1]. The programs work. They deliver lower customer bills and help reduce peak load. So, what if every residential customer in ComEd and Ameren Illinois territory was on an hourly pricing program?

III. HOURLY PRICING AS THE DEFAULT RATE

Elevate Energy utilized hourly data from ComEd smart meters for customers who were paying the flat rate for electricity to determine how they would have performed on hourly pricing. The analysis was conducted over two time periods. The 2010 to 2011 analysis included 83,891 households that were using the flat rate between June 2010 and May 2011. The 2011 to 2012 analysis included data for 97,928 households that were using the flat rate between December 2011 and November 2012.

A. 2010 – 2011 Results

The study found that 67.4 percent of customers would have saved if they were on an hourly rate compared to the flat rate. Among those who would have saved money on hourly pricing, mean savings would have been \$50.45 for the year. Savings from all 83,891 customers would have been \$6,867,480.

B. 2011 – 2012 Results

The study found that 85 percent of customers would have saved if they were on an hourly rate compared to the flat rate. Among those who would have saved money on hourly pricing, mean savings would have been \$178.76 for the year. Savings from all 97,938 customers would have been \$14,434,592.

It is worth noting that these customers were not using hourly rates, nor were they especially aware of hourly rates. Consequently, the majority of customers would have saved money on RRTP without changing their usage patterns at all. With customer education and price signals, it is reasonable to expect that a greater percentage of customers would have saved had they actually been on hourly rates.

Hourly pricing as it is currently designed, may not provide economic benefits to all customers. Smaller users (under 300 kWh/month on average) are more likely to pay less on the flat rate than on hourly pricing. Capacity charges are a leading determinant in whether a particular customer saves or loses money on hourly pricing, compared to the flat rate. In the study, capacity charges made up 56 percent of total supply costs for customers who used under 300kWh/month (22 percent of study customers), but only 35 percent for customers who used more (78 percent of study customers). As more smart meters are deployed and more household-specific data is gathered, the capacity charges assigned to each customers will better align with actual usage, which should benefit smaller users on hourly pricing.

IV. HOURLY PRICING SAVINGS ARE CONSISTENT ACROSS INCOME LEVELS AND AGE GROUPS

In 2013, PSP participants saved a total of \$1,014,616.10. This represents a 13.9 percent electricity supply savings compared to Ameren's fixed-price rate. The average annualized savings per Ameren PSP participant was \$77.66. These savings persisted across household income ranges:



In 2013, RRTP participants saved a total of \$2,279,271.54, representing an average 27.7 percent savings on supply charges compared to the ComEd fixed-price rate. These savings persisted across household income ranges:



In addition, Elevate Energy analyzed households that reported the presence of a senior (age 65+) in the household. Of reporting RRTP participant households, 31 percent of households included seniors, and 17 percent have only seniors living in the household. In 2013, where the average ComEd RRTP household saved 27.7 percent off of their supply costs, households containing seniors fared almost as well, saving 20 percent on average.

V. ENVIRONMENTAL BENEFITS OF HOURLY PRICING

When participants in hourly pricing shift electricity use or reduce overall electricity use, there can be associated environmental benefits. Analysis of usage data showed that peak load reduction during the summer months was 25 percent below non-participants' for PSP, and 12 percent below for RRTP[1]. These reductions were translated into emission reductions based on the results of the Holland and Mansur study [2]. Their study was based on daily electric load data and emissions data from January 1997 to December 2000 for each of the ten regions in the National Electric Reliability Council (NERC). They developed estimates of how much a change in within-day variability of load would affect emissions in that region. Based on this study, the annual environmental benefits from PSP was \$74,458 and \$30,369 for RRTP. Participants in RRTP also reduced overall electricity use by 4 percent annually, which equated to an annual environmental benefit of \$198,238 due to emissions reduction. Participants in RRTP reduce their electricity use annually by an average of 500 kWh, which keeps 1,006 pounds of carbon-equivalent greenhouse gases out of the environment each year. In addition, participants in hourly pricing support off-peak electricity generation which could better align with wind power and other renewable energy sources.

VI. ADVANTAGES OF HOURLY PRICING FOR ELECTRIC VEHICLE OWNERS

Hourly prices in Illinois are typically lowest at night, when many electric vehicle (EV) owners charge their cars at home. Sometimes, wholesale electricity prices in Illinois even dip below zero, allowing EV owners on hourly pricing to get paid to charge their cars. As wind generation expands in MISO and PJM, negative prices should become even more common. From 2006 to 2011, the percentage of hours with negative prices in PJM grew from approximately 0.5 percent to 2 percent, reaching 3 percent in 2010. In MISO's Illinois zone, negative prices grew from approximately 0.5 percent of hours to close to 3 percent, topping out at over 4 percent in 2009.

These figures show that RRTP and PSP provide EV owners with an additional opportunity for annual savings on vehicle charging costs. Assuming an EV owner is charging their vehicle from 1-5 a.m., the cost for ComEd's fixed rate and MC2s time-of-use (TOU) rate are 82 percent and 62 percent more expensive, respectively, than the RRTP cost. Annual charging costs on the Ameren fixed rate is 41 percent more expensive than Power Smart Pricing.

TABLE I. SAVINGS OPPORTUNITIES FOR ELECTRIC VEHICLE OWNERS

		-	-	-
	ComEd	ComEd	Ameren	Ameren
	Standard	RRTP	Illinois	PSP
	Flat Rate	1 a.m. –	Standard	1 a.m. –
		5 a.m.	Flat Rate	5 a.m.
		average		average
		2013		2013
Cost per kWh	\$0.0426	\$0.02217	\$0.0426	\$0.02269
Total Monthly	\$12.78	\$6.65	\$12.78	\$6.80
Supply Cost				
(charging 300				
kWh)				
Extra	N.A.	\$0.39	N.A.	\$2.25
Administrative				
Costs				
(participation				
fee/month)				
Total Monthly	\$12.78	\$7.04	\$12.78	\$9.06
Supply Cost				
Including				
Administrative				
Fees (charging				
300 kWh)				
Annual Supply	\$153.36	\$84.49	\$153.36	\$108.72
Cost (including				
admin fees)				
Percent more	82%		41%	
with flat rate				
average supply				
cost				

VII. HOURLY PRICING NEEDS SMART METERS

The future of hourly pricing hinges on smart meter deployment. Smart meters allow customers to more easily and quickly sign up for an hourly pricing program. The data that is collected by smart meters could allow prospective customers to view potential savings on hourly pricing based on historical usage data prior to enrollment. Smart meters also allow for better integration with in-home display devices, which broadcast pricing information to enable the customer to use electricity most efficiently. As we have seen, existing hourly pricing programs enable customer savings and environmental benefits and are particularly attractive to EV owners. As more households receive smart meters, there is more potential to grow the hourly pricing programs and deliver greater immediate consumer benefits from smart meter deployment.

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