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I. Identification and Qualifications

Q: Mr. Chernick, please state your name, occupation and business address.

A: I am Paul L. Chernick. I am the president of Resource Insight, Inc., 5 Water Street, Arlington, Massachusetts.

Q: Summarize your professional education and experience.

A: I received an SB degree from the Massachusetts Institute of Technology in June 1974 from the Civil Engineering Department, and an SM degree from the Massachusetts Institute of Technology in February 1978 in technology and policy. I have been elected to membership in the civil engineering honorary society Chi Epsilon, and the engineering honor society Tau Beta Pi, and to associate membership in the research honorary society Sigma Xi.

I was a utility analyst for the Massachusetts Attorney General for more than three years, and was involved in numerous aspects of utility rate design, costing, load forecasting, and the evaluation of power supply options. Since 1981, I have been a consultant in utility regulation and planning, first as a research associate at Analysis and Inference, after 1986 as president of PLC, Inc., and in my current position at Resource Insight. In these capacities, I have advised a variety of clients on utility matters.

My work has considered, among other things, the cost-effectiveness of prospective new generation plants and transmission lines, retrospective review of generation-planning decisions, ratemaking for plant under construction, ratemaking for excess and/or uneconomical plant entering service, conservation program design, cost recovery for utility efficiency programs, the valuation of environmental externalities from energy production and use, allocation of costs of service between rate classes and jurisdictions, design of retail and wholesale rates, and performance-based ratemaking and cost recovery in restructured gas and electric industries. My professional qualifications are further detailed in Exhibit PF-PLC-1, attached hereto.

Q: Have you testified previously in utility proceedings?

A: Yes. I have testified approximately two hundred times on utility issues before various regulatory, legislative, and judicial bodies in the United States and Canada. These testimonies are listed in my resume.

Q: Have you testified previously on utility rate design issues?

A: Yes. Since 1978, I have testified approximately twenty times on rate design, including time-of-use and real-time pricing.

Q: Have you testified previously before the Pennsylvania PUC?

A: Yes. I testified in the following cases:

- Docket R-842651 on costs and cost-recovery for Susquehanna 2,
- Docket R-850152 on costs and cost-recovery for Limerick 1,
- Docket R-850290 on Philadelphia Electric Auxiliary Service Rates
- Dockets I-900005, R-901880 on DSM cost recovery mechanism

In various proceedings, I testified on behalf of the Pennsylvania Consumer Advocate, the Utility Users Committee, the University of Pennsylvania, Albert Einstein Medical Center, AMTRAK, and the Pennsylvania Energy Office.

II. Introduction

Q: On whose behalf are you testifying?

A: My testimony is sponsored by Citizens for Pennsylvania's Future (PennFuture).

Q: What is the purpose of your direct testimony?

A: I have been asked to recommend a policy for implementation of real-time pricing and other time-dependent pricing by Pennsylvania Electric Company and Metropolitan Edison Company (collectively, the Companies).

Q: What is the purpose of time-dependent pricing?

A: There are at least four categories of benefits from time-dependent pricing:

- If customers are given incentives to reduce energy use at the times when energy is most expensive, they can reduce the costs of their energy use and their energy bills.
- Reducing customer usage in high-price, high-load periods will tend to reduce capacity requirements to the customer's power supplier (one of the Companies or a competitive supplier), and hence generation capacity costs. These costs may become much larger, depending on the outcome of on-going negotiations and litigation at FERC over PJM's rules for setting capacity prices and requirements.
- Reducing customer consumption at high-load periods will tend to reduce critical loads on the transmission and distribution systems and hence the cost of those systems.
- Reducing energy loads will tend to reduce market prices, resulting in lower energy bills for all consumers in the region.

Q: Are all time-dependent rate designs equally capable of reflecting the variation in costs?

A: No. Prices for any time interval vary unpredictably, so no fixed time schedule can reflect the actual variation in prices. In order to give customers accurate price signals, the prices must change to reflect conditions on an hourly or daily basis. To the extent feasible, load must be metered and priced on the same basis as market prices change; that is, hourly.

The technology for market-responsive metering will generally include remote-reading technology, reducing the costs of meter-reading.

Q: What actions should the Commission take in this proceeding?

A: The Commission should establish a policy of providing all customers with the most responsive metering system justified by the level of the customer's load and potential for load-shifting. These programs would include:

- Comparing the costs of metering, controls and communication equipment with the possible savings to participants and non-participants from reduced consumption of high-cost energy, reduced capacity requirements, and from reductions in market prices due to reduced load levels.
- Installing metering and associated equipment for customers whose size appears to justify the additional costs.
- Designing delivery rates to take advantage of the improved metering and reflect the varying contributions to peak transmission and distribution loads.
- Designing POLR rates to use the improved metering and reflect varying energy costs and contributions to generation capacity requirements.

- Collecting analyzing data on price response to monitor the effectiveness of the program design and identify (and correct) problems promptly.

Q: What can the Companies do to improve participation and customer response in time-dependent pricing programs?

A: The Companies should develop:

- Real-time pricing rate designs appropriate to the size and sophistication of a range of customers.
- Effective education and marketing. Especially for companies too small to have staff dedicated to power procurement, it is vital that the utility explain the benefits to potential participants and get the attention of senior management.
- A simple, effective system to assist customers in managing price risk and hedging costs, without damping incentives to conserve or shift load at times of high costs.
- Methods for providing participants with data on their hourly usage, so they can modify usage patterns and understand their bills.

III. Options for Time-Dependent Pricing

Q: How can prices be set on a time-dependent basis?

A: There is a whole spectrum of time-dependent pricing from time-of-use at one end to real-time pricing (RTP) in 15 minute increments at the other. For example, utilities and competitive suppliers may implement:

- Traditional TOU with fixed prices over fixed period: California's experiment in real-time pricing includes a TOU rate with a fixed premium price for pre-determined critical peak hours.
- Critical peak pricing: In this approach, which California is also exploring, the timing of the critical hours is allowed to vary based on short-term (hour-ahead or day-ahead) conditions, but the premium price is fixed in advance. The critical hours may be determined by energy prices, load levels, or reliability of the supply and delivery systems.
- Variable peak pricing: The timing of the peak periods is fixed and the peak price is variable (essentially, the reverse of critical-peak pricing in reverse).
- Full real-time pricing: The price is set for every hour, typically based on market prices posted either the day before or on the real-time prices determined by the ISO in the hour.

Q: Should time-dependent rates reflect variability in all costs?

A: Time-dependent rates should vary, as much as feasible, with all the costs that vary over time. For generation supply, rates would ideally reflect variation of prices for energy and ancillary services, and varying contributions to determining the required generation capacity. Delivery rates should vary over time to reflect the likely contribution to peak loads and other critical conditions on the transmission and distribution systems.[1]

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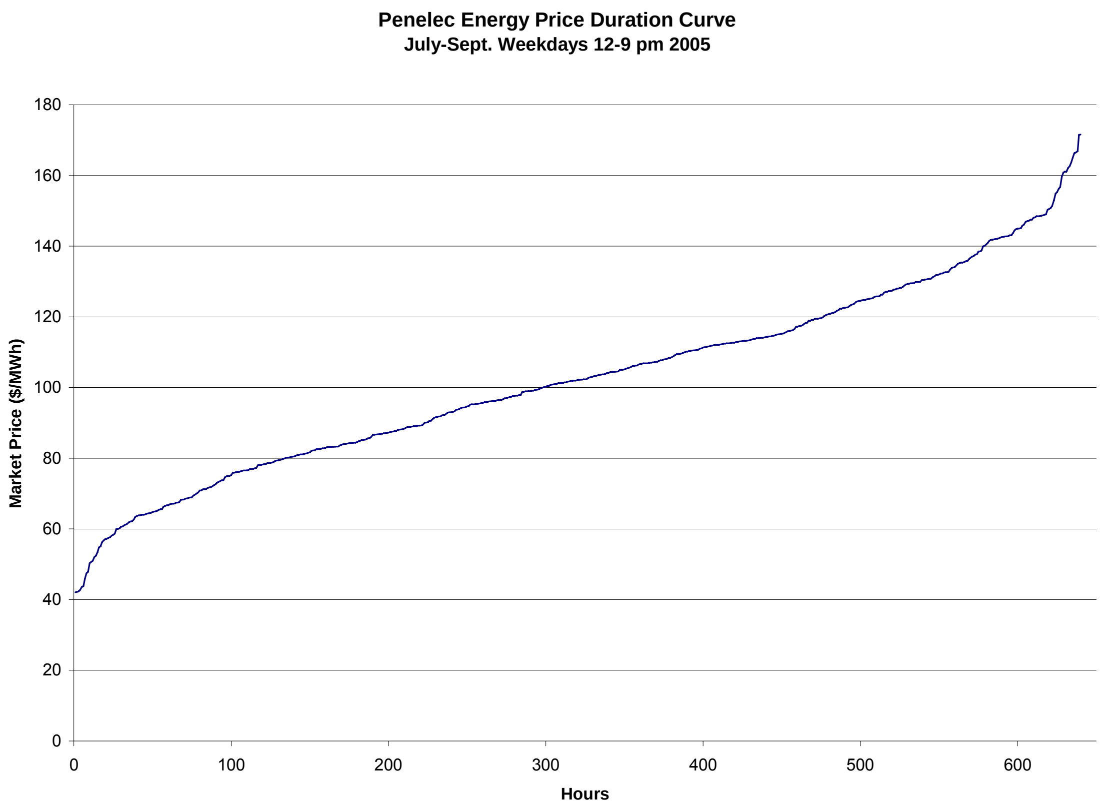
[1]Allocating delivery costs as a function of load is more complicated and judgmental than observing market prices for energy, but imperfect time-differentiation of delivery costs is better than none.

Q: Why is real-time pricing preferable to time-of-use pricing?

A: While energy costs tend to be higher in some months than in others, higher on weekdays than weekends, and higher at some hours than others, costs still vary widely within any pre-defined pricing period.

For example, for PJM's PennElec pricing zone, prices were over $140/MWh in 62 weekday hours during July to September 2005, all between noon and 9 PM.[2] Prices in those hours averaged $150/MWh. In the same noon–9 PM hours in those three months, there were 578 hours with prices less than $140/MWh, averaging $96/MWh. The prices were spread rather smoothly from about $60/MWh to $150/MWh, as shown in the following figure:



[2] That is, in the hours ending 1 PM through 7 PM.

Thus, a time-of-use rate could not signal customers that power cost $161/MWh at 5 PM on July 25, $80/MWh on the same hour four days later, and just $64/MWh at the same hour July 7.

PennElec Market Energy Prices Over $140/MWh, Summer 2005

	Hour Ending									
Date	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
7/19/2005				142	142	142				
7/20/2005						145	142			
7/25/2005				149	155	161	153			
7/26/2005			142	150	147	149	148			
8/3/2005				143	146	148	143			
8/4/2005		143	151	163	166	172	167	147		
8/5/2005				148	149	149				
8/12/2005					143	147	141			
8/15/2005						144				
8/31/2005					143	145	142			
9/1/2005				146	151	156	155			
9/12/2005					143	148	140			
9/13/2005					142	147				
9/22/2005			149	164	167	172	160		142	144
9/23/2005	141	143	157	161	162	161	145			
9/26/2005				147	151	165	145			
Hours >$140/MWh	1	2	4	10	14	16	12	1	1	1
other weekday hours	63	62	60	54	50	48	52	63	63	63
Average price										
on days >$140/MWh	141	143	149	151	150	153	148	147	142	144
on other weekdays	78	95	103	106	108	109	105	91	87	91

Similar patterns of prices occur in other months with high prices. For example, in December 2005, there were 38 hours over $140/MWh, spread over 6–9 am and 5–9 pm, averaging $151/MWh. The other 109 December hours in those time periods averaged $106/MWh.

Q: How does real-time pricing benefit consumers in a restructured generation market?

A: There are three types of benefits. First, consumers on real-time pricing rates can save money in the short term, by reducing usage in the highest-priced hours. Second, all electricity users will benefit from improved reliability. To the extent that hours with low operating reserves tend to have high energy prices, even real-time pricing driven entirely by the energy will tend to reduce loads at the times that the bulk-power system is most stressed. Third, real-time pricing will tend to reduce market prices for energy and operating reserves, and perhaps capacity as well, depending on the eventual structure of the market. Fourth, line losses are highest at high load levels; reducing customer loads at high-load, high-price hours will reduce losses paid by all consumers. Fifth, transmission and distribution costs remain under cost-of-service regulation; reducing peak loads will tend to reduce the need for T&D additions and replacements, reducing T&D costs. Thus, both participating and non-participating Company customers, and other Pennsylvania electric consumers, will benefit from appropriately-designed real-time pricing.

Q: How can the Companies, which have POLR rates well below the market price of power, use ISO market prices to set real-time prices?

A: While the design of a real-time pricing rate is slightly more complex under these circumstances, it is not excessively so. Georgia Power, for example, has a number of real-time pricing rate schedules, even though it is an integrated utility with fully-bundled rates. Each real-time pricing customer is billed based on its bill under a standard rate for a baseline load shape, and the hourly variation of its load from the baseline:

$$\text{RTP Bill}_m = \text{Standard Bill}_m + \Sigma\ \text{Price}_h \times [\text{Load}_h - \text{CBL}_h]$$

where:

m = month

h = hour

CBL = the customer's baseline load

The baseline provides revenue-neutrality and also functions as a hedge for customer bills. Georgia Power has developed a standardized method for setting the hourly baseline. Part of the description of that method is laid out in the following tariff language par allows customers to set their baseline

> The CBL is initially developed using one complete calendar year of either customer-specific hourly firm load data or monthly billing determinant data that represents the electricity consumption pattern and level agreed to by the customer and Georgia Power. This CBL represents the customer's operation for billing under its conventional tariff. Changes in consumption, measured from the CBL, are billed at RTP prices. The CBL is the basis for achieving revenue neutrality with the appropriate non-RTP firm load tariff on a customer-specific basis. Mutual agreement on the CBL is a precondition for use of RTP.
>
> For customers with Existing Load, the CBL will initially be developed from either actual historical metered half-hourly interval data for a customer's specific location or from a Template scaled to the actual historical monthly energy and monthly peak demands. (from Georgia Power Electric Service Tariff: Real Time Pricing - Day Ahead, Schedule: "RTP-DA-2")

In addition, Georgia Power offers customers the option of choosing to "raise or lower the original CBL for a contract period specified by the company. The monthly Standard Bills will be recalculated to reflect the adjustment to the CBL. RTP prices will then apply to differences between the customer's actual load and the adjusted CBL. RTP credits will be given for load reductions below the customer's adjusted CBL."

Georgia Power has over 1,600 customers on these full real-time pricing rates, representing about half its total commercial and industrial sales.

IV. Variable Delivery Charges in Real-Time Pricing

Q: Why should T&D costs be recovered through variable charges?

A: First, capacity limitations on the Companies' T&D systems generally occur in the high-load summer and winter hours. Therefore, the average kWh sold in peak periods, and especially during summer peak periods (when capacity is more limited), result in higher transmission and distribution costs than energy sold in other periods.

Second, fixed charges are not an efficient way of recovering delivery costs. Charging more for summer usage and less for winter and shoulder use may provide customers with more appropriate price signals than demand charges that are constant over the year. Shifting revenues onto the summer would increase customers' incentive to control summer loads that determine the need for distribution-system capacity.

Q: In what ways do summer peak loads affect T&D costs?

A: Most of the large and expensive distribution elements—substations, subtransmission lines, feeders—experience their peak loads in the summer. The capacity of distribution equipment is generally lower under the weather conditions of summer peak loads than winter peak load. The capacities of transformers and underground power lines are limited by the build-up of heat created by the electric energy losses in the equipment itself, and the equipment heats up faster when the air and soil are already warm. The capacity of overhead lines is often limited by the sagging caused by thermal expansion of the conductors, which also occurs more readily with summer peak conditions of high air temperatures, light winds and strong sunlight.

In addition to driving the sizing of equipment, summer energy use tends to shorten the life of lines and transformers by overheating and degrading the insulation.

While load in the peak hour for any particular piece of equipment is important, so are loads in other high-load hours around the peak, since they contribute to the heating that reduces the load-carrying capacity of the equipment in the peak hour. Even off-peak energy use during a heat wave will contribute to overloading and degradation, by keeping the equipment from cooling off overnight.

For the minority of distribution costs that are not driven by summer loads, extreme winter loads would drive most of the remaining costs.

For most portions of the distribution system—a line transformer serving by a few or dozens of customers, a feeder serving hundreds or thousands of customer, or a substation serving many thousands—an additional kWh of load in the summer will impose higher costs on the system than an additional in other seasons. Winter energy use, particularly on-peak use, imposes higher costs than shoulder usage.

Q: How do transmission costs vary among time periods?

A: While some transmission costs were incurred to tie large remote generators into the power grid, or to allow for economic exchanges of energy with other regions, peak loads are certainly a major driver of transmission costs. On a time-of-use basis, transmission costs should be allocated primarily to the summer peak period or to the highest-price period in real-time pricing approaches.

Q: Why are fixed (or demand) charges not well suited to recovery of distribution or other costs, particularly in rate designs that include time-dependent rates?

A: Demand charges are particularly inefficient means for giving price signals, for the following reasons:

- Demand charges are not generally very effective at reflecting costs. The customer's peak hour is not likely to coincide with the peak hour of the other customers sharing the equipment it uses: the secondary system, line transformer, primary tap, feeder, substations, sub-transmission lines, and transmission lines.
- Demand charges are not effective in shifting loads off high-cost hours, and may even cause customers to increase their contribution to maximum or critical loads on the local distribution system, the transmission system, or the regional generation system.
- The sizing of transformers and underground lines is also driven by the energy use on the equipment in high-load periods, in addition to maximum hourly loads.
- Demand charges and limit customers' control over the size of their bills.

Most of these problems flow from the fact that demand charges are difficult to avoid; even a single failure to control load results in the same demand charge as if the same demand had been reached in every day or every hour. Some of the problems with demand charges result from (1) the diversity among customers' individual peak load measured by demand meters and (2) the differences between those peaks and the coincident demands on utility equipment that determine costs.

Q: Please explain the importance of the diversity of consumer peak demands.

A: The investment in distribution equipment depends in large part (although not entirely) on the peak load on that equipment. If demand charges measured the contribution of customers to the peak loads on the distribution equipment, they would be very useful in providing price signals. Unfortunately, they do not.

The diversity of demand among a group of customers results in a group peak demand that is less than the sum of customers' individual maximum demands. In general, utilities size plant to meet the group peak, not the sum of customers' individual maximum demands.

Q: What pricing signals do demand charges give to customers?

A: Not only are demand charges ineffective in shifting loads off high-cost hours, they may cause some customers to shift loads in ways that increase costs.

Demand charges provide little or no incentive to control or shift load from those times which are off the customer's peak hours but which are very much on the distribution peak hours. Customers can avoid demand charges merely by redistributing load within the peak period. Some of those customers will be shifting loads from their own peak to the peak hour on the local distribution system, on the transmission peak, or on the peak load hour of the utility or other load-serving entities serving the Companies' consumers.

Q: How should delivery costs be recovered in RTP rates?

A: All system, regional, substation and feeder costs should be transferred to on-peak energy charges. Demand charges may make sense for recovering the costs of equipment used only (or primarily) by a single customer, but they should rarely be used otherwise. The additional revenues currently collected through demand charges can instead be collected through peak-period energy charges. This will encourage reduction of usage in high-load periods, when transmission and distribution equipment is heavily loaded.

V. Effective Real-Time Pricing Design

Q: What factors are important in developing effective real-time rate designs?

A: The key issues in creating effective real-time pricing include

- Effective education and marketing.
- A simple, effective system to assist customers in managing price risk and hedging costs.
- Designing the real-time pricing rate design for each class, recognizing the level of complexity the customers can tolerate and the metering can support.
- Providing participants with data on their hourly usage, so they can modify usage patterns and understand their bills.

- Cost-effective design of RTP programs, comparing the costs of metering, controls and communication equipment with the savings to participants and non-participants from reduced consumption of high-cost power and from reduction in market price due to reduced load levels
- Collection and analysis of data on price response to monitor the effectiveness of the program design and identify (and correct) problems promptly.

Especially for companies too small to have staff dedicated to power procurement, it is vital that the utility explain the benefits to potential participants and get the attention of senior management.

Q: What is the point of hedging in a real-time rate design?

A: The objective of real-time pricing is to give customers clear signals regarding when to use power, or avoid using it, to allow customers to decide which load-reducing measures they are willing to undertake at any particular time, given the cost of purchasing power at that time. At the same time, it is not desirable to expose customers to the risks of price volatility and unexpectedly high prices. Hedging reconciles these two objectives.

Q: How can customers be hedged against price volatility, without destroying the real-time price incentives?

A: The basic principle is that the customer should be eligible for a pre-determined amount of energy (the baseline) at the hedged price and should pay the real-time price for consumption above that amount or receive a credit for using less than that amount. This principle can be implemented in two ways. For a customer with a baseline of H MWh at $\$h$/MWh and an actual load of R MWh at $\$r$/MWh real-time price, the bill can be computed as either by

- Charging the customer the real-time price for all its consumption ($r \times R$) and crediting the customer for the difference between the real-time and hedged prices for the baseline ($[r-h] \times H$), for a net cost of $r \times R - [r-h] \times H$.
- Charging the customer the hedged price for the hedged amount ($h \times H$), plus the real-time price for the difference between the actual and baseline consumption ($r \times [R-H]$), for a net cost of $h \times H + r \times [R-H]$.

The first approach follows the pricing of conventional third-party hedges, in which the customer purchases a commodity (such as natural gas) in the forward market and sells that supply into the market to moderate the cost of its actual service. The second approach may be easier to explain to smaller customers. In any case, the two approaches produce identical net costs.[3]

Hedging thus protects customers from price fluctuations, without damping incentives to conserve or shift load at times of high costs.

Q: How should the baseline amount of hedged energy be determined?

A: Various programs have used variations on one of two approaches: either the baseline is set automatically based on the customer's previous use, or the customer selects the baseline.

Customers in the medium commercial-industrial class may be able to deal with the complications of selecting the level and shape of energy supply they want

[3] Both price formulas simplify to $h \times H + r \times R - r \times H$.

to lock in. For smaller customers, the utility will need to apply some mechanism for automatically determining the baseline (such as the customer's average load in some earlier period). Baselines can be set at a fixed time (a year ahead or a month ahead), or the customer can be given several opportunities to select hedges. For example, the Companies could post forward prices every season for peak and off-peak hours in each the following four seasons, based on supplier bids. Customers would have one day to nominate the MWh of energy per hour they wish to hedge at that time. For example, in late October 2007 the Companies might post prices for winter 2007–08 (December–February), Spring 2008 (March–May), Summer 2008 (June–September) and Fall 2008 (October–November). Each customer could select the amount of forward energy it wishes to hedge for each of those periods; for all except winter 2007–08, the customers would have another hedging opportunity in January 2008.

Baseline quantities can vary by hour, or can be equal across the hours within each pricing period (e.g., on-peak, nights, and weekend daytime).

Q: How could the Companies design the real-time pricing rate for each class to recognize the level of complexity the customers can tolerate?

A: Large customers, with staff dedicated to building operations and energy purchasing, can follow hourly (or even 15-minute) real-time price signals, and respond as appropriate. This category may include some large companies with multiple facilities, even if the individual customer accounts are modest. For example, a fast-food chain with twenty restaurants in the Duquesne territory (or in other parts of PJM with real-time pricing) may be able to centrally monitor real-time prices and remotely control lighting and other loads at the individual locations. For such customers, tracking energy prices on the PJM web site would probably not be burdensome.

While full hourly real-time pricing is the theoretic ideal, many customers may be overwhelmed by the prospect of tracking hourly prices and deciding how to react to each change in price.[4] Two alternative approaches have been developed that preserve much of benefit of real-time pricing for mitigating the highest prices, while simplifying the rate design.

- Critical-peak pricing. This approach, which has been applied to residential and small commercial customers in California, includes fixed time-of-use prices for two or three periods, with a fixed super-peak rate (e.g., $0.50/kWh) activated at variable times as justified by market conditions. This approach simplifies the rate design and may find greater acceptance with customers, who only need to decide how they will respond to a few price levels. But it still provides powerful incentives for load reductions at times of high costs or reliability problems. Hedging can be automatic, with customers charged or credited the super-peak price for the difference between their usage at the time the super-peak is invoked and their usage at comparable times on similar days. Metering and billing can be simplified by the limitation of rates to three or four pre-defined rates, as opposed to a wide range of hourly prices.

[4] The metering may also be too expensive, compared to the potential load shifts of smaller customers.

- Variable-peak pricing. This approach, which has been advocated by the New England ISO, uses entirely fixed time-of-use periods, with fixed prices for all the periods except a super-peak period, for which the super-peak rate determined by market conditions. Customers would know that the really high retail rates would occur only in the super-peak period, and that a single super-peak price would be posted for each day. Thus, they could schedule routine activities to avoid the super-peak, and decide which additional usage reductions to undertake based on the daily price. If high energy prices reliably occur in a narrow time period (e.g., noon to 4 pm), this approach may capture most of the potential benefits of real-time pricing, while being easier for customers to understand and adapt to.

Q: How would expansion of real-time pricing by the Companies affect retail competition in their service territory?

A: Expanded real-time pricing should enhance retail competition, in several ways. First, the Companies should provide competitive suppliers with access to all the data collected from the advanced meters, and work with competitive suppliers to develop meter-reading protocols that maximize the value of the data to competitive suppliers in serving their customers. Second, competitive suppliers will be able to offer variants on the real-time pricing approach, which may be more attractive to some customers than the Companies' rate designs. Third, some customers may prefer to have less price variability, and may choose competitive suppliers to move to a time-of-use rate. Fourth, real-time pricing will tend to reduce market prices and price volatility, making competitive supply less risky and more attractive.

VI. Benefits and Costs of Real-Time Pricing

Q: Why should electricity prices vary from hour to hour and month to month?

A: Costs of energy supply vary from hour to hour; the contribution of loads to the need for generation, transmission and distribution capacity also varies from hour to hour. Hence, supplying usage at some times is much more expensive than supplying that usage at other times. If customers are charged the same price in every hour, they have no incentive to reduce usage at high-cost times, and total costs of supplying customer loads will be higher than necessary.

Q: What does real-time pricing provide that conventional time-of-use rates do not?

A: Time-of-use rates price generation at a fixed price averaged over hours within defined periods of time. Real-time pricing allows customers to respond to variation in peak market prices that is not reflected in the on-peak price of a TOU rate.

Q: What magnitude of peak reductions might be possible with simplified real-time pricing for small customers?

A: In California, critical-peak pricing reduced peak usage on the critical days in 2003 and 2004 by almost 16 percent, about 25 percent more than for time-of-use rates. Adding some enabling technologies, such as smart thermostats, increased the critical peak-period reduction to 27 percent.[5] While Duquesne results would vary

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[5] "Final Report: Impact Evaluation of the California Statewide Pricing Pilot," prepared for California Energy Commission Working Group 3 by Charles River Associates, March 16, 2005, page 9.

with the size and type of customers, climate, price variability, and details of rate design, the potential appears to be significant.

Q: Would customers on real-time pricing benefit from lower costs?

A: Yes, if the program is properly designed, and the participating customers are properly chosen. Real-time pricing, in any variation, should be applied only to customers who are large enough that potential savings from their load responses could cover the incremental costs of the real-time metering.[6] The program should also include hedging and revenue-neutrality, so that the average customer who did not respond to the real-time price signals would experience no significant bill change. With that background, if a customer chooses to reduce its usage in high-cost hours, its bill would decline.[7]

Q: Can real-time pricing benefit customers who are not on the real-time rates?

A: Yes. Customer response to real-time pricing would tend to reduce a number of costs for all customers:

- Real-time pricing customers will tend to reduce their use in high-price hours, allowing the ISO to back out the most expensive generators, reducing market energy prices, and probably prices for operating reserves.

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[6] Some customers, such as traffic signals, will clearly not respond to real-time prices, and should not be transferred to more expensive metering.

[7] Some customers with particularly expensive load shapes have been imposing higher-than average costs on Duquesne and other customers. Those customers would experience some increase in their bills unless they change their usage patterns. Conversely, the customers whose load have been less expensive than average to serve would experience lower bills with real-time pricing, even before they respond to the pricing signals.

- By reducing loads at highest cost hours and when price spikes occur, real-time pricing will reduce the ability of generators to exercise market power.
- Whether real-time price signals are used to signal customers when loads are likely to increase generation requirements, or only to signal high energy prices, real-time pricing is likely to reduce loads at the peak hours that increase capacity requirements. Reducing capacity demand will tend to reduce the market price.[8]
- Similarly, whether or not real-time pricing targets hours of stress on the transmission and distribution, it will tend to reduce loads at those times. Reducing future transmission and distribution investments will tend to reduce rates for all customers.
- Reduced electric load will tend to reduce the upward pressure on natural-gas prices, reducing costs for all gas consumers.[9]

Q: What are the costs of real-time pricing?

A: The categories of costs are

- Metering, which can be as much as $586 for a full real-time meter capable of recording every hour's use independently, but is also reported to be less than

[8] The PJM capacity-pricing method is currently in litigation before FERC.

[9] See "Natural Gas Price Effects of Energy Efficiency and Renewable Energy Practices and Policies," Elliot, RN, et al, American Council for an Energy-Efficient Economy, Report E032, December 2003, and "Impacts of Energy Efficiency and Renewable Energy on Natural Gas Markets: Updated and Expanded Analysis," Elliot RN and Shipley AM, ACEEE Report E052, April 2005.

$100 for meters that would be suitable for critical-peak pricing or variable-peak pricing, and perhaps full real-time pricing.[10]

- Basic communications, which may be by phone line or various wireless technologies, to allow daily reading of the meter and/or remote signaling of the meter of the timing of the critical peak period.
- Advanced communications and controls, including equipment to signal customers of the time or pricing of super-peak periods, or to remotely control customer equipment, such as resetting thermostats, interrupting water heaters, dimming lighting, or cycling cooling equipment. This can be the most expensive component of real-time pricing; these advanced features should be added only where (1) they are useful for data collection or demonstration projects, (2) they are likely to be warranted by customer response, or (3) where the customer is willing to pay for the feature.

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[10] The $586 value is the price Duquesne currently charges for a real-time meter. The price of less than $100 is reported in Jurgen Weiss (LECG, LLC), "Time-Based Rates in Vermont," Workshop on Smart Meters and Time-based Rates, Montpelier VT, March, 15, 2006; Chris King, eMeter Corporation, "Advanced Metering Infrastructure (AMI): Overview of System Features and Capabilities," presentation in California Energy Commission Demand Response Workshop, October 5, 2004; U.S. Department of Energy, *Benefits of Demand Response in Electricity Markets and Recommendations for Achieving Them: A Report to the United States Congress Pursuant to Section 1252 of the Energy Policy Act*, February 2006, page 25.

VII. Experience with Real-Time Pricing

A. National Implementation Experience

Q: How many utilities have implemented real-time pricing?

A: Real-time pricing has been extensively implemented in the United States, in some form or another. According to a 2004 Lawrence Berkeley National Laboratory report, "*A* Survey *of Utility Experience with Real Time Pricing*, December 2004, there have been at least 70 voluntary real-time pricing programs or pilots in existence on or before 2004.[11] The LBNL survey reviewed 43 of the programs in some detail.

B. Experience with Real-Time Pricing Effects

Q: Did real-time pricing programs reviewed by LBNL show positive results?

A: Results from the following seven of the 43 programs indicated that customers were price-responsive:

- Commonwealth Edison and The Community Energy Cooperative
- Duke Power Company
- Georgia Power (subsidiary of Southern Company)
- Gulf Power Company (subsidiary of Southern Company)
- Kansas City Power & Light
- Pacific Gas & Electric Company

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[11] Barbose et. al., "A Survey of Utility Experience with Real Time Pricing, Lawrence Berkeley National Laboratory (LBNL-54238), December 2004.

- Public Service Company of Oklahoma (subsidiary of American Electric Power)

Q: Can you provide a summary description of the seven real-time pricing programs and their results?

A: The description and results of the seven utility real-time pricing are survey are presented in more detail in Exhibit PF-PLC-2. This information in this table is drawn from LBNL's 2004 survey report. Georgia Power estimates that it have achieved reductions of as much as 16% reduction the peak loads of its participating customers, and estimates 7% to be typical for future years, if peak prices are around $100/MWh.

Q: In your view, does the lack of positive results for the other programs surveyed by LBNL indicate that real-time pricing in general is ineffective?

A: No. There are at least the following three reasons why the programs surveyed did not show positive results, First, without a rigorous analysis of the results, there is no way of measuring the success of the program. According to LBNL's descriptions, only the seven utilities of the 43 surveyed collected or analyzed usage data. Some of the other utilities collected anecdotal evidence that some participants shifted or reduced peak usage. Otherwise, the utilities made no effort to monitor the price response of its customers.

Second, for many of the programs, there was not enough data for analysis because there was too little, dwindling or no participation. Third, some participants may have actually shown little price response for reasons that would not apply today under market pricing and a well-designed rate.

Q: Why would voluntary participants have shown little price-response?

A: For a number of reasons:

- In the past, when electric prices were much lower or markets did not exist, the price may not have reached the customer's trigger point, where the savings from shifting or load reduction justify the costs.
- The rate may have been designed to give a discount from the standard rate. This rate design attracted participants who could benefit even if they were price-inelastic.
- The lower-cost-to-serve customers on a standard rate, which is based on class average loads, could benefit from switching to an RTP rate even if they were price-inelastic.
- Participants were permitted to transfer off the RTP rate in peak months.
- When retail markets were created, customers switched to a competitive supplier.
- The utilities did not market the program to attract more of the customers who had the potential to reduce or shift their loads.

Q: What real-time pricing programs have been implemented since the LBNL 2004 survey?

A: The most aggressive, well-documented and carefully analyzed program is California's statewide test of a simplified real-time pricing method applied to residential and small commercial customers. According to preliminary results, this critical-peak pricing reduced peak usage on the critical days in 2003 and 2004 by almost 16 percent, about 25 percent more than for time-of-use rates. Adding some enabling technologies, such as smart thermostats, increased the critical peak-period reduction to 27 percent.[12] While the Companies' results would vary with the size and type of customers, climate, price variability, and details of rate design, the potential appears to be significant.

C. The Companies' Experience

Q: Do Metropolitan Edison Company or Pennsylvania Electric Company has any real-time pricing tariffs?

A: Not currently. A real-time tariff was introduced in 1996 but closed in January 1999. There were never more than two participants and currently there are none. The Companies acknowledge that they had not developed a real-time pricing tariff that was competitive with the standard tariff:

> The below market price of energy and capacity provided by Met-Ed and Penelec insulates customers from the true energy and capacity market costs thereby making any market based RTP program ineffective. (IR PF 1-53)

D. Other Pennsylvania Experience

Q: Do other Pennsylvania utilities offer real-time pricing?

A: Yes. Duquesne's large commercial and industrial users can receive POLR service under Rider No. 9—Hourly Price Service. After May 31, 2007, this will be the only POLR service for these customers. All of Duquesne's large commercial and industrial customers—over 800—have hourly real-time pricing meters.

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[12] "Final Report: Impact Evaluation of the California Statewide Pricing Pilot," prepared for California Energy Commission Working Group 3 by Charles River Associates, March 16, 2005, page 9.

Rider No. 9 flows hourly PJM real-time market charges (e.g., zonal energy, capacity, ancillary services) through to the customer. Capacity charges are computed from the customer's coincident demands and the PJM daily capacity market. The tariff does provide for any hedging.

Since most of Duquesne's large customers are served by competitive suppliers, there is no way to know whether they are on real-time pricing for energy. Of the 95 large customers on POLR, 91 are on the real-time pricing rate.

Q: How has real-time pricing affected Duquesne's load shape?

A: Duquesne has not collected detailed information nor conducted a detailed evaluation of the response to hourly pricing, so there is no way of knowing.

VIII. Conclusions and Recommendations

Q: What are your conclusions?

A: Real-time pricing, both as full hourly pricing (as in Duquesne's Rider 9) and in various simplified forms, has significant potential for reducing costs to customers and improving the efficiency of the competitive market. Compared to full hourly real-time pricing, simplified real-time pricing may be both less expensive and more acceptable to customers. These rate designs would benefit both participating and non-participating Company customers, whether they are served by POLR or competitive suppliers, as well as other Pennsylvania electric consumers.

Q: What are your recommendations?

A: My principal recommendation is that the Commission instruct the Companies to expand their offerings of market-responsive rates, to include smaller customers. This process would include:

- Working with a workgroup of stakeholders (e.g., PennFuture, OCA, OSBA and representatives of competitive suppliers) to evaluate the cost-effectiveness of alternative real-time metering and select appropriate metering options and protocols for sharing metering data with competitive suppliers.
- Working with PennFuture, OCA, OSBA and other consumer advocates to develop alternative real-time rate designs for delivery and POLR rates, including POLR hedging mechanisms, effective education and marketing.
- Installing appropriate improved metering for all customer groups for which the metering appears to be cost-effective.
- Seeking approval from the Commission for new rate designs.
- Providing customers with bill comparisons between standard and real-time rates.
- Collecting load and cost data and performing rigorous evaluation of the results of the rate redesign.

Q: How should the Companies recover the costs of these activities?

A: The Commission should order the Companies to defer the incremental costs of studies, new meters and other equipment and projects required to implement effective real-time pricing. They should also track any operating-cost savings from the improved meters. The Companies should report to the Commission every six months on actual expenditures and projected expenditures, as those are clarified.

The Commission should allow the Companies to propose a mechanism for recovering the balance of the program costs, either by deferral until the next rate case or filing a reconciling rate adjustment, if necessary.

This concludes the testimony of Paul Chernick