Frequently Asked Questions about Implementing Real-Time Electricity Pricing in California for Summer 2001

Severin Borenstein[1]

March 2001

What is real-time pricing?

Real-Time Pricing (RTP) is any system that charges different retail electricity prices for different hours of the day and for different days. For each hour, say 4pm-5pm on June 21, the price may differ from the price at any other hour, such as 3pm-4pm on June 21 or 4pm-5pm on June 22.

Real-time pricing does not necessarily mean that the retail price in any given hour would be equal to the wholesale price for that hour, though that would be one way to implement RTP. The retail price under RTP could be set in a myriad of ways, including methods that are *based on* the wholesale price but consider other factors as well to determine the real-time retail price.

How does real-time pricing differ from Time-of-Use pricing?

Time-of-Use (TOU) pricing is any system under which price varies in a preset way within certain blocks of time. For instance, a typical TOU pricing plan in the summer might charge on weekdays 4¢/KWh from 10pm to 6am, 7¢/KWh for 6am to noon and 7pm to 10pm, and 14¢/KWh for noon to 7pm. Typically, the rates and blocks are different on weekends.

Two key factors distinguish TOU from RTP. The first is obvious: TOU doesn't allow as much gradation in pricing as RTP. Under TOU, the day is typically only divided into 3 or 4 periods and the price is constant within these periods. More importantly, the price is the same at a given time of day (on a weekday) throughout the month or season for

[1] Director of the University of California Energy Institute (www.ucei.org) and E.T. Grether Professor of Business Administration and Public Policy at the Haas School of Business, U.C. Berkeley (www.haas.berkeley.edu). Email: borenste@haas.berkeley.edu

which the prices are set. The retail price signal is exactly the same on a very hot summer afternoon or one in which supply has been reduced as it is on a mild summer afternoon with plenty of supply. In June 2000, the 3-4pm weekday ISO load was as high as 44,000 MW and as low as 30,000 MW. The 3-4pm weekday wholesale price was as high as 92.5¢/KWh and as low as 6.4¢/KWh.[2] TOU pricing is unable to capture this sort of variation in supply/demand balance.

The second key distinction is more subtle, but probably more important for reducing the exercise of market power. Because TOU prices are set for long periods of time — typically three months or more — they do not create demand that responds to changes in the price of electricity. A supplier that attempts to exercise market power in the wholesale market need not worry that the higher prices it is establishing in the wholesale market will deter consumption by end users and thus reduce the profitability of restricting output in order to drive up prices.[3] By establishing separate prices for each hour on each day RTP produces prices that can directly reflect changes in supply/demand conditions for that specific hour and day, and can signal to consumers when power is particularly expensive, whether due to a true supply/demand imbalance or to the exercise of market power.[4] When suppliers know that consumers are able to respond to hour-to-hour price variation, they have less incentive to try to exercise market power by, for instance, declaring an outage at a plant for the purpose of driving up the wholesale electricity price.

What are demand charges?

A "demand charge" is a monthly (in most cases) charge based on the customer's maximum usage during the month. Usually the maximum usage is measured over a 15 minute time period. Importantly, demand charges are based on the customer's maximum usage regardless of whether that usage occurs at a time when the system as a whole has a tight supply/demand balance or not. Most of the meters that register maximum usage for demand charge billing are not capable of storing information indicating the time at which

---

[2] This is the PX day-ahead price unweighted average of the NP15 and SP15 zones.

[3] See S. Borenstein, "Understanding Competitive Pricing and Market Power in Wholesale Electricity Markets," (available at http://www.ucei.org/PDF/pwp067.pdf) for an explanation of how price-responsive demand reduces the incentive to exercise market power.

[4] RTP is slightly less effective in establishing such signals if it is based on a day-ahead wholesale price than if it is based on the real-time ISO balancing market. Arbitrage between the day-ahead and real-time wholesale markets by buyers and sellers, however, makes it unlikely that the day-ahead wholesale price will be systematically higher or lower than the real-time wholesale price.

that maximum usage occurred.[5]

Demand charges are a way to charge for a customer's peak usage, but the economic incentives that they establish are a very imperfect proxy for the real economic cost imposed on the system. First, demand charges are not synchronized to the usage on the system as a whole, so they charge as much for a peak usage that occurs at a lower demand time as at a higher demand time. In fact, this might not be as bad as it seems at first, because air conditioning-driven demand peaks tend to be highly correlated across users. More importantly, however, by charging only for the peak usage, demand charges don't give strong (or potentially any) incentive for a customer to conserve until usage is near the peak level for the period. If a very hot day occurs early in a billing period, the demand charge gives a customer little incentive to conserve after that.

The economics of demand charges made more sense under the old regulatory regime. The concept was to charge customers for their contribution to the need to build additional peaking capacity (though this still suffered from the problem that the customer's peak consumption may not occur at the system peak consumption). Apart from the peak, charges varied little. This makes much less sense in a deregulated wholesale market where demand increases result in significant increases in wholesale price even before the system gets right up to its capacity.

In addition, demand charges make no adjustment for the supply side of the market. If an unusually high number of forced outages occurs on a fairly hot day, the system can be more strained than on a very hot day, even if the total system load is lower. Though wholesale prices vary systematically with system demand, many other factors cause wholesale prices to fluctuate throughout the month. Variations in supply available (and the prices at which that supply is offered) can be as important as variations in demand in explaining fluctuating wholesale prices.

Does a switch to real-time pricing mean an increase in electricity bills?

NO. Real-time pricing simply means that the price will vary hour-to-hour and day-to-day. It *could* be used in conjunction with increased prices. Or the prices could be set in such a way that average bills are about the same as they would have been without any

[5] Customers that have TOU meters usually face on-peak and off-peak demand charges, with the on-peak maximum usage carrying a much higher price. Within the peak price TOU period, such as noon-7pm on weekdays, the meters do not indicate at what time or day the maximum usage occurred.

change in current pricing.[6] The critical point is that RTP means that prices vary by hour. This can be done while achieving any particular average price that is desired.

In reality, whether RTP is implemented this summer or not, retail bills are likely to have to rise. But whatever average level is deemed appropriate for retail electricity prices, that average can be achieved with time-varying prices, rather than with a constant price or rigid TOU prices, and can send much more informative signals to customers about when electricity consumption is most expensive. By doing so, they can also create demand that is price-responsive in a way that will deter the exercise of market power.

What is the advantage of real-time pricing over the current forms of retail electricity pricing?

The primary advantage of RTP is that it will induce more conservation at the peak usage and price times than will be achieved with constant or rigid TOU pricing. This is important in a deregulated market because reducing demand at peak times not only saves money on the energy that is not consumed, and therefore does not have to be bought in the wholesale market, it also reduces the price on the energy that is bought.

Experience in California and in all other electricity markets has demonstrated that at any given time wholesale prices increase with demand on the system and the increase is steeper when demand is high relative to supply. That is, a demand increase of 1000 MW increases the wholesale price much more when the system demand in California is already 41,000 MW than when it is 35,000 MW. So, saving that 1000 MW is more valuable to consumers in peak demand hours than at other times. RTP sends appropriate price signals to achieve conservation when it is most valuable. Thus, RTP can reduce prices for the power that does need to be used at peak times as well as save the price on usage that can be curtailed at peak times.

Why is there so much urgency to implement RTP by this summer?

Implementing RTP by this summer is urgent for two distinct reasons. The first reason, which is most often suggested, is that California is likely to be short of power at peak times this summer. The ISO control area is likely to find itself 2000-5000 MW short at peak times. The exact number depends greatly on available hydroelectric production and how

[6] For instance, a program currently operated by Georgia Power has a fixed charge/credit that keeps bills stable if the customer's usage remains at about the level and shape as during a previous baseline period.

hot this summer turns out to be. RTP can be used to send strong economic signals to large commercial and industrial users about when conservation is particularly valuable. It does so without usage rules (such as rules about air conditioner temperature settings or when outdoor lighting can be used) that are difficult to enforce and not necessarily equally appropriate for all customers.

Just like energy use, conservation is not done most efficiently with a one-size-fits-all model. The value of RTP is that it sends the correct economic signal about the value of conservation and then lets the individual customer decide what measures should be taken. Without RTP, we are likely to see not only usage rules, but also interruptions and rolling blackouts. These are the most inefficient and disruptive forms of conservation. RTP allows broad distribution of the conservation across many users. This is likely to be much less disruptive than forcing 100% reductions upon certain customers while others are free to set their air conditioners at 72 degrees without recognizing the cost that is imposing on the system.

The second reason that implementing RTP this summer is so critical is that without significant conservation, we are likely to face extremely high wholesale electricity prices this summer. The problem will occur not just at the times when demand is at its very highest, but also at other times when demand is fairly high. Reducing energy use will help avoid blackouts when demand otherwise would be 44,000 MW. But it will also help to significantly reduce wholesale electricity prices both when demand is around 44,000 MW and when it is around 41,000 MW. All hot days this summer are likely to produce extremely high prices, not just the super scorchers.

How much can be saved by implementing RTP?

The current plans being discussed in Sacramento would implement RTP for all commercial and insudstrial customers whose peak usage is above either 200 KW or 500 KW. The 200-KW-and-above plan would amount to users who constitute about 30% of peak load while the less-aggresive 500-KW-and-above plan would only cover users that constitute 21% of the peak load. The question is how quickly all of the installations and infrastructure can be put in place.

Exactly how much demand would be reduced with this program depends on many factors including the weather, the degree to which average prices are permitted to increase, and the number of users who are on the program. Conservative estimates, however, are that the program for 500 KW and above could reduce demand by at least 1000 MW at peak times and the larger program for 200 KW and above could reduce demand by 1500

MW at peak times.[7]

Just as important as the energy savings is the economic savings that RTP can deliver. By reducing demand at peak demand and price times, RTP can save wholesale expense on the power that isn't used and reduce the price that must be paid for the power that is used. Using June 2000 as the basis for analysis, and taking demand elasticity estimates from the RTP program that has been in use by Georgia Power for a number of years, a conservative estimate is that RTP would have saved $150 million last June off the payments that went to merchant generators.[8]

Why not put all customers on RTP, including residential users?

The argument against a broader implementation of RTP is logistical and cost. For this summer, it is simply not feasible to put all California customers on RTP. The 200 KW and above plan for the ISO control area would require installing 18,000 new meters by this summer. To implement that plan for *all* customers in the area would require installing about 10 million meters. Also, the meters cost $200-$1000 per installation.[9] This is clearly cost-effective for large users, but may not be for very small users. After this summer, expansion of the program should be a top priority. Whether it will make sense to go down to the residential level will depend on the economies of scale in meter installation and use, and the degree to which RTP for large users alone reduces the time-variation in wholesale prices.

How much is this plan going to cost?

To get all customers above 200 KW on RTP by this summer will require fast action by the California Public Utilities Commission (and possibly the Legislature and Governor) and then fast action by the utilities. Because a crash installation program is likely to require overtime payments, the cost will be higher than it would be with a more gradual approach. In addition, billing systems will need to be reprogrammed quickly to handle the hourly price changes. The best estimate right now is that the 200 KW and above plan

---

[7] My own view is that much greater savings are likely to be found once the customers have these economic incentives.

[8] This counts only payments to generation that is not owned by or under long-term contract to the California utilities.

[9] This figure does not count potential savings from the new meters such as reduced meter-reading costs.

would cost about $30 million. While this is a significant cost, it is almost certain to result in savings that will outweigh this cost within the first week or two of the program this summer. And if it helps to avoid one day of rolling blackouts, the expense (which amounts to about $1 per California citizen) will certainly be justified.

Who are the winners and losers under RTP?

The main effect of RTP will be to reduce the total payments to merchant generators in the wholesale electricity market. That will benefit all customers in the state, those on RTP and those who are not. It is crucial to understand that the full cost of every kilowatt bought in the wholesale market this summer is going to be paid for by Californians. The only question is whether we will pay for it through electricity prices in a way that encourages conservation, and thus will lower the total wholesale electricity bill substantially, or through taxes in a way that will not encourage any conservation.

Among customers on RTP the benefits will vary depending on when a customer consumes power. Customers with a relatively flat consumption profile – whose consumption has less hour-to-hour and day-to-day variance than others on RTP — will see the greatest benefits. Because their consumption does not "peak" as much as the aggregate demand at high-demand times, they will be buying a smaller share of their power at the most expensive times. As a result, their average price per kilowatt-hour will be lower than for customers with more "peaky" demand.

Customers with more "peaky" demand who do not respond to the higher prices that will occur when supply is tight will be consuming a disproportionate share of their power at the more expensive times. These customers will face a higher average price per kilowatt-hour than will customers with a flatter demand profile. In California, the peak demands occur on hot summer days and are driven primarily by air conditioning. There are no completely reliable rules, but in general customers that use power disproportionately for air conditioning probably have more "peaky" demand that is greatest at the time when elctricity is expensive. Customers that use power disproportionately for other uses (lighting, industrial production, machinery) generally have flatter demand profiles.

Thus, the losers from RTP will be the merchant generators, who will receive lower prices in the wholesale electricity market. The biggest winners will be RTP customers that have relatively flat demand profiles or can change their consumption to have relatively flat demand profiles. RTP customers that have peaky demand profiles that they cannot adjust will not be as big winners as those with flat demand profiles, but since all of the wholesale cost of power will eventually have to be paid, even those with peakier demand profiles are likely to be big winners as the wholesale price of power will fall at peak times. Customers not on RTP will also be winners since they too will have to shoulder some of the wholesale cost of electricity.

And, of course, to the extent that RTP helps to avoid stressing the system to the point that the ISO has to order rolling blackouts, all California consumers will be big winners.

What about customers that run 24x7 and can't reduce their demand?

First, customers that run 24x7 tend to have flatter demand profiles than the system as a whole. Thus, although they will have to buy power at higher prices during system peaks, they will buy a smaller share of their power at these times than will other users. Customers with relatively flatter demand profiles are the biggest winners.

Furthermore, the question is not whether *you* are able to conserve, but whether enough users in aggregate are able to conserve to lower demand, thereby reducing wholesale electricity prices and reducing the risk of rolling blackouts. If you are a user that cannot conserve at all without causing great economic or other harm to your company, then RTP offers enormous benefits. It can greatly reduce the chance of rolling blackouts, which are especially costly to your company, and it reduces the wholesale price of electricity at peak time because *other* users reduce their demand.

Finally, there are very few companies that cannot find additional ways to conserve when there are strong economic incentives. By not establishing these economic incentives, we have set up a system that is more costly for *all* customers. The only winners from the current system are the merchant generators that benefit from high wholesale prices.

Instead of RTP, why not implement a system that uses positive reenforcement by paying customers to reduce their usage?

The short answer is that given the electricity and financial crunch we are facing this summer, we should do both. But RTP is likely to be more effective if we get it in place. And all the money that is paid out in positive reenforcement has to come from somewhere. It comes from ratepayers or taxpayers. Paying for demand reduction is not a free lunch.

The reason that RTP is more effective that paying for demand reduction is that there is no reliable baseline from which to pay for reduction. With most goods, the natural baseline is zero: you start with none of the good and pay more as you consume more. Programs that pay for demand reduction set a baseline that comes from the past behavior of the customer. This sets up two serious problems.

First, if the program is voluntary, it will be joined disproportionately by the customers that already knew they would have lower consumption. For instance, if the program uses last year's consumption as the baseline (presumably with an adjustment for weather), the companies that have shrunk since last year will be the first to sign up. Their electricity consumption has fallen compared to the baseline for reasons having nothing to do with the program. We (that is, everyone who pays for the rewards that the program doles out) end up paying for "conservation" that would have occurred anyway. Meanwhile, the companies that have grown rapidly since last year simply won't sign up.

Second, if the baseline that is used can be affected by the customer, it will probably discourage conservation during times when the payments are not in effect. For instance, consider a plan that sets the baseline at the level of consumption the customer had on the previous day. Then on days when the payments are not in effect, customers would be foolish to conserve at all since that would just lower their baseline. Californian's saw this effect in the 1970s with water rationing. Many users figured out that they were better off being wasteful in normal-rainfall years so that they would have a higher baseline if a drought hit. Of course, if the payments are in effect all the time, this won't be a problem. But then we'll have to find a lot of money to pay out and we'll have to use a baseline from before the time the program began. That raises the first problem again.

Finally, there could be a program that uses a baseline from an earlier period and was not voluntary. This would raise serious equity concerns. Shrinking companies would reap a windfall and expanding successful companies would be penalized.

The proposals seem to make RTP mandatory for certain users. Why not make it voluntary so only those customers that can reduce their consumption would have to sign up?

A voluntary RTP program would encourage some customers with the ability to reduce consumption at peak times to sign up. But customers that know their demand would still be "peakier" than the system as a whole would avoid the program. So, the customers with the peakiest demand would not join. These are the customers who need to have the incentive to conserve where possible. A lot of their peaky demand is air conditioning. They might not be able to reduce their peaks below the system as a whole, but they can still probably make adjustments that will save power at those peak times.

More importantly, the proposals do not make RTP mandatory. Rather, they make

RTP the *default*. Customers would still be free to sign financial contracts with energy marketers that could offset the price at the peak times. By doing so, the customers could reduce their exposure from consuming power at peak times. Those contracts, however, typically are for a fixed amount of power. Thus, *at the margin* the customer sill has a strong incentive to conserve. If the customer uses extra power, it faces the RTP price for that additional consumption. If it conserves power, such contracts usually allow the customer to sell the power it has saved at the wholesale price. Contracts that lock in prices for certain times (often called "contracts for differences" or CfDs) can protect the customer from the costs of price swings under RTP while still giving them strong incentives to conserve.

Isn't implementing a RTP program only for the large users unfair to them?

There is no reason the proposed RTP program has to be unfair to large users. As pointed out above, the *average price* under a RTP program can be set at whatever level is desired. The RTP price can track the wholesale price but have an "adder" (more likely a "subtractor") to target a certain average price. That average price can be set to reflect a rate increase that is comparable to the rate increase imposed on other users that are not on RTP. In fact, such a system would benefit RTP customers more than other customers. RTP customers would have the opportunity for large savings by scaling back their usage at peak times. Other customers would not.

Also, remember that the biggest effect of RTP will be to reduce the risk of rolling blackouts and reduce the wholesale price of power, which eventually is going to be paid by all customers in the system. It may turn out that RTP customers will be bigger winners than other customers, or it may turn out that other customers will be bigger winners. But going into this summer without an RTP program that is applied as extensively as possible is just making sure that the merchant generators will be the winners and all customers will lose.