Why Real-Time Pricing is Better than Other Dynamic Pricing Rates

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ABSTRACT

With the growth of the Smart Grid comes the opportunity to offer new dynamic pricing rates that will optimize when residential customers use energy and how much they use. Many utilities are offering or developing variations of Time of Use (TOU), Critical Peak Pricing (CPP), Peak Time Rebate (PTR) and Variable Peak Pricing (VPP) rates. Very few are considering offering Real-Time Pricing (RTP) rates and the question is "Why not?".

It is believed there is a general feeling across the industry that RTP rates are too risky and too complicated for residential customers. This paper will present evaluation results from RTP programs that have been offered by two large Midwestern utilities for the last five years, and then compare RTP rates to the other dynamic pricing options to show why RTP rates are better both for customers and for the utilities offering them.

Introduction

When considering the implementation of a new dynamic pricing rate, there are a myriad of questions to be examined and answered. Two key questions are “Does it work?” and “Does it create net benefits?” This paper starts by answering these questions for Real-Time Pricing (RTP), a dynamic pricing rate design where the energy price that customers pay changes every hour and matches the market price for electricity.

While utilities have tested many dynamic pricing rate designs for residential customers in pilots across the country, few have tested RTP. Pilots testing Time of Use (TOU), Critical Peak Pricing (CPP), and Peak Time Rebate (PTR) are more common. For example, looking at the Energy Information Administration's case studies on advanced metering projects, twelve utilities have tested new dynamic pricing rates. (U.S. EIA 2011) Out of the twelve, TOU was tested eight times and CPP and PTR were tested six times each. RTP was tested only twice.

This leads one to believe that RTP rates are not being given serious consideration for implementation by utilities, which is both surprising and unfortunate. It is surprising because opt-in RTP rates have been successfully offered to residential customers at Gulf Power since 1998 and at the two largest Illinois utilities for the last five years. It is unfortunate because RTP rates offer many advantages to customers and utilities compared to other dynamic pricing designs.

Why aren't RTP rates more common in both pilots and programs? There is no definitive answer to this question, but in general it seems that RTP rates are considered too risky and too complicated for residential customers.

Unfortunately, they got off to a rocky start. Gulf Power has demonstrated a successful implementation of a technology-enabled RTP rate since 1998. However, when Ontario experimented with offering RTP to customers they encountered problems. Their RTP rates began in May of 2002, and by September of the same year the average daily market price for electricity had nearly tripled, from 2.9¢ per kWh to 8.1¢ per kWh. This rapid price increase was due to several factors: a new untested electric market, an extremely hot summer creating a large demand for air-conditioning, and a simultaneous reduced electric supply caused by a drought that had lowered water levels, cutting reserves of cheap hydroelectric power. (Mittelstaedt and Muhtadie 2002) In many ways, this was the 'perfect storm' for RTP rates. The sharp and sudden increase in bills created such an outcry from customers that the RTP

rates were stopped by the end of the year. Unfortunately, this ill-timed effort left a label of "risky" on RTP rates.

Also, RTP rates are often considered too complicated. How can regular customers possibly pay attention to and respond to prices that change every hour? From the utility perspective, RTP rates seem to be more complicated to implement and bill than other dynamic pricing options. RTP rates require over 700 meter readings and corresponding prices for every individual monthly bill. Also, customers want access to real-time information on hourly prices and their hourly consumption. These operational hurdles probably explain why RTP rates aren't included in many pilots.

The good news is that we now have thorough evaluation data available on two long-standing RTP offerings in Illinois. Commonwealth Edison has offered Residential Real-Time Pricing (RRTP) since 2007, and Ameren-Illinois has offered Power Smart Pricing (PSP) since 2008. Each of these programs had over 10,000 participants by the end of 2010 when the evaluations were performed.

The independent evaluations of these two programs were filed with the Illinois Commerce Commission and cover the operation of the programs through the first four years of implementation (2007-2010). The evaluations show that, yes, RTP programs work. Customers save money on their bills and they reduce peak load. The other key finding is that, yes, the programs do create net benefits.

Other work has already documented the customer bill savings and peak load reductions from these RTP programs. (Klos 2012) The rest of this paper will focus on describing the net benefits that RTP programs create, followed by a discussion of why I believe that RTP rate designs serve both customers and utilities better than other dynamic pricing rates.

Overview of Net Benefits of RTP

Net benefits are total benefits minus total costs. When the total benefits are greater than the total costs, there will be positive net benefits for a program. First we will start with a brief description of all the different benefit and cost categories that were included in the Illinois RTP net benefits calculations. This will be followed by a summary of how the net benefits look to two different stakeholder groups: society in general and the offering utility. Spoiler alert: both of the Illinois RTP programs showed on-going positive net benefits after the first four years of operation, and both have received approval from the ICC to continue.

RTP Benefits

There are three primary benefits created by an RTP program which are relatively easy to quantify using standard economic theory. These three are avoided capacity costs, bill savings for participants, and a reduction in market prices for everyone buying energy in the same market.

Additional benefits that are more difficult to quantify include:

1) Health and environmental benefits (reductions in emissions)
2) Economic efficiency (reductions in consumption-related deadweight loss)
3) Increased customer satisfaction (fewer high bill complaints)
4) Increased national security (less dependence on foreign oil)
5) Improved power quality and reliability
6) Lower price volatility
7) Market power mitigation

Reasonable efforts based on available industry data were used to quantify the benefits from the first four items in the difficult-to-quantify list for the Illinois RTP net benefits evaluations. Using these methods, it was found that these four items added approximately 15% more benefits to the total benefits

calculated for the three primary categories. (Brattle 2012) The last three items in the difficult-to-quantify list were recognized as benefits, but not quantifiable.

This tells us that the lion's share of total benefits come from the three primary benefit categories. Each of the three primary benefits of these programs will now be discussed in more detail.

Avoided Capacity Costs. Benefits come from avoiding the need to build new capacity for generation, transmission and distribution of energy at peak times. Participants in the RTP programs at both utilities showed a consistent reduction in electric use of approximately 0.5 kW per customer during the summer peak demand hour, adjusted for normal peak temperatures. (Navigant 2011a, 6; 2011b, 98)

This load reduction compares favorably with the level of load reduction achieved in Direct Load Control (DLC) programs across the country, which typically achieve 0.7 to 1.0 kW reduction per customer for 50% cycling. (Summit Blue 2007, 32) The observed RTP peak reductions are lower than DLC results, but this is not surprising when you consider that the RTP load reductions come simply from education and information that motivate behavioral changes, rather than from extra equipment installed at the participants' premises. It shows that participants can make a substantial response to prices without incurring extra equipment costs.

The quantified benefits related to avoided capacity costs come from valuing the load reductions at the estimated cost to build additional generation, transmission and distribution capacity. This is the same as how the benefits of avoided capacity costs are calculated for other energy efficiency and demand response programs.

Bill Savings. Bill savings for participants are the difference between what the participant electric bills were on the RTP rate compared to what they would have been if they had been on the regular flat rate. This difference averaged about $200 per participant per year for each utility over the historical years of the evaluation (2007-2010). (Navigant 2011a, 96; 2011b, 102) On a percentage basis, most participants saw 10 to 20% savings in their total bill compared to what they would have paid on the flat rate.[1] (Navigant 2011b, 68)

Several different factors contributed to this level of bill savings.

Some savings came from the fact that customers used less total energy after switching to the RTP program. They generally reduced their consumption by 2 to 5% during the seasons of spring, summer and autumn. (Navigant 2011a, 7; 2011b, 6) However, winter consumption actually increased in Ameren-Illinois' PSP program which serves southern Illinois and has more electric space-heating load. ComEd's RRTP customers continued to show conservation savings of 3% in the winter months. Participants also realized some bill savings from shifting load from high price periods to low price periods, in addition to the conservation effect.

Other bill savings come from the fact that the RTP energy rates do not include a hedging premium. The hedging premium can be thought of as the insurance premium that is embedded in the flat rate so residential customers on the flat rate can pay a predictable rate every month and be protected from both high and low price swings in the electric energy market. It is uncertain what the hedging premium actually is. It is part of the electricity supply price that utilities agree to within long-term electricity supply contracts undertaken to ensure their customers' future electricity needs are met. However, the portion of the electricity supply price that covers pricing risk (the hedging premium) is not explicitly stated. It is estimated that the hedging premium is between 5% and 15% of the cost of electricity for flat rate customers. For the purposes of the evaluations, a hedging premium of 10% was

[1]The percentage savings is higher than this when looking only at the energy charges portion of the total bill. The percentage savings in energy charges is often used for comparison of utility rates to other Retail Energy Supplier (RES) competitive offerings in Illinois.

assumed. Essentially, RTP customers get a 10% reduction in the cost of their electricity supply because they are willing to take the risk of accepting high market prices without any protection. Utilities do not contract to cover the future needs of RTP customers at a particular price because RTP customers will be buying directly from the markets and they assume all price risk themselves.

After accounting for the bill savings that come from changing usage patterns and the bill savings that come from avoiding the hedging premium, there were still additional bill savings in the historical period that arose because market prices were lower than had been forecasted when the comparable flat rates were set. This largely happened as a result of the economic recession which reduced demand for electricity and created a soft electricity market. RTP participants were able to take advantage of very low electric market prices during 2009 and 2010. While these bill savings were real for participants in the historical period, it is expected that the flat rates will re-adjust to the new market conditions and come in balance with future market prices. For the evaluation of net benefits, it is assumed that the share of bill savings benefits due to falling electric prices will become zero in forecast years. Consequently, this becomes a non-issue in the prediction of future net benefits from the program.

Demand Reduction Induced Price Effect (DRIPE). When the RTP program causes a reduction in system demand during a high price hour, the reduction in demand induces a reduction in the Locational Marginal Price (LMP) for energy in the market. This reduction in price becomes a benefit for everyone buying energy in the market. It is a benefit of the program that is largely enjoyed by non-participants in the program, not participants. In fact, the non-participants that receive this benefit come from all of the customer classes, not just residential, and from all of the service territories in the regional transmission market that sets the LMP. While the price reduction per kWh is assuredly small, the fact that it is shared across so many electric customers makes it a large benefit to the program.

It is also true that low price hours increase demand from RTP participants and this has the effect of increasing the price for everyone. However, studies have shown that the greatest market price impacts from the RTP programs occur at the high price hours and they are minimal during low price hours. When you offset the benefits of price decreases in high price hours with the extra costs of price increases in low price hours, you still end up with overall positive benefits from the DRIPE effect.

RTP Costs

Most of the costs for an RTP program are heavily loaded at the start. IT systems and processes for billing a customer on an RTP tariff need to be built before even one customer can start on the rate. The other big cost is the metering that needs to be installed to collect hourly usage information for each participant. After these two large costs are covered, the remaining program costs are marketing costs and on-going customer support.

Start-up Program Implementation Costs. Both of the Illinois utilities were able to build the IT systems and processes they needed to get an RTP program up and running in less than a year. The start-up cost for this effort was roughly $1 million for each utility. (Navigant 2011a, 105; 2011b, 4) It is likely that the implementation of any new dynamic pricing tariff offered on this scale would require a similar level of resources.

Meter Costs. The RTP programs in Illinois were offered to residential customers before the utilities began their Advanced Metering Infrastructure (AMI) implementations. This means that an interval meter needed to be installed for any customer who requested the RTP rate. In the net benefits evaluation, the incremental cost of an interval meter compared to a regular meter is included in the program costs and is, in fact, the greatest cost of the program. During the evaluation years of 2007-

2010, both utilities charged a monthly fee to participants to help cover this incremental meter cost. When the day comes that AMI meters are standard for residential customers, this particular program cost will become zero. Essentially, the greatest program cost will be gone. Sensitivity studies have shown that this change will double the net benefits of the RTP program. (Navigant 2011a, 106; 2011b, 117)

Marketing Costs. Marketing costs are incurred to bring new participants into the program. Both utilities were able to improve on their marketing methods and messages and reduce their marketing cost per new participant over the four years of the evaluation. Marketing costs are only incurred once for each new participant and have less of an effect on overall program net benefits as the ratio of new participants to existing participants dwindles with time.

On-going Customer Support. Both of the Illinois RTP programs are based on providing information and education to participants so they can make the behavioral changes necessary to benefit from the program.[2] It has been found that on-going communication helps in the effort to inform and motivate. As part of the on-going support, a third-party administrator provides a call center which explains hourly pricing to new customers, helps customers become participants, and answers participants' on-going individual questions about the program. In addition to staffing a call center, the third-party administrator also provides the following customer support: seasonal mailings with information on typical daily price curves and how to save, alerts via text, phone or e-mail when hourly prices will exceed pre-selected thresholds, monthly and annual bill comparisons, on-line tools to quantify hourly usage and savings, and local seminars to provide tips on implementing peak period reductions and capturing savings. (Millburg 2012) These on-going customer support costs are largely fixed costs, so increased participation in the program reduces these costs on a per participant basis over time.

RTP Net Benefits from the Societal Perspective

From the societal perspective, the net benefits of these two RTP programs are both highly positive when they are evaluated as on-going programs through the year 2020. (Navigant 2011a, 3; 2011b, 4) This is true even if no new customers join the program because all of the early start-up costs and marketing costs are offset by year after year of program benefits.

Approximately 20% of the program benefits over this time period come from avoided capacity costs. In one utility these benefits are shared by everyone in the residential class. In the other utility, a demand charge for each participant based on their individual contribution to peak allows the participants themselves to receive this benefit directly as additional bill savings.

The remaining 80% of the program benefits are roughly divided evenly between bill savings for participants and reduced market prices for non-participants.

If the quantified benefits from the difficult-to-quantify list are added in, the net benefits of the RTP programs become even higher. From the societal perspective, the RTP programs are clear winners, even when the incremental costs of the meters are included.

RTP Net Benefits from the Utility Perspective

While societal net benefits for the RTP programs are high, utilities need to focus on their own balance sheets. Utilities, and their customers, directly incur all of the costs for the RTP programs. If a large share of the benefits come from price reductions for other people who are in their regional

[2]Both utilities have done some experimentation with the use of direct load control devices combined with the RTP rates, but this is not a significant part of either program and the net benefits of this combination were not estimated separately.

transmission market, but are not part of their own service territory, then net benefits must be re-assessed from the utility perspective. With this in mind, the Illinois Commerce Commission directed that the net benefits of the RTP programs be determined based solely on the costs and benefits that accrue to the residential customers of each utility. This is important from a rate-making perspective, because if the residential customers (both participants and non-participants) are paying for the programs, then their costs should be compared to their benefits.

From this residential class perspective, the only thing that changes in the net benefits calculation is the amount of benefits coming from reduced market prices (DRIPE). Since residential energy sales are less than one-third of total sales within each utility, and each utility is only a small share of their Regional Transmission Organization (RTO), the total DRIPE benefit is greatly reduced. Instead of being roughly 40% of the total benefits, as is seen from the societal perspective, DRIPE becomes less than 5% of the total benefits from each utility's residential class perspective. (Navigant 2011a, 3; 2011b, 4)

Even with this large reduction in benefits, long-term RTP programs are still able to achieve small but positive net benefits from the perspective of all residential customers of the utility if program costs are carefully monitored. Experience has shown that RTP programs can be successful when they are run in this way, and they will create long-term net benefits for the residential class.

Net benefits in the short-term are also important to understand. After only four years of operation, one utility achieved enough net benefits for their residential customers to offset all of the early start-up costs, and the other utility reached a position where annual benefits for their residential customers outweighed their annual program costs and were on an upward path. Within a year or two it is expected that their total benefits will also have offset all of their early start-up costs. So, within four to six years after start-up, a utility can expect to have recovered enough benefits for their residential customers to offset the full costs of the program. After that point, net benefits continue to be positive on an annual basis.

This finding still leaves the question of which residential customers should pay the program costs: the participants or the non-participants? In each utility, program costs are shared between both groups. While the exact rates are different for each utility and they have been changing over time, it can be stated as a general rule-of-thumb that participants pay a couple dollars per month to be in the RTP program, and non-participants pay a few cents per month.

When considering the rates being charged to cover the costs of the RTP programs, it is important to remember that much of the current cost is related to the installation of the interval meters. These program costs will go away as AMI meters become the standard issue. The other largest part of the programs' costs are the on-going support costs which have a high fixed cost component. As the number of RTP participants increases, the cost per participant will decline. While non-participants have had to contribute to program costs to get the RTP program started, the need for this contribution will be decreasing over time.

In return for their contribution, non-participants get the opportunity to participate in the RTP program as a rate option. Without their support, the start-up funds would not be available to even have this option on the table.

Discussion of the Advantages of RTP

Now that we have seen the results of four years of actual RTP implementation at two different utilities, we know that RTP rates can create net benefits. It is likely that other dynamic pricing rates also create net benefits when carefully implemented, although there are few full-fledged and independently-evaluated dynamic pricing programs to compare to. Most dynamic pricing rates have only been tested in pilots at this time, or are just getting started as utility-wide offerings.

Over the three decades of my career as a utility forecaster, planner and evaluator, I have had the opportunity to evaluate many TOU, CPP, RTP and other load curtailment programs. I have even had the good fortune to help design a few. I was lucky to start my career in Wisconsin where one of the earliest residential TOU experiments was conducted in 1978. During the 80's, the Public Service Commission of Wisconsin encouraged offering TOU rates to residential customers and interruptible and curtailable rates to large nonresidential customers among all of the Wisconsin utilities. In the 90's, Direct Load Control (DLC) programs were started at every large utility. In the early 00's, Wisconsin Public Service Corporation completed an installation of Automated Meter Reading (AMR) meters that covered their whole service territory. This opened the door to testing, design and implementation of CPP rates for residential customers and medium-sized Business customers. Working for Wisconsin Public Service Corporation, I was able to be involved in all of these activities. In 2006, I became a full-time independent evaluator which gave me the opportunity to evaluate dozens of DLC, CPP, RTP and other curtailable rate programs across the country.

Along the way, I have also had the good fortune to actually be a TOU program participant for over twenty years. This gives me experience with dynamic prices on both sides of the meter.

I offer all of this background to explain my interest when a call for comments on dynamic pricing programs crossed my desk last February. It came from the Public Utilities Commission of Ohio, and it was a general call for comments in Case No. 12-150-EL-COI. There were a series of questions related to "Time-Differentiated and Dynamic Pricing Options for Retail Electric Services". Essentially, they wanted to figure out the best dynamic pricing rate designs to offer. They were even considering the best rates to test in a pilot. Having been an evaluator of these types of rates for so many years, I felt I had a lot of information to share with them.

In fact, I felt I could tell them the results of their yet-to-be-done pilot since the results of all these pilots seem to be turning out pretty much the same. Yes, customers respond to all dynamic prices. They respond more when the price-differential is higher, and they respond the most when they are facing a stiff penalty (although this is not a very customer-friendly way to do things.) Generally, only 10 to 20% will opt-in to one of these programs and that is only if there is strong marketing/encouragement. Opt-out programs will garner high participation, because few customers will bother to opt-out. Adding some kind of enabling technology, such as an in-home energy monitor, or a programmable thermostat, or a load control device, or a color-changing orb will increase the savings, but the additional savings will rarely cover the additional cost of the technology. Total bill savings are real, but relatively small (in the 5% to 20% range) and net benefits for the program can be achieved if program costs are also kept low. Behind these generalizations are thousands of pages of studies filled with the detailed findings. Given my background as an evaluator, I was ready to offer up a summary of all of these details to Ohio.

Then I realized that sharing this mountain of information isn't the answer to the question. I could tell you all sorts of details about the different rate designs, and I am sure others could, too, because they have read the same studies. The real answer comes from synthesizing all of this detailed information into what it says about the best way to go forward with dynamic pricing. So, instead of assembling information for others to consider, as I usually do in my evaluation work, I took the step of using the information to make my own decision on the best way to move forward with dynamic pricing for retail customers if you were starting with a blank slate.

Being in this decision-making mode of thinking was different for me, and forced me to consider all of the facts I knew as well as the values involved. From this point of view, I considered all of the dynamic pricing options and came to the conclusion that RTP would be the best way to move forward. The rest of this paper will explain my reasons for that conclusion.

Advantages of RTP

The RTP rate design has a few characteristics that makes it outshine all other dynamic pricing options. It offers optimal economic efficiency, it provides the maximum opportunity for bill savings for customers, and it reduces rate design risk for utilities.

Optimal Economic Efficiency. With RTP, consumers face the true market prices for electric energy. Each hour, they use just as much as they really want at the true price. Consequently, their use of electric energy is optimized to make the allocation of scarce resources as efficient as possible. For example, since they are facing the true price for summer peak energy, they will adjust their air-conditioning to use just as much as they want at that price level. This is different from the flat rate which tells customers that energy for air-conditioning during a hot summer afternoon doesn't cost any more than energy for a refrigerator at midnight in April. With the inaccurate price signal of the flat rate, they use more summer peak energy than they really want to pay for, and they are upset when their flat rate consequently goes up year after year and there is nothing they can do about it.

Maximum Bill Savings for Customers. Every survey I have seen that asks customers why they did or would participate in a dynamic pricing rate shows that the primary reason is "bill savings". We know that bill savings from any dynamic pricing program are usually low (5 to 20%), even with great attention and effort. If customers want dynamic prices to help them reduce their bills, then we should offer them the design that allows them to save the most. RTP offers the greatest savings opportunities because savings are available every hour when the market price is actually below the flat rate. CPP, PTR and VPP only offer savings during a few of the highest market price hours. Total bill savings are limited and arbitrarily determined by the calling of the events. TOU rates could potentially offer an equal amount of savings as RTP, but only if the period times and prices were exactly matched to the market price averages that really occur. In all likelihood, this exact match is impossible. Without a perfect rate design, TOU participants will either be over-paying or utilities will be under-collecting. RTP is already the perfect rate design and doesn't require any guesswork. If there is a CPP, PTR or VPP rate design that offers participants more bill savings than they would get on an RTP rate, those rates are giving participants more benefits than they really should have and they are unsustainable.

Bill savings are only part of the consumer surplus benefits available to customers on dynamic pricing. Customers enjoy bill savings when they face a higher market price and reduce their usage, but they also benefit when they face lower market prices and they can use additional electric energy to give them more of the things they want at a lower price. For example, on RTP a customer can use low cost off-peak energy for electric space-heating or to charge an electric vehicle, giving them the opportunity to get warmth and transportation at a lower cost than otherwise possible. PTR does not offer any of these off-peak consumer surplus benefits. CPP and VPP do offer lower off-peak rates, but they are not likely to be as low as RTP off-peak rates. When customers say they want to save money, they are not looking narrowly at only their electric bill. They will spend more of their budget on electricity if it means they will spend less for natural gas or gasoline. RTP is the way to give customers the maximum ability to save money on all of their energy bills.

Less Rate Design Risk for Utilities. RTP is the only rate design option that is always correctly cost-based, and being cost-based is one of the primary objectives of good rate-making. All other options, TOU, CPP, PTR and VPP, require some estimation of what average customer use will be in different time periods. While these dynamic pricing rates are a great deal of fun to design (and I speak from experience here), I know that even my best efforts will always be wrong and the rates that are set for the

dynamic pricing options will not really be revenue neutral. RTP takes away the risk of being wrong in the rate design and the need to check and adjust it every year.

Comparative Advantages of Other Dynamic Pricing Rate Designs

Every dynamic pricing rate design has its own advantages, so it is only fair to review the advantages of the other designs and explain why I find them less compelling than the advantages of the RTP design.

RTP Compared to TOU. One advantage of TOU rates is that they do not require a meter that keeps hourly data. A simpler meter can do, as long as the meter can put electric use into the correct bucket (on-peak, off-peak, possibly shoulder times, too, for 3-tier rates). The TOU meter only needs to provide two or three pieces of information each month to prepare a bill. An RTP rate requires over 700 pieces of information from the meter to prepare a monthly bill. This difference in metering requirements is one of the main reasons that TOU rates already exist instead of RTP. We've been able to use them for the last thirty years, decades before any full-scale AMI meter installations occurred. Given the advances in metering technology and information technology for billing that we have seen in the last thirty years, there is no technical reason that we should continue with TOU rates. We can now meter and bill for RTP in a cost-effective manner. The Illinois RTP implementations have proven this.

Some may believe that TOU rates are simpler than RTP rates for customers. With TOU rates, customers just need to remember a few time periods and prices and they know what to expect every day and they can plan their activities accordingly. On an RTP rate, customers have to somehow pay attention to market prices that change every hour to know what to do. Here again, the Illinois implementations are instructive. They have figured out a way to make RTP simple for customers. When surveyed, 81% of Ameren-Illinois' PSP customers report that participation in the program is "quick and easy". (Navigant 2011a, App. A, 21)

How is this done? Participants are given information on basic time-differentiated pricing patterns so they can benefit from RTP rates without ever checking the actual hourly prices. Only 52% ever go on-line or to the phone to check hourly rates. (Navigant 2011a, App. A, 19) Basically, "use as little energy as possible on hot summer afternoons" goes a long way towards helping customers know what to do to achieve bill savings on RTP. And customers receive alerts when prices for the next day and/or real-time day-of prices are expected to reach very high levels. This notification is simple and cost-effective to do and keeps participants engaged in market prices without significant effort on their part.

From my experience as a participant in TOU rates, I have to say that TOU periods and prices are not particularly easy to remember. I did alright when I was on a two-tier TOU rate, but I had to check my refrigerator magnet to remember when the seasons changed and what the new seasonal rates were. Now that I am on a three-tier TOU rate, I am checking my refrigerator magnet much more often. It's not as easy to keep three different prices assigned to four different time periods top-of-mind. So, my personal experience does not tell me that TOU rates are 'simpler' than RTP.

I also find TOU rates particularly frustrating during spring and fall. Why should I pay a peak price of 27 cents/kWh to wash my clothes at four o'clock in the afternoon on a Thursday in October? Market prices are not anywhere near the energy component of that rate. TOU cannot give price signals as clearly or accurately as RTP. I don't like having to change my laundry plans because someone arbitrarily assigned a peak price period that doesn't reflect the market, all in the name of "simplicity". Sure, TOU rates could be designed with more seasons, more periods, etc. to make them a better reflection of the market, but then they just get harder to remember.

I do not see any advantages that TOU has over an RTP rate. I think that TOU rates are our dinosaurs from the past and they have no place in our current modern world. If anyone is considering starting a TOU program, I sincerely hope they implement RTP instead (particularly if I ever get to be one of their customers!)

RTP Compared to CPP. CPP rates have the very valuable advantage of being nearly risk-free to utilities. If customers don't reduce their loads during critical peak periods, utilities are not at risk because the high CPP rates fully cover the added cost of supplying energy during those peak times.

The problem with CPP rates is that they are totally backwards from a customer's perspective. This is because customers save money during times that they do nothing to change their electric use, and then when they take action to reduce their load they end up paying a penalty. At least, that is what it feels like to them. I had the opportunity to help develop a CPP rate for medium-sized business customers. To help them see their savings on the CPP rate, we developed a Web application where they could log in every day and see their savings accumulate over time in a nice little chart. Every day they would save a little on their bills because their rates were a little lower than their regular rate. Then a CPP event would occur. Customers would take action to reduce their loads. But they still had to pay such a high rate for the energy that they did use during events that their bill savings would erode. When they checked their savings chart, they would see their accumulated savings drop substantially.

Now, when you do the math any rational mind can see that this is ok as long as you still end up with some net savings at the end of the year. However, it still feels backwards, no matter how rational you are. I think of it as a program that has a big stick and a few tiny carrots. I have seen cases where non-response to an event can wipe out the accumulated savings for the year. After this experience, I would not recommend implementation of a CPP program to anyone. It is a very difficult program to sell to customers.

RTP Compared to PTR. PTR programs are a great improvement over CPP rates. PTR programs give rebates, or rewards, to customers when they reduce their energy use during events. If they do something, they get a reward. If they do nothing, they are not hurt the way a CPP customer is. These programs make sense to customers, and since there is no down-side to participation it is easier to implement them as opt-out programs, which will greatly increase participation.

I have always considered PTR programs to be a win-win solution to the dynamic pricing puzzle. My biggest concern with them is that customer rewards cannot always be doled out fairly. Measurement of customer action depends on comparison of their usage during the event to a baseline. While this method usually gives the right answer, there are many individual aberrations from the norm that can make the measurement of load reductions (and consequent rewards) inaccurate. For example, if a customer never uses their air-conditioning during the afternoon when they are away from home because they believe in conservation of resources, they will show no additional reduction in use during a PTR event. Consequently, they get no capacity-based reward for their conservation action, even though they are performing it regularly. On the flip side, a profligate air-conditioning user may be out-of-town when a PTR event occurs and they will get rewarded for a reduction in use that was inadvertent. I think of PTR rates as a roulette wheel, where you usually win a good amount of carrots for doing something, but sometimes you may get lucky and win lots of carrots for doing nothing. And sometimes, if you are a regular conserver, you don't win anything even though you paid your money to be in the game.

Putting aside these concerns regarding fairness, I understand that the overall benefits of PTR are based on statistical averages and are real, and usually the rewards given to each customer are correct. In fact, very clever work has been done to make the estimates of individual baselines as accurate as possible, and I expect that these algorithms will continue to get more accurate as we move into the

future. I also concede that the no-harm aspect of PTR that makes it an acceptable opt-out program is a very powerful advantage. For these reasons, I do see a place for PTR rates in situations where utilities are facing capacity shortages in the near-term.

However, if capacity shortages are not imminent, I would still recommend RTP instead of PTR. RTP is more fair than PTR, and it optimizes all hours, not just PTR event hours.

I would not recommend implementing RTP as an opt-out program, even though the "rational economic man" part of my brain says that this is exactly what should be done to maximize economic efficiency for our society. I would not recommend it as an opt-out program because I think an opt-out strategy would create a great deal of customer dissatisfaction. And any utility person that has lived through a major rate increase or any other type of major operational change can tell you that it is wise to stay away from moves that upset large groups of customers. In addition to just being very uncomfortable to live through, too much customer dissatisfaction is likely to overturn whatever is causing it in the first place. So, for the sake of actually achieving large numbers of customers on RTP, I recommend an opt-in strategy.

This will not bring major demand reductions or optimal economic efficiency quickly. However, it will be a sure step in the right direction. I think we want to be in a position someday where customer charges and delivery charges and demand charges and energy charges are properly disaggregated on a cost basis. RTP will put us in the right rate position for dealing with distributed generation and fueling of electric cars in the future.

Offering RTP as an opt-in rate also has the advantage of automatically moving all customers towards rates that are more fair, even if they don't choose to participate. There is no such thing as 'free-riders' with an RTP rate. If a customer moves to an RTP rate and achieves great bill savings without doing anything to change their usage pattern, they deserve those bill savings. It means they have been paying more than their fair share all along. If RTP attracts all of these 'structural benefitters' who benefit without changing their usage, along with all people who are willing to change their usage to get some bill savings, the only customers left on the flat rate will be the customers who are using more than average during high-price peak periods. This will be reflected in the load curves for their class. When load research is done to support new rate design, the remaining "flat-raters" will automatically pick up a higher share of energy and capacity costs than they had been paying. They will start paying the higher rate that is fair for them. Opt-in RTP will orchestrate a natural alignment of customers into their fair-share rates, without the need to force anyone onto a rate they don't want.

RTP Compared to VPP. VPP rates could be considered a stepping stone to RTP rates, since they use real-time prices, but only during the limited hours of peak events. VPP rate designs are relatively new. They are being implemented in Oklahoma right now as an opt-in program, and it will be interesting to see the results. I expect they will share the same basic problem of CPP rates- they will feel backwards to customers and they will be a hard sell. They are an improvement over CPP rates, however, in that they provide the correct market price signals during peak times. We will find out how much electricity is worth to customers on peak days. I still see RTP rates as preferable to VPP because they offer the additional benefit of a maximized and sustainable low price for energy during off-peak times.

Summary: Keep It Simple

My experience has also taught me, the hard way, the great importance of keeping offerings simple when working with customers. I do not think it is a good idea to offer customers a smorgasbord of dynamic pricing options. They are just too confusing. I have worked with these different rate designs for decades, and my mind still boggles when I go on-line and learn that I can choose between a 3-tier TOU rate and a 3-tier TOU rate with CPP, at alternative price periods, with or without technology

options. The differences in these offerings are difficult to comprehend and the actual difference in potential bill savings between each of them is minor. I think customers will be very tempted to give up trying to understand the differences before they feel comfortable enough to select one. Although customers like having an option, having too many complex options to choose from is counter-productive. I think the options for customers should be simple: regular flat rate or RTP. These are the two extremes, and RTP creates the maximum possible benefits for the customer and for society while providing a rate design that is low risk and fair and will put utilities where they want to be in the future.

References

Brattle Group. 2012. *The Benefits of Ameren-Illinois Residential PSP Program.* Direct Testimony of Peter J. Millburg, April 4, 2012, Exhibit 1.2, Illinois Commerce Commission Docket No. 11-0547.

Klos, M. 2012. Creating Habits That Will Last With Hourly Pricing. Presentation at the Behavior, Energy and Climate Change Conference, Sacramento, CA, November 12-14.

Mittelstaedt, M., and L. Muhtadie. 2002. "Ontario Power Prices Rival Rates Set in U.S." *Globe and Mail, Bell Globemedia Interactive, Inc*. September 25.

Millburg, P. 2012. Direct Testimony of Peter J. Millburg, April 4, 2012, Illinois Commerce Commission Docket No. 11-0547.

Navigant. 2011a. *Ameren Illinois Utilities Power Smart Pricing Evaluation 2008-2010.* Filed in Illinois Commerce Commission Case 06-0693.
http://www.icc.illinois.gov/downloads/public/edocket/292827.pdf
http://www.icc.illinois.gov/downloads/public/edocket/292828.pdf
http://www.icc.illinois.gov/downloads/public/edocket/292829.pdf
for "Part 1", "Part 2" and "Part 3"

Navigant. 2011b. *Commonwealth Edison Residential Real Time Pricing Evaluation 2007-2010.* Filed in Illinois Commerce Commission Case 06-0617.
http://www.icc.illinois.gov/downloads/public/edocket/296671.pdf
http://www.icc.illinois.gov/downloads/public/edocket/296673.pdf
for "Part 1" and "Part 2"

Summit Blue Consulting. 2007. New Jersey Central Air Conditioner Cycling Program Assessment. Prepared for Atlantic City Electric, Jersey Central Power & Light and Public Service Electric & Gas.

U.S. Energy Information Administration. 2011. *Smart Grid Legislative and Regulatory Policies and Case Studies, Attachment B.*
http://www.eia.gov/analysis/studies/electricity/pdf/sg_case_studies.pdf